Final Report

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

Study on the effectiveness and on the improvement of the EU legislative framework on road infrastructure safety management (Directive 2008/96/EC)

PRELIMINARY ANALYSIS OF SOME CRUCIAL AREAS FOR ROAD SAFETY AND FOR SAFETY OF ROAD INFRASTRUCTURE

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Glossary

BCR	Benefit-Cost Ratio
CBA	Cost Benefit Analysis
CEDR	Conference of European Directors of Roads
EIB	European Investment Bank
ERDF	European Regional Development Fund
EU	European Union
IFIs	International Financial Institutions
ISPA	Instrument for Structural Policies for Pre-accession
ITS	Intelligent Transport System
MS	Member State
NSM	Network Safety Management
O&M	Operating and maintenance costs
PTW	Powered Two Wheelers
RISM	Road Safety Infrastructure Management
RSA	Road Safety Audit
RSI	Road Safety Inspection
RSIA	Road Safety Impact Assessment
TIN	Trainer's International Network project
VMS	Variable Message Signing
VRU	Vulnerable Road User
V2V	vehicle-to-vehicle

Summary

Context and objective

The overall objective of this study is to assist the European Commission with the evaluation of Directive 2008/96/EC on road infrastructure safety management and to investigate possible changes in the light of new technological developments. The specific objectives of the study are:

1) To carry out an ex-post evaluation of the application of Directive 2008/96/EC. What were the main impacts of its application on road safety? What steps were taken to implement the Directive? What is the relevance of the Directive?

2) To provide a preliminary analysis of the possible areas of improvement with regards to road safety and the safety of road infrastructure in particular.

Important elements within the study were the stakeholder survey to collect the necessary data and the organisation of a stakeholder conference.

This report focuses on the preliminary analysis of the possible areas of improvement with regards to road safety and the safety of road infrastructure in particular. A separate report discusses the ex-post evaluation, including the results of the stakeholder survey and conference. Minutes of the stakeholder conference can be found on the Commissions' website. This summary discusses the results of both reports: the ex post evaluation **and** the results of the preliminary analysis of possible areas of improvement.

Ex-post evaluation

The ex-post evaluation seeks to gauge the extent or degree to which the Directive has been put into practice across the countries of the EU during the five years after it was adopted. The evaluation also seeks to meaningfully identify the main impacts generated by its implementation by considering a wide range of evaluation criteria. Together, these criteria were used to determine how the Directive has been able to responded to the initial needs and problems of its target beneficiaries and European citizens, the extent to which positive changes that can be attributed to the Directive may be expected to continue to have an effect and whether or not EU level interventions have led to benefits that exceed those that would have been achieved had Member State acted independently. One of the issues considered was whether the objectives of the Directive continue to be relevant to the needs, problems and issues they were designed to target. Finally, the extent to which the Directive can be coherent with the deployment of ITS was a central question.

Methodology

In order to carry out the evaluation, we developed an intervention logic and a methodological framework on the basis of the evaluation criteria of implementation, relevance, effectiveness, sustainability, coherence, utility, efficiency, and EU added value of the legislation. Guided by a set of specific evaluation questions, we used a combination of research tools. These tools included a review of relevant documents and publications, collection and analysis of data from published sources, analysis of the responses provided by Member States and stakeholders to the online

survey, analysis of the outcomes of the stakeholder conference and, finally, an interview programme. The latter ones provided additional information and evidence that supported the identification of the main evaluation findings and the development of the main conclusions.

Results of the ex post evaluation

As a whole, the Directive has certainly triggered a different way of thinking about and dealing with road safety management. Firstly, this is because it has encouraged a generalized use of the Road Safety Infrastructure Management (RISM) procedures which are now established in all Member States and which are based on a minimal set of compulsory rules in the management of the TEN-T roads (in many cases also applied to non-TEN-T roads). It is equally important that the Directive provides a "common language" for carrying out road infrastructure safety management which relies upon a harmonized legislative framework. At a national level, the Directive has instigated a normative and operational process that would not have happened in such a widespread manner without EC intervention.

The main weakness of this Directive, by contrast, relates to the limited scope of its application, i.e. this piece of EU legislation only applies to the TEN-T road network and not to non-TEN-T roads. The possibility of extending the requirements stipulated by the Directive to non TEN-T roads was left to the discretion of Member States and, accordingly, the national legislative settings have been developed by most Member States

Focussing on **implementation**, all Member States (with the exception of Croatia) have transposed Directive 2008/96/EC and, significantly, many of them have not encountered difficulties in the application of the Directive. Furthermore, evidence suggests that Member States with poorer pre-Directive levels of road safety performance are those where the application of the Directive has been more robust. Also important, the RISM procedures are applied to non TEN-T roads (national roads, dual carriageways and motorways), thus beyond the scope of the Directive although the degree of compulsion of such application is variable. However, the RISM procedures were not found to have a significant impact in the planning phase in those EU countries where they were already in place, while in those Member States where they were not established the overall impact is also expected to be low. Finally, Member States do not earmark funds to carry out the RISM procedures and costs for the latter are generally incorporated in the overall costs of the road project investments.

Concerning **relevance**, the objectives of the Directive remain fit-for-purpose when considering the overall EU objectives in terms of improved road safety. The Directive has led to an improved and much more consistent regulatory framework compared with the prior system of national legislation. The relevance, however, could be further improved by being more prescriptive. This would also increase the effectiveness of the Directive. For uniformity can be read more on a formal level that on a substantial one as the Directive does not provide any detailed guidance on the application of the RISM procedures, nor harmonisation between Member States is prospectively foreseen.

The **effectiveness** of the Directive can be observed in the changes it has encouraged towards a more systematic approach in dealing with the operational management of infrastructure-related road safety. The Directive has increased the use of cost-effective procedures (e.g. RSAs and RSIs) and has initialled a process that can prospectively produce positive results in terms of correction of the detected road infrastructure deficiencies both on new roads and existing roads. On the other hand, no modification has been triggered on the approach followed by road managers in selecting

safety equipment and components. Similarly, no specific improvements in national practices and procedures have been reported as a result of the exchange of best practices between Member States. We also did not observe that the Directive has provided an incentive to a greater degree of exchange of good practices. Equally, despite that training programmes and curricula are established in the larger part of Member States hence suggesting that training and certification process is effectively set up, the Directive has not favoured the mobility of road safety professionals across Member States and, at present, there is no evidence indicating that such mobility is taking place.

The changes propped by the Directive in the operation of the Member States' RISM national practices are expected to last in the long run (**sustainability**). However, differences in their application still remain within the current detail of the Directive. Also sustainability of funding sources for undertaking these procedures is key.

As far as the interlinking with ITS is concerned the Directive (**coherence**), which in itself does not really focus on ITS, does not really influence the deployment of ITS in a negative or in a positive way.

In the light of the EU road safety objectives, the Directive can be considered an adequate instrument since a correlation was observed between having lower fatality rates and having road safety procedures (**utility**). This indicates that the Directive will most probably positively impact road safety and certainly in countries which did not have these procedures in place before.

On **efficiency**, the application of the Directive is still considered to be too recent to acquire an understanding of whether it has led to a more efficient and cost saving planning and management of the network. Also, Member States do not collect evidence on costs and benefits of the application of the procedures. Costs associated with the follow-up of safety assessment have been reported as the most significant cost category, while no evidence has shown a direct effect on road users of costs generated by the Directive. Concerning benefits, in general terms, the reduction in the number of road victims/injuries can be considered the main benefit of the application of the Directive, but a quantification of them is still not possible. Finally, administrative costs account for nearly one-fifth of the global cost involved in the application of the RISM procedures and are largely borne by national authorities which keep the primary responsibility role for administering the RISM procedures on along the road network.

Lastly, Directive 2008/96/EC had the clear benefit (**EU added value**) to request Member States to have all RISM procedures established in their national law systems and to comply with its requirements within a clear time line. Though contents and practices might be different at national level, a common framework and a common approach is applied. This outcome could not have been achieved through Member States acting independently in developing (or not) their own comparable legislation which would had led to disparities in their application.

Areas for further development

The following paragraphs summarize the results of the work done on the areas for further development.

Methodology

We first discussed the starting points for the further analysis. We based ourselves on a data analysis of the location in which accidents happen and the types of road users that are involved. We also took into account the data that was available on the TEN-T network. Another point of departure was the input which we received by consulting the stakeholders. As previously mentioned, we consulted them by way of a survey and a stakeholder conference. Finally, we added the information which came out of the ex post evaluation of the Directive to this. Given this analysis, we elaborated the eight themes which proved most promising. We established a baseline that predicts the expected evolution in fatalities and seriously injured victims, per road type until the year 2030. Next, we presented a first analysis of the eight themes which came out of the starting points. This analysis includes a definition of the scenarios, an estimation of the size of the target groups, an identification of positive and negative effects, including unintended side-effects. If and when possible, we calculated the effects on road safety, the economic impact as well as the costs.

Results the work done of areas for further development

Potentially, a large number of lives could be saved if the Directive was to be **extended to other roads**. However, the costs and the administrative burden this would entail cannot be underestimated. Given that many countries have already extended the current provisions on a voluntary basis this might be a better option than the decision to enforce the extension to all roads and make it mandatory. A possible compromise, in this respect, could be a mandatory extension to all motorways. This would also create more consistency for road users who do not know whether they are travelling on a TEN-T motorway section or not. Including all roads which receive an EU contribution will have a relatively low effect on road safety, but it also comes at a low cost. The benefits in terms of safety and support for, the extension of the Directive to the tunnels that fall under the Tunnel Directive appear to be small. On the other hand, including the provisions of the tunnel Directive within the RSIM Directive would improve the overall coherence and leads to an integrated approach to road infrastructure safety.

Focussing more on VRU, without extending the Directive to other roads comes down to focussing more on PTW and the effect on road safety in general remains limited. In a scenario in which the Directive is extended, the target group becomes much wider as it now also includes cyclist and pedestrians and the expected safety effect is much larger. However, as discussed above, extending the Directive to other roads would come at a substantial cost.

The **measurement of safety performance of roads and the possibility of linking a certification** to this process would make it easier to benchmark countries and might give an incentive to policy makers to improve their performance. This process of certification would require a shared methodology. This would not be in line with the current spirit of the Directive, since the Directive leaves the countries a lot of freedom with respect to the actual implementation.

In general, the literature agrees that the direct safety effect of p**roviding more information to citizens and road users** is very limited. However, the costs in doing so are relatively low and it will increase general awareness. Specific message signing that draw attention to points that are especially dangerous can have a direct safety effect.

Information exchange between professionals may be an effective way to improve road safety at a limited cost and there is a demand from the stakeholders for this type of exchange. However, a lot of information is available today and information exchange does take place. It would be of upmost importance not to duplicate existing work. Therefore a first step should be a thorough analysis of what is already available in the field, its effectiveness and the ways in which effectiveness could be improved. A closer **monitoring** of the resources that are spent and the effectiveness of the Directive would make it easier to evaluate the Directive and would provide relevant information which can also be used in other projects. Still, this would require a lot of efforts from the administrations as data will not be readily available.

The **obligation to accept road safety auditor certificates from other Member States** may potentially increase the efficiency of the RSA since it would lead to an exchange in information and a possible saving in training costs. However, even without this obligation the majority of the Member States accept certificates from other Member States. To oblige Member States to accept road safety auditor certificates from other Member States would require the certification of the training centres and this might require a shared training structure.

The matter **of better integrating ITS systems** and services is a very broad topic. If we focus on a scenario such as explicitly including the requirement to assess ITS infrastructure within the different procedures, it is clear that this is a low cost measure which would improve the efficiency of the ITS itself. Including information about specific ITS systems as a form of remedial actions risks being rapidly outdated. In general, there is little interest in this area among the stakeholders and it is unsure if this Directive is the right place to be targeting ITS measures. There could however be a role for the Directive focussing on the support road infrastructure can give to the deployment of ITS applications. Related to this is the question of **standardisation** of the road infrastructure itself. Today, following the provisions of the European Construction Products Regulation (3005/2011/EU-CPD) different norms apply to road equipment and road materials. These norms provide great improvements to harmonise the European practices in terms of test methods, but they leave each country free to specify the requirement level in terms of performance on its own national network. These differences in norms have an important impact on the potential health outcomes of an accident and, as such, establishing standards for certain road infrastructure elements or making their use mandatory could help improve road safety and deserves more research.

The demand for **clearer definitions** was raised within the stakeholder consultation and the ex post evaluation which showed that there are differences in the actual implementation of procedures in real life that might hinder the efficiency of procedures. On the other hand this freedom also allowed the Member States to adapt procedures to their own needs. It would be a good starting point to first investigate the differences in implementation in the field to find out if these differences are beneficial for road safety (as they are more likely to be adapted to the local situation) or negative (as the procedures that are used are very far away from what could be considered as best practice).

The analysis above focusses on the different, separate areas individually, even though there are in fact some interlinkeages between them. For example extending the provisions to other roads will automatically better bring VRU into the picture. An explicit mutual recognition of the certificates for auditors will also lead to an exchange of information and might decrease the need for a separate series of workshops, guidelines, etc. This explicit recognition will also lead to a more streamlined definition of the RSA, making the last area less relevant for this procedure. Better integrating ITS systems in an informative way can also be taken as a specific topic that relates to information exchange, as can the topic of VRU.

Policy discussion and conclusions

From the ex post evaluation

In the light of the main findings of the study, a general recommendation may be put forth to support the decision making of EU institutions in their assessment of the effectiveness of Directive 2008/96/EC. This, consequently, will improve the overall implementation across the Member States.

As is noted in the course of the study, the main obstacle in evaluating the application of the Directive is the poor quantity and quality of available data. Efforts should be made towards improving the EU common accident database and accessibility, in particular as far as accident data on the TEN-T network is concerned. Moreover, data collection of costs and benefits should also be improved. At the EU level, harmonized procedures for gauging the cost-benefit ratio of road safety treatments are to be developed. In this respect, benchmarking methodologies should be put forth to track the performance of the Directive as a whole and of each single road infrastructure safety management procedure individually.

From the analysis of areas of further improvements

In light of the main findings of this study and the ex post evaluation the following recommendations can be made.

- A mandatory extension to all motorways would improve traffic safety and create more consistency for the road users. At the same time, it avoids the large costs associated with an extension of the Directive to all roads. The extension to tunnels falling under the Tunnel Directive will probably not have a large impact on road safety but it would lead to a more coherent approach towards safer road infrastructure.

- Given that it does not seem feasible to extend the Directive to all road users, it makes sense to focus more on PTW. This can be done within the framework of a series of workshops/guidelines which should be developed to facilitate the exchange of information. Note that the decision to set up workshops in order to facilitate the exchange of information should be preceded by a thorough analysis of current practices and the information that is currently available.

- The measurement of safety performance of roads might provide incentives to policy makers, but should probably not be linked to a certification since there is little support for this. It would also require a common methodology which would not be in line with the spirit of the current Directive.

- The Directive could emphasise the role that infrastructure plays to support the deployment of ITS applications. Linked to this is the issue of establishing standards for certain road infrastructure elements or making their use mandatory. This could help improve road safety and deserves more research.

Résumé

Contexte et objectif

L'objectif global de cette étude consiste à épauler la Commission européenne dans l'évaluation de la Directive 2008/96/CE concernant la gestion de la sécurité des infrastructures routières et à examiner les changements possibles compte tenu des nouveaux progrès technologiques. Les objectifs spécifiques de l'étude sont :

1) Mener une évaluation ex post de l'application de la Directive 2008/96/CE. Quels ont été les principaux impacts de son application sur la sécurité routière ? Quelles mesures ont été prises pour mettre en œuvre la Directive ? En quoi la Directive est-elle pertinente ?

2) Livrer une analyse préliminaire des éventuels domaines à améliorer en matière de sécurité routière et de la sécurité des infrastructures routières en particulier.

L'étude a comporté deux éléments importants: le sondage mené auprès des parties prenantes afin de recueillir les données nécessaires et l'organisation d'une conférence réunissant les parties prenantes.

Le présent rapport est consacré à l analyse préliminaire des éventuels domaines à améliorer en matière de sécurité routière et de la sécurité des infrastructures routières en particulier. Il ya aussi un rapport dstinct sur le premier volet de l'etude - l'évaluation ex post, y compris les résultats du sondage et de la conférence destinés aux parties prenantes. Le procès-verbal de la conférence est disponible sur le site Internet de la Commission. Ce résumé s'attarde sur les résultats de deux rapports: l'évaluation ex post **et** les résultats de l'analyse préliminaire des éventuels domaines à améliorer.

Évaluation ex post

L'évaluation ex post est destinée à estimer dans quelle mesure et à quel degré la Directive a été mise en pratique dans les différents pays de l'UE au cours des cinq années qui ont suivi son adoption. L'évaluation cherche également à identifier de façon significative les principaux impacts générés par la mise en œuvre de la Directive en examinant un large éventail de critères d'évaluation. Tous ces critères ont servi à déterminer comment la Directive a pu répondre aux besoins et aux problèmes initiaux des bénéficiaires visés et des citoyens européens, dans quelle mesure les changements positifs pouvant être attribués à la Directive sont susceptibles de se montrer durables et si oui ou non les interventions au niveau de l'UE ont apporté des bénéfices supérieurs à ceux qui auraient été obtenus si chaque État membre avait pris des mesures de manière indépendante. L'une des questions abordées était de savoir si les objectifs de la Directive sont toujours pertinents quant aux besoins, problèmes et questions qu'ils étaient destinés à cibler. Enfin, le degré de cohérence de la Directive avec le déploiement de systèmes de transport intelligents (STI) a fait l'objet d'une attention particulière.

Méthodologie

Afin de procéder à l'évaluation, nous avons développé un cadre d'intervention logique et méthodologique basé sur les critères d'évaluation suivants : mise en œuvre, pertinence, efficacité,

durabilité, cohérence, utilité, rendement et valeur ajoutée de la législation de l'UE. Guidés par un ensemble de questions spécifiques d'évaluation, nous avons eu recours à une combinaison d'outils de recherche, à savoir l'analyse des documents et publications pertinents, la collecte et l'analyse de données issues de sources publiées, l'analyse des réponses fournies par les États membres et les parties prenantes dans le cadre du sondage en ligne, l'analyse des résultats de la conférence des parties prenantes et enfin, un programme d'interviews. Celui-ci nous a livré des informations et des preuves supplémentaires qui ont contribué à l'identification des principaux résultats de l'évaluation et à l'élaboration des conclusions essentielles.

Résultats de l'évaluation ex post

Dans l'ensemble, la Directive a assurément suscité un changement dans la manière de considérer et d'aborder la gestion de la sécurité routière. Tout d'abord, elle a encouragé un recours généralisé aux procédures de Gestion de la Sécurité des Infrastructures Routières (GSIR) qui sont à présent établies dans tous les États membres et sont basées sur un ensemble minimum de règles obligatoires en matière de gestion des routes appartenant au RTE-T (dans de nombreux cas, elles sont également appliquées aux routes ne faisant pas partie du RTE-T). Élément tout aussi important, la Directive fournit un « langage commun » pour la gestion de la sécurité des infrastructures routières qui repose sur un cadre législatif harmonisé. Sur le plan national, la Directive a été l'instigatrice d'un processus normatif et opérationnel qui n'aurait pas pu s'étendre avec une telle ampleur sans l'intervention de la CE.

En revanche, la principale faiblesse de cette Directive est liée à la portée limitée de son application. En effet, cette mesure législative de l'UE s'applique uniquement au réseau routier RTE-T et non aux routes n'appartenant pas au RTE-T. La possibilité d'étendre les exigences stipulées dans la Directive aux routes non RTE-T a été laissée à la discrétion des États membres et, en conséquence, le cadre législatif national a été développé par la plupart des États membres.

En matière de **mise en œuvre**, tous les États membres (à l'exception de la Croatie) ont transposé la Directive 2008/96/CE et, chose importante, beaucoup d'entre eux n'ont rencontré aucune difficulté à l'appliquer. En outre, tout porte à croire que les États membres dont les performances en matière de sécurité routière étaient plus faibles avant la mise en œuvre de la Directive sont ceux où l'application de la Directive s'est révélée la plus solide. Autre élément important, les procédures GSIR sont appliquées aux routes non RTE-T (routes nationales, chaussées à deux voies de circulation et autoroutes), donc au-delà du cadre de la Directive, même si le degré d'obligation d'une telle application est variable. Cependant, nous avons constaté que les procédures GSIR n'exercent pas d'influence majeure sur la phase de planification dans les pays de l'UE où elles étaient déjà en place, tandis que dans les États membres où elles n'étaient pas appliquées, l'impact global devrait également être faible. Enfin, les États membres ne prévoient pas de fonds destinés à la mise en place des procédures GSIR et les coûts de ces dernières sont généralement incorporés dans les coûts globaux des projets d'investissement dans le secteur routier.

En ce qui concerne la **pertinence**, les objectifs de la Directive demeurent adaptés aux finalités poursuivies lorsque l'on tient compte des objectifs globaux de l'UE en matière d'amélioration de la sécurité routière. La Directive a permis d'améliorer le cadre réglementaire et l'a rendu bien plus cohérent par rapport au système antérieur de législation nationale. Cependant, la pertinence pourrait être encore améliore en étant plus prescriptive comme cette uniformité peut toutefois être davantage interprétée au niveau formel que substantiel. Dans la mesure où la Directive ne fournit aucune orientation détaillée quant à l'application des procédures GSIR et qu'une harmonisation

entre les États membres n'est potentiellement pas envisagée non plus, cela permettrait également d'accroître l'efficacité de la Directive.

L'**efficacité** de la Directive peut se traduire par les changements qu'elle a encouragés vers une approche plus systématique en matière de gestion opérationnelle de la sécurité routière liée aux infrastructures. La Directive a augmenté l'utilisation de procédures rentables (par exemple, ASR et ISR) et a enclenché un processus pouvant potentiellement entraîner des résultats positifs concernant la façon de pallier les manquements constatés sur les nouvelles routes et les routes actuelles. D'autre part, aucune modification n'a été apportée à l'approche adoptée par les gestionnaires des routes pour sélectionner les équipements et le matériel de sécurité. De la même manière, aucune amélioration spécifique des pratiques et procédures nationales n'a été signalée par suite de l'échange de bonnes pratiques entre les États membres. Nous n'avons pas non plus constaté que la Directive avait contribué à inciter les États membres à accroître les échanges de bonnes pratiques. De même, bien que des programmes de formation soient établis dans la majeure partie des États membres – ce qui laisse penser qu'un processus de formation et de certification est effectivement mis en place – la Directive n'a pas encouragé la mobilité des professionnels de la sécurité routière à travers les États membres et, à l'heure actuelle, aucun élément probant n'indique que cette mobilité a lieu.

Les changements soutenus par la Directive en matière de gestion des pratiques nationales GSIR des États membres devraient se poursuivre à long terme (**durabilité**). Toutefois, il subsiste des différences d'application de ces pratiques au sein des dispositions actuelles de la Directive. Le caractère durable des sources de financement nécessaires à l'exécution de ces mesures est également primordial.

En ce qui concerne l'interconnexion avec les STI (**cohérence**), la Directive, qui en elle-même n'aborde pas vraiment les STI, n'influence pas réellement le déploiement des STI de manière négative, ni positive.

À la lumière des objectifs de l'UE en matière de sécurité routière, la Directive peut être considérée comme un instrument adéquat étant donné qu'une corrélation a été observée entre la diminution du taux de mortalité et l'existence de procédures de sécurité routière (**utilité**). Ceci indique que la Directive produira plus que probablement des effets positifs sur la sécurité routière et certainement dans les pays qui ne disposaient pas de telles procédures auparavant.

Sur le plan du **rendement**, l'application de la Directive est jugée encore trop récente pour que l'on puisse déterminer si elle a entraîné une gestion et une planification plus efficaces et rentables du réseau. En outre, les États membres ne recueillent pas d'éléments probants relatifs aux coûts et aux bénéfices liés à l'application des procédures. Les coûts associés au suivi de l'évaluation de la sécurité ont été considérés comme la plus importante catégorie de coûts, tandis qu'aucun élément concret n'a démontré que les coûts générés par la Directive avaient un impact direct sur les usagers de la route. En ce qui concerne les bénéfices, globalement, la réduction du nombre de victimes/blessés dans des accidents de la route peut être considérée comme étant le principal bénéfice de l'application de la Directive, mais il n'est pas encore possible de les quantifier. Enfin, les coûts administratifs représentent près d'un cinquième du coût global lié à l'application des procédures GSIR et sont en grande partie supportés par les autorités nationales qui demeurent les principales responsables de l'administration des procédures GSIR le long du réseau routier.

Enfin, la Directive 2008/96/CE a eu le net avantage (**valeur ajoutée de l'UE**) de demander aux États membres de transposer toutes les procédures GSIR dans leur propre système législatif national et de se conformer à leurs exigences dans un délai clairement défini. Même si le contenu et les pratiques comportent sans doute des différences sur le plan national, un cadre commun et une approche commune sont en vigueur. Ce résultat n'aurait pas été possible si les États membres avaient agi de manière indépendante lors de l'élaboration (ou non) de leur propre législation comparable, une situation qui aurait débouché sur des disparités dans son application.

Domaines pouvant être améliorés

Les paragraphes suivants résument les résultats du travail effectué concernant les éventuels domaines à améliorer.

Méthodologie

Nous avons d'abord discuté des points de départ de cette analyse plus approfondie. Nous nous sommes basés sur une analyse de données relatives aux endroits où se produisent les accidents et aux types d'usagers de la route impliqués. Nous avons également tenu compte des données disponibles concernant le réseau RTE-T. Les renseignements obtenus en consultant les parties prenantes ont constitué un autre point de départ. Comme indiqué précédemment, nous les avons consultées au moyen d'un sondage et d'une conférence. Enfin, nous avons ajouté les informations issues de l'évaluation ex post de la Directive. Compte tenu de cette analyse, nous avons déterminé les huit thèmes qui s'avéraient les plus prometteurs. Nous avons établi un niveau de référence prévoyant l'évolution attendue du nombre de décès et de blessés graves par type de route jusqu'en 2030. Ensuite, nous avons livré une analyse des huit thèmes issus des points de départ. Cette analyse comporte une définition des scénarios, une estimation de la taille des groupes cibles, une identification des effets positifs et négatifs, notamment les effets secondaires involontaires. Le cas échéant, nous avons mesuré les effets sur la sécurité routière, l'impact économique et les coûts.

Résultats du travail effectué concernant les éventuels domaines à améliorer

Potentiellement, de nombreuses vies pourraient être sauvées si la Directive était **élargie à d'autres routes**. Il convient toutefois de ne pas sous-estimer les coûts et la charge administrative que cette mesure impliquerait. Étant donné que beaucoup de pays ont déjà étendu les dispositions actuelles de manière volontaire, il pourrait s'agir d'une meilleure option que celle qui consisterait à imposer l'élargissement à toutes les routes et à le rendre obligatoire. À cet égard, une extension obligatoire à toutes les autoroutes pourrait constituer une solution de compromis. Cela renforcerait également la cohérence pour les usagers de la route qui ne savent pas s'ils circulent ou non sur une section d'autoroute RTE-T. Le fait d'intégrer toutes les routes qui bénéficient d'une intervention de l'UE aura un impact assez faible sur la sécurité routière, mais le coût de l'opération est lui aussi relativement faible. Les avantages en termes de sécurité et de soutien liés à l'extension de la Directive aux tunnels qui relèvent de la Directive sur les tunnels semblent être minimes. D'un autre côté, le fait d'incorporer les dispositions de la Directive sur les tunnels au sein de la Directive GSIR améliorerait la cohérence globale et déboucherait sur une approche intégrée de la sécurité des infrastructures routières.

Accorder plus d'attention aux usagers vulnérables de la route (UVR) sans étendre la Directive à d'autres routes revient à se focaliser sur les DRM (deux-roues à moteur) et l'impact sur la sécurité routière en général demeure limité. Dans un scénario où la Directive est élargie, le groupe cible

devient beaucoup plus vaste, car il englobe alors les cyclistes et les piétons et l'impact attendu sur la sécurité est bien plus important. Cependant, comme évoqué plus haut, l'extension de la Directive à d'autres routes impliquerait un coût non négligeable.

L'**évaluation des bilans de sécurité des routes et la possibilité d'associer une certification** à ce processus simplifieraient l'étude comparative entre les pays et pourraient inciter les décideurs politiques à améliorer leurs performances. Ce processus de certification nécessiterait toutefois une méthodologie partagée, ce qui ne serait pas conforme à l'esprit actuel de la Directive, étant donné que la Directive laisse une grande liberté aux États membres en matière de mise en œuvre effective.

En général, les spécialistes reconnaissent que le fait de **fournir plus d'informations aux citoyens et aux usagers de la route** a un impact direct très limité sur la sécurité. Néanmoins, cette opération peut s'effectuer à moindre coût et accroître la sensibilisation générale. Des messages spécifiques attirant l'attention sur des zones particulièrement dangereuses peuvent avoir un impact direct sur la sécurité.

L'échange d'informations entre professionnels peut s'avérer efficace pour améliorer la sécurité routière à moindre coût et les différents intervenants sont demandeurs de ce type d'échange. Cela dit, une grande quantité d'informations est déjà disponible aujourd'hui et des échanges d'informations ont effectivement lieu. Il est donc primordial de ne pas faire double emploi avec les efforts existants. Dès lors, une première étape serait de réaliser une analyse rigoureuse des informations déjà disponibles dans le domaine, de leur efficacité et des moyens d'améliorer leur efficacité. Une **surveillance** plus étroite des ressources consacrées et de l'efficacité de la Directive faciliterait l'évaluation de la Directive et fournirait des informations pertinentes qui pourraient être utilisées dans le cadre d'autres projets. Cela demanderait toutefois beaucoup d'efforts de la part des administrations, en raison d'un accès difficile aux données.

L'**obligation d'accepter des certificats d'auditeurs en sécurité routière venant d'autres États membres** pourrait augmenter l'efficacité des ASR puisque cela favoriserait un échange d'informations et d'éventuelles économies en matière de coûts de formation. Cependant, même en l'absence d'une telle obligation, la majorité des États membres accepte des certificats d'autres États membres. Obliger les États membres à accepter des certificats d'auditeurs en sécurité routière venant d'autres États membres impliquerait la certification des centres de formation, ce qui pourrait nécessiter la création d'une structure de formation partagée.

La **meilleure intégration des systèmes et services de STI** est un sujet très vaste. Si l'on imagine un scénario qui exige expressément qu'on évalue l'infrastructure des STI au sein des différentes procédures, il est évident qu'il s'agit d'une mesure peu coûteuse qui améliorerait l'efficacité des STI eux-mêmes. Intégrer des informations relatives à des STI spécifiques en tant que mesures correctives risque d'être rapidement obsolète. En général, les parties prenantes manifestent peu d'intérêt pour ce domaine et il n'est pas certain que la Directive soit l'endroit approprié pour se pencher sur les mesures STI. La Directive pourrait toutefois jouer un rôle en s'intéressant particulièrement au soutien que les infrastructures routières peuvent apporter au déploiement d'applications STI. La **standardisation** de l'infrastructure de la route même est en relation avec cette question. Aujourd'hui, suivant les dispositions du Règlement sur les produits de construction européenne (3005/2011 / UE-DPC) des normes différentes s'appliquent aux équipements routiers et matériaux routiers. Ces normes fournissent des grandes améliorations afin d'harmoniser les pratiques européennes en ce qui concerne les méthodes d'essai, mais ils laissent la liberté à chaque pays de spécifier le niveau nécessité en termes de performance sur son propre réseau national. Ces

différences dans les normes ont un impact important sur les conséquences de santé potentiels en cas d'accident et, à ce titre, sur l'établissement des normes pour certains éléments de l'infrastructure routière. Rendant leur utilisation obligatoire peut contribuer à améliorer la sécurité routière et de ce fait, mérite plus des recherches

La demande de **définitions plus claires** est apparue lors de la consultation des parties prenantes et de l'évaluation ex post, qui ont montré qu'il existe des différences en matière de mise en œuvre des procédures sur le terrain, différences qui pourraient desservir l'efficacité des procédures. D'un autre côté, cette liberté a également permis aux États membres d'adapter les procédures à leurs propres besoins. Il serait opportun de commencer par analyser les différences de mise en œuvre dans le domaine afin de savoir si ces différences sont bénéfiques pour la sécurité routière (car il est plus probable qu'elles soient adaptées aux circonstances locales) ou préjudiciables (car les procédures utilisées sont encore très loin d'être ce que l'on considère comme étant de bonnes pratiques).

L'analyse ci-dessus se consacre aux différents domaines séparément, bien qu'il existe en réalité certains liens entre eux. Par exemple, étendre les dispositions à d'autres routes mettra automatiquement l'accent sur les UVR. Une reconnaissance explicite mutuelle des certificats pour auditeurs entraînera également un échange d'informations et pourrait réduire la nécessité de disposer d'une gamme distincte d'ateliers, de lignes directrices, etc. Cette reconnaissance explicite permettra aussi d'harmoniser la définition de l'ASR, rendant ce dernier domaine moins pertinent pour cette procédure. La meilleure intégration des STI de manière informative peut également être considérée comme un sujet spécifique lié à l'échange d'informations, de même que la question des UVR.

Discussion sur la politique et conclusions

D'après l'évaluation ex post

Eu égard aux principaux résultats de l'étude, une recommandation générale peut être proposée afin de soutenir le processus de décision des institutions européennes dans le cadre de leur évaluation de l'efficacité de la Directive 2008/96/CE. Ceci améliorera par conséquent la mise en œuvre globale de la Directive à travers les États membres.

Comme mentionné dans l'étude, le principal obstacle à l'évaluation de l'application de la Directive consiste en la faible quantité et qualité des données disponibles. Des efforts devraient être entrepris afin d'améliorer la base de données de l'UE sur les accidents courants ainsi que l'accès à ces données, particulièrement en ce qui concerne les données sur les accidents qui ont lieu sur le réseau RTE-T. En outre, la collecte de données relatives aux coûts et aux bénéfices devrait également être améliorée. Au niveau de l'UE, des procédures harmonisées visant à estimer le ratio coûts-bénéfices des mesures prises en matière de sécurité routière doivent être élaborées. À cet égard, des méthodologies d'évaluation comparative devraient être proposées afin d'assurer le suivi des résultats de la Directive dans son ensemble et de chacune des procédures de gestion de la sécurité des infrastructures routières.

D'après l'analyse des domaines pouvant être améliorés

Eu égard aux principaux résultats de l'étude et de l'évaluation ex post, les recommandations suivantes peuvent être formulées :

- Une extension obligatoire de la Directive à toutes les autoroutes améliorerait la sécurité routière et assurerait une meilleure cohérence pour les usagers de la route. Parallèlement, cela permettrait d'éviter de dépenser des sommes considérables en cas d'extension de la Directive à toutes les routes. L'extension aux tunnels relevant de la Directive sur les tunnels n'aura probablement pas d'impact réel sur la sécurité routière, mais pourrait générer une approche plus cohérente axée sur une sécurité accrue des infrastructures routières.

- Étant donné que l'extension de la Directive à tous les usagers de la route semble irréalisable, il est plus logique de se focaliser sur les DRM. Ceci peut se faire au moyen d'une série d'ateliers/lignes directrices qui devraient être mis en place afin de faciliter l'échange d'informations. La décision d'élaborer des ateliers destinés à faciliter l'échange d'informations devrait toutefois être précédée d'une analyse minutieuse des pratiques en vigueur et des informations déjà disponibles.

- L'évaluation des bilans de sécurité des routes pourrait inciter les décideurs politiques à améliorer leurs performances, mais ne devrait probablement pas être associée à une certification, étant donné le peu de soutien dont bénéficie cette proposition. En outre, ce processus de certification nécessiterait une méthodologie commune, ce qui ne serait pas conforme à l'esprit de la Directive actuelle.

- La Directive pourrait mettre l'accent sur le rôle joué par les infrastructures routières dans le cadre du soutien qu'elles peuvent apporter au déploiement d'applications STI. La standardisation de l'infrastructure de la route même est en relation avec cette question. Rendant leur utilisation obligatoire peut contribuer à améliorer la sécurité routière et de ce fait, mérite plus des recherches.

1 Introduction

1.1 Background

Road infrastructure plays an important role in traffic safety, together with the behaviour of road users and the vehicle that is used. With the adoption of Directive 2008/96/EC on road infrastructure safety management (also known as "Infrastructure Safety Management Directive – hereinafter "the Directive") the general principles of infrastructure safety managements were introduced for all EU28 countries. Specifically, the Directive introduces the general principle of safety impact assessment at pre-design stage, of safety audit at the design stage, regular inspections at operation stage and the ranking of high accident concentration sections. It establishes a comprehensive system of road infrastructure safety management and, therefore, a coherent series of measures for:

- Road Safety Impact Assessments (hereinafter referred to as RSIAs[1]), covering new roads and applicable at the pre-design stage of the planning process;
- Road Safety Audits (hereinafter referred to as RSAs), covering new roads and applicable at the design, construction and early operational stages of the planning process;
- Road Safety Inspections (hereinafter referred to as RSIs), covering existing roads; and lastly
- Network Safety Management (hereinafter referred to as NSM) targeting the management of so-called accident "black spots".

The table below gives an overview of these different procedures and explains their definition and scope.

Table 1: Overview of the RISM procedures

RISM procedure	Definition and scope
Road Safety Impact Assessments (RSIA)	The road safety impact assessment is a strategic comparative analysis of the impact of a new road or a substantial modification to an existing network on the safety performance of a road network. The assessment takes place during the initial planning stage before the infrastructure project is approved.
Road Safety Audits (RSA)	A road safety audit is an independent detailed systematic and technical safety check that relates to the design characteristics of a road infrastructure project and that covers all stages from planning to early operation. Its goal is to identify, in a detailed manner, features of a road infrastructure project that could prove unsafe.

[1] It is worth underlining that the Directive does not include any specific acronyms to identify each procedure. This report derives its acronyms from the existing literature on this topic and uses them to refer the seperate procedures it discusses.

Road Safety Inspections (RSI)	A road safety inspection is an ordinary intermittent verification of the characteristics and defects that require maintenance work for reasons of safety. It operates as a preventive tool. RSIs aim to identify potential problems so that appropriate countermeasures can be taken to eliminate or minimize the chances of an accident occurring.
Network Safety Management (NSM)	The ranking of high accident concentration sections is a method to identify, analyse and rank sections of the existing road network on which a large number of accidents in proportion to the traffic flow have occurred. In addition, the network safety ranking is a method to identify, analyse and classify parts of the existing road network according to their potential for safety development and accident cost savings.

Source: based on (Gerlach, 2012)

This piece of EU legislation aims, therefore, to ensure that safety and safety management procedures (RSIAs, RSAs, RSIs and NSM) are integrated in all phases of planning, design and operation of the road infrastructure in the TEN-T road network. It also encourages Member States to apply its provisions to the rest of the network insofar that it was built with the use of EU funding (either as a whole or only in part).

1.2 Objective of the study

The overall objective of this study is to assist the European Commission with the evaluation of the current Directive 2008/96/EC on road infrastructure safety management and to investigate possible changes in light of new technological developments. The specific objectives of the study are:

3) To carry out an ex-post evaluation of the application of Directive 2008/96/EC. What were the main impacts of its application on road safety? What steps were taken to implement the Directive? What is the relevance of the Directive?

4) To provide a preliminary analysis of the possible areas of improvement with regards to road safety and the safety of road infrastructure in particular.

Important elements within the study were the stakeholder survey to collect the necessary data and the organisation of a stakeholder conference.

This report focuses on the second objective, the preliminary analysis of further areas of improvement with regards to road safety and of safety of road infrastructure in particular. Separate reports discus the ex post evaluation and the stakeholder conference. Input from both the survey and the conference is used in the ex post evaluation as well as in this analysis.

Taking the current Directive and its application as a starting point, this document looks into further areas of improvement with regards road safety and road infrastructure safety in particular.

1.3 Approach

The goal of this report is to look into possible policy areas for a further analysis. The objective is to provide a preliminary analysis of the main costs and benefits of areas linked to road infrastructure that may be considered to be possible improvements for the Directive.

This work requires us to distinguish five consecutive tasks:

1. Description of starting points for our further analysis;
2. Further development of the areas of improvement of the Directive based on the information received from the Commission, the ex post evaluation and the stakeholder consultation;
3. Methodology and construction of the baseline;
4. Preliminary analysis of the main costs and benefits of the areas of improvement linked to road infrastructure safety;
5. Conclusions and possible recommendations.

This work should be seen as a first preliminary analysis and is not intended to represent a full impact assessment.

1.4 Structure of the report

This report is structured along the lines of the five tasks that are described above. Hence the next chapter focusses on starting points for our further analysis which came forward during the ex post evaluation, the stakeholder consultation and the data analysis. Given this analysis, we elaborate on those themes which proved most promising. The third chapter discusses the methodology that was used and the construction of a baseline. In the fourth chapter the actual analysis of the main costs and benefits of the areas of improvement of the Directive is made. This then leads to our conclusions and to our possible recommendations in the concluding chapter.

2 Starting points for the analysis

In order to justify our analysis of further directions for the future, our first step is to discuss the current limitations of the Directive as well as the points of view of the stakeholders which were consulted.

In this section some of the current limitations of the Directive are described. We start with a description of accident data and of data on the share of the TEN-T network in the different countries. This information is complemented with the views of stakeholders as they were expressed in the survey and the stakeholder conference. We then correlate this information with the results from the ex post evaluation the accident data and the data on the share of the TEN-T network in the different countries.

2.1 Data analysis

Today the Directive applies to the TEN-T network and hence primarily targets motorways. Hence, we first look into differences in accidents depending on the different types of roads. As we will discuss further on in the text, this element came also forward from the ex post evaluation and the stakeholder consultation. We also look at the VRU, including motorcycles. Although the Directive explicitly mentions vulnerable road users, some stakeholders expressed the view that these users may require more attention.

Accident data with respect to road type

The nature of rural roads[2] as well as the type, level and speed of traffic which they carry differs significantly from urban roads and motorways. This means that the risks people face on rural roads, and the type of accidents they suffer on them, also differ from the risks they face or the accidents they suffer on or near urban roads and motorways.

Due to the lower traffic flow on rural roads many people think that they are safer than they actually are. But, the winding and hilly character of many of these roads reduces the distance drivers, riders and walkers are able to see ahead. The higher speeds at which traffic normally travels on these roads leaves road users with less time to react and so results in accidents that are characterized by a higher impact.

In urban areas, accidents usually cluster at junctions or on particular stretches of road. In rural areas accidents tend to be more scattered and are less likely to take place at a junction, which makes implementing infrastructure measures more difficult.[3]

Generally, in the EU 28 the largest proportion of accidents occurs in urban areas, whereas the most serious crashes happen on rural roads. Table 2 shows that almost 55% of fatalities in EU27 occur on non-urban non-motorways even though almost 67% of all casualties happen on urban roads. Motorways are the safest roads with only 6% of all fatalities.

[2] Rural roads are defined in this report as roads outside urban areas that are not motorways or unpaved roads.

[3] (Royal Society for the Prevention of Accidents, 2007)

Table 2 Distribution of casualties and fatalities on urban and non-urban roads (EU 27- 2010)

EU 28 aggregates	Urban	Motorways	Non-Motorways ('rural roads')
Casualties	67%	6%	27%
Fatalities	38%	8%	55%
Seriously injured	53%	7%	40%

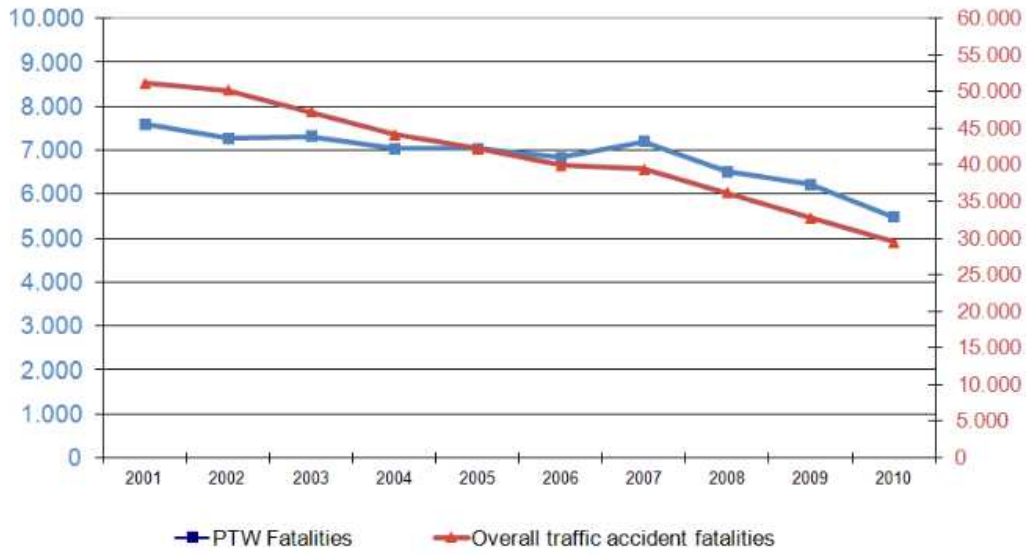
Source: (CARE and CADAS database), year 2010 chosen as most complete recent year

Accident data with respect to vulnerable road users

Vulnerable road user fatalities consist of three groups: pedestrian fatalities, bicycle fatalities and Power Two Wheelers (PTW – motorcycle and moped) fatalities. In 2010, the EU27 registered 9349 vulnerable road user fatalities. If we look at the three different groups we see that there were 2043 bicycle fatalities, 5462 PTW fatalities and 6194 pedestrian fatalities[4]. These fatalities make up 30% of the total number of fatalities in 2010 (6.6% bicycle fatalities, 15% PTW fatalities and 20% pedestrian fatalities).

PTW are of particular interest, since the decrease in PTW traffic fatalities has been lower than the overall decrease. This much can be seen on the figure below.

Figure 1: Distribution of road traffic fatalities in the EU-20, 2001-2010



Source: (ERSO, 2013)

The ERSO factsheet on PTW also shows that between 2001 and 2010 the fatality rate of PTW declined in most of the EU-20 countries. The most significant reduction took place in Portugal (-

[4] (ERSO, 2013) – motorcycles and mopeds; (ERSO, 2013)- cyclists; (ERSO, 2013)- pedestrians.

61%), while in Romania, Finland, Sweden, Poland and the Czech Republic, the number of fatalities increased. Over time, PTW rider fatalities as a % of the total number of road accident fatalities also increased: the increase goes from around 15% in 2001 to 19% in 2010. Overall, the trend for PTW fatalities differs from the trend for other modes of transport. It is the only mode of transport which saw an increase between 2001 and 2007, and only in the latest year has there been a significant decrease compared to 2001.

Also for pedestrians and cyclists the overall decrease in fatalities have been slower (a reduction of 39% and 38% respectively between 2001 and 2010) compared with the overall decrease of more than 42%[5]. There are large differences between Member States with respect to the % of bicycle fatalities ranging from 21% in the Netherlands to 2% in Greece and Ireland. This is directly linked to the amount of exposure.

If we make the link with the location in which the fatalities occur, in general 55% of bicycle fatalities happen inside urban areas (although there are large differences between countries)[6]. The majority of PTW fatalities happen on non-motorways. The majority of moped fatalities occur in urban areas (56%) whereas the majority of motorcycle fatalities occur in rural areas (55%). About 28% of all motorcycle and moped rider fatalities occur at a junction. It is about the same for cyclists (33%). For car occupants, the corresponding figure is only 18%.

Data on the TEN-T network

Overall, the TEN-T network only covers about 1% of the total road network in a country as can be gathered from the table below.

[5] (ERSO, 2013)– Pedestrians; (ERSO, 2013)- Cyclists

[6] (ERSO, 2013)- Cyclists

Table 3: Share of the TEN-T Core roads by EU 28 Member States (calculated on the basis of the total length of the road network for each EU28 country).

km	Length of other roads	Length of motorways	Total road network	Length of Ten-T	Share Ten-T in total road network	Extended application Directive to non-TenT roads
Belgium	153,447	1,763	155,210	829	0.5%	NO/YES
Bulgaria	19,061	541	19,602	1,349	6.9%	YES
Czech Republic	129,884	751	130,635	766	0.6%	YES
Denmark	72,203	1,128	73,331	543	0.7%	YES
Germany	n.a.	12,879	644,480	6,153	1.0%	n.a.
Estonia	58,644	124	58,768	478	0.8%	YES
Ireland	95,102	900	96,002	711	0.7%	YES
Greece	n.a.	n.a.	116,711	1,742	1.5%	n.a.
Spain	150,894	14,701	165,595	5,432	3.3%	YES
France	1,054,092	11,465	1,065,557	4,759	0.4%	YES
Croatia	25,436	1,254	26,690	0	0.0%	NO
Italy	244,374	6,668	251,042	3,963	1.6%	YES
Cyprus	12,792	257	13,049	0	0.0%	YES
Latvia	58,566	0	58,566	836	1.4%	YES
Lithuania	82,602	309	82,911	629	0.8%	NO
Luxembourg	2,747	152	2,899	68	2.3%	YES
Hungary	200,426	1,515	201,941	974	0.5%	YES
Malta	2,361	0	2,361	0	0.0%	YES
Netherlands	128,903	2,631	131,534	629	0.5%	YES
Austria	122,400	1,719	124,119	1,058	0.9%	YES
Poland	412,035	1,365	413,400	2,834	0.7%	YES
Portugal	11,296	2,988	14,284	910	6.4%	YES
Romania	84,185	550	84,735	1,785	2.1%	YES
Slovenia	38,216	769	38,985	412	1.1%	NO
Slovakia	42,948	419	43,367	408	0.9%	NO
Finland	106,228	780	107,008	1,078	1.0%	YES
Sweden	144,984	1,891	146,875	2,988	2.0%	NO
United Kingdom	416,067	3,686	419,753	3,020	0.7%	YES
Total	**3,869,894**	**71,205**	**4,689,411**	**44,353**	**0.9%**	**20**

n.a.: not available

Source: TRT analysis on the TRUST network model and Eurostat data on the length of motorways and of "other roads" (for Germany: http://en.wikipedia.org/wiki/List_of_OECD_countries_by_road_network_size and for Greece: http://en.wikipedia.org/wiki/List_of_countries_by_road_network_size

The Directive is only mandatory on the TEN-T network – in practice this means that it is mostly motorways which are covered. However, not all TEN-T roads are motorways and not all motorways are TEN- T roads and, in this respect, there is a lot of variation between the different countries in Europe.

For some countries it is the case that the TEN-T network represents a large share in the total length of motorways (e.g. 99% of the Slovakian motorways are part of the TEN-T core network) as shown in the table below. On the other hand, for other countries this share is much lower (e.g. for the Netherlands it is only 26%). Having this said, the TEN-T network consists of the most important road links within a country. This is also reflected in the table below when we compare the share of vehicle km driven on the TEN-T motorways relative tot the total network of

motorways. In general, the share of vehiclekm is larger than the share in km. For example, in Austria the TEN-T network represents 48% of all motorwaykm, but in traffic terms it carries 63% of all vehiclekm on motorways. This means that the TEN-T motorways are on average the most intensively used motorways

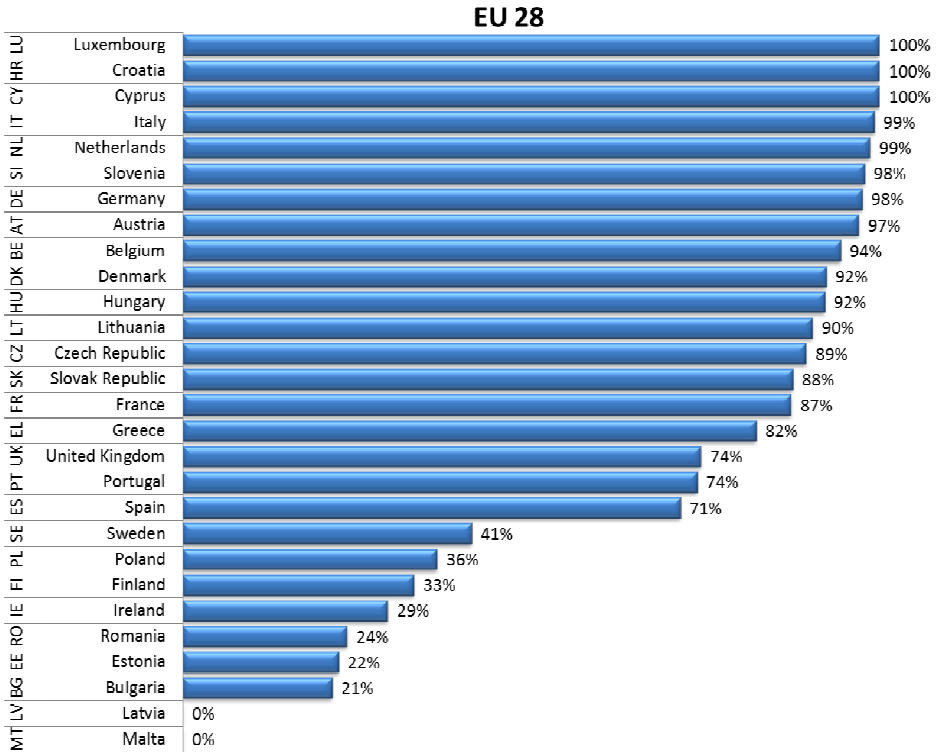
Table 4: share of the TEN-T Core motorways by EU28 Member States (calculated on the total length of the modelled network of motorways for each EU28 country) and share of carkm, HDVkm and vehicle km on the TEN-T Core motorways compared to the the traffic on the total network of motorways.

		CAR	HDV	TOTAL (CAR+HDV)
EU28	**share of TEN-T Core motorways (wrt total motorway network)**	**share car-km**	**share hdv-km**	**share veh-km**
AT	48%	62%	69%	63%
BE	46%	64%	69%	65%
DE	49%	60%	68%	61%
DK	44%	46%	43%	45%
EL	78%	85%	91%	86%
ES	57%	70%	77%	71%
FI	51%	53%	39%	52%
FR	40%	51%	54%	51%
IE	52%	45%	52%	45%
IT	59%	71%	76%	71%
LU	48%	69%	84%	71%
NL	26%	35%	33%	35%
PT	33%	44%	65%	45%
SE	72%	86%	88%	86%
UK	65%	80%	81%	80%
BG	47%	71%	63%	70%
CZ	77%	81%	81%	81%
HR	74%	72%	78%	72%
HU	74%	83%	87%	84%
LT	35%	43%	63%	44%
PL	94%	92%	97%	93%
RO	84%	80%	72%	80%
SI	74%	78%	81%	78%
SK	99%	100%	99%	99%
EE	87%	88%	89%	88%

Note: in Malta and Estonia no motorways exist.
Source: TRT analysis on the TRUST network model – vehicle shares are based on modelled data.

Furthermore, while the TEN-T road network mainly consists of motorways (In Luxembourg 100% is motorway, in Italy and the Netherlands 99%), for some countries the share is much lower (21% in Bulgaria and 0% in both Latvia and Malta) as can be seen in the figure below.

Figure 2: share of the TEN-T Core motorways by EU28 Member States (calculated on the total length of the TEN-T Core road network for each EU28 country)



Note: in Malta and Estonia no motorways exist.

Source: TRT analysis on the TRUST network model

Even in countries in which the share of motorways that belong to the TEN-T road network is low, the roads which are included are usually larger express roads (2 lane roads, often with separated directions).

In summary, at first sight it seems that the Directive only covers a limited amount of km of road in each country. However, Table 4 showed that these roads represent the busiest roads while Table 3 showed that most countries also apply the Directive to other roads. Not all countries apply all procedures to all roads and the criteria to select the road vary between countries. Moreover procedures are often non mandatory on the other roads.

Conclusions from the data analysis

This section focussed on data on where accidents happen, accidents with vulnerable road users and on the coverage of the Directive. The coverage of the Directive is an element which will also come forward in the stakeholder consultation and the ex post evaluation. The focus on VRU is also discussed in the results of the stakeholder consultation.

The following table summarizes the shares of accidents on non-motorways and of accidents with VRU.

Table 5: Overview of accidents, for different road types and for VRU (2010)

Problem area	%	Traffic deaths	Traffic injuries
Vulnerable road users	Pedestrians	20%	10%
	Cyclists	6.5%	6.3%
	PTWS	19%	20.6%
Rural Roads		55%	27%
Urban Roads		38%	67%

If we combine this with the information on the coverage of the TEN-T network it is clear that the Directive is not targeting the types of roads on which most accidents happen. Moreover, even when we only focus on motorways there might still be a problem. When we consider the share of TEN-T roads in the different road networks, in some countries a problem of expectations can arise. For example in the Netherlands, 99% of the TEN-T roads are motorways while only 26% of the motorways are part of the TEN-T. This means that for a same type of road different legislation might be relevant. This however, is not the case for the Netherlands as the four procedures are also mandatory for roads that are not part of the TEN-T network. For other countries this problem does arise.

VRU are not explicitly targeted by the Directive[7] given the current focus (TEN-T network which mostly consist of motorways and expressways versus the use by VRU (limited primarily to PTWs) and the locations most dangerous for VRU (junctions). This does not mean that there should not be a stronger focus on VRU, since they (especially PTWs) are a group for whom traffic safety has not increased as much relative to the overall tendencies in traffic safety.

2.2 Stakeholder view from the survey

The survey

An online questionnaire-based survey was widely disseminated. The goal of this survey was to collect information and to assess the responses provided by Member States and by a broad range of stakeholders.

Two dedicated questionnaires were designed: the first questionnaire was designed specifically to target Member States with the aim of collating evidence on the functioning of the Directive; the second questionnaire was designed to gather stakeholders' points of view, and to involve them in the examination of possible shortcomings and improvements. More information on the survey, the questionnaires that were used and the results that were obtained can be found in the report that discusses the ex post evaluation.

[7] The Directive does mention VRU within the framework of the different road safety management procedures.

This extensive consultation was announced on March 2014 and conducted in April and May 2014. It featured a total of 29 responses for the "Member State Survey" (27 Member States,[8] including two responses for Belgium,[9] plus two non-Member States[10] (a response rate of 90% of all Member States that were contacted) and responses from 27 stakeholder representatives (a response rate of 43%).

Results

One of the questions in the survey explicitly asked about possible revisions with regards to the application or the scope of the Directive, although in the two questionnaires the phrasing differed sightly. The table below shows the results.

Table 6: Opinion on the scope/revisions of the Directive

		YES	NO
MS survey	In your opinion are there any issues to be considered regarding the scope and application of Directive 2008/96/EC	4	23
Stakeholder survey	In your opinion, after 5 years since its adoption are there any revisions you think would be beneficial to the Directive	19	8

Source: Data based on replied Member States' questionnaires (25 Member States plus Belgium-Wallonia and Belgium-Flanders) + 27 replies to the stakeholder survey.

There is a clear difference in opinion between the two groups of respondents, although it should be noted that the phrasing was different in their respective surveys.

The respondents to the MS survey do not see any issues for consideration with regards to the scope and application of the Directive, while the stakeholders do support a revision. Not a lot of additional comments were given when the reply was "no", but some countries (mostly the countries with least experience with the RISM procedures) did indicate that it is too early for any changes, since more time is needed to experience working with the current Directive. In the MS survey, Member States who stated "yes" wanted to focus on a stronger coordination with the tunnel Directive. Further issues that were raised were the possible problems of having suffiecient resources (both human and financial) and the fact that one has to take into account that each country has its own particularities.

The stakeholders focus on (in order of the number of times stated): Extending the provisions to other roads, the need to measure the outcomes/benchmarking/before and after studies; the need to have clearer definitions of procedures; Vulnerable Road Users (VRU); maintenance issues; (conditional) funding; ensuring the independence of auditors and the need for harmonised training and certification. One respondent states that they ought to have the freedom to choose between

[8] Austria, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

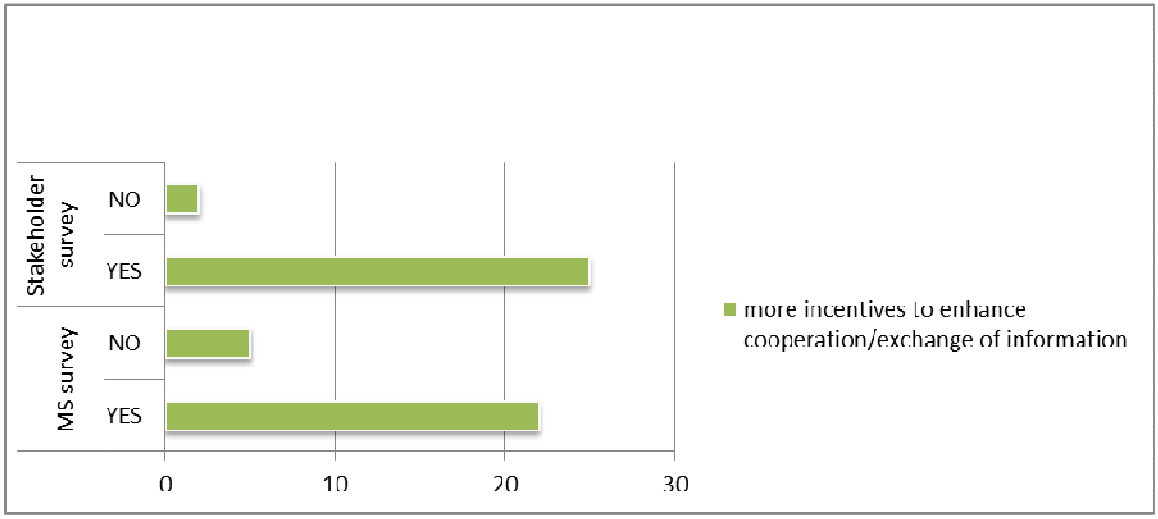
[9] Belgium-Wallonia and Belgium-Flanders.

[10] Switzerland and Iceland.

instruments. No particular bias was found between the different stakeholder groups, even if there was some difference in focus with respect to the subjects "extending to other roads" and VRU. Some replies focussed only on urban or only on rural areas and some focussed on VRU as being only pedestrians and cyclists even though problems for PTW were also raised. Other issues which were seen as a problem were the problem of capacity and funding and the need for road maintenance. Some stakeholders also discussed the need for appropriate infrastructure-to-vehicle communication. Finally, as also discussed in the ex post evaluation section, some respondents raised the issue of the unclear definitions of some of the procedures, which leaves too much freedom in the process of implementation.

Both Member States and stakeholders do emphasise that there is a need for a higher degree of cooperation as can be seen in the figure below.

Figure 3: Opinion of stakeholders and Member States as to whether there should be more incentives to enhance cooperation/exchange information and best practices



Source: Data based on replied Member States' questionnaires (25 Member States plus Belgium-Wallonia and Belgium-Flanders) + 27 replies to the stakeholder survey.

Member states respond to this by stating that it would be very beneficial for the less experienced countries and that professionals can always learn from one another. On the other hand, they also stress that the CEDR is a platform which is currently already actively used to facilitate the exchange of best practices.The additional comments that follow when the reply is "no" focus on the particularities the different individual countries and on the fact that such an exchange ought to be voluntary.

Stakeholders state (in order of the number of times a topic was mentioned) that exchanging information is a cheap and effective way to improve road safety; that the focus should be on specific topics (such as data collection, implementation in the field, specific target groups)and that there is still a lack of information in some countries. With respect to the format, the stakeholders mention forums of experts, the CEDR TG Road infrastructure working group, observatories, more studies, etc. It is remarked that one should not overlook the differences in the network characteristics and that it would be beneficial if a controller would assess the actual implementation of the Directive in the different countries.

Conclusions from the survey

The survey showed that the Member States and the stakeholders clearly hold different points of view. Member States stressed the importance of freedom to act, the problem of manpower and financial resources as well as the fact that the actual implementation of the Directive has only just started in some of the countries involved.

Stakeholders focused mostly on extending the Directive to other roads. They focused on VRU and emphasised the need for clearer definition of procedures.

There does seem to be a consensus on the need for a more substantial exchange of information and the need for a higher degree of cooperation. This could be achieved via the existing CEDR working group or via an EU-led initiative.

2.3 Stakeholder view from the conference

On 13 June 2014, the European Commission organized a Stakeholder Conference as part of the review of Directive 2008/96/EC on road safety infrastructure management. The "Study on the effectiveness and on the improvement of the EU legislative framework on road infrastructure safety management (Directive 2008/96/EC)" is meant to assist the European Commission in the assessment of the Directive, and to examine preliminary possible changes in light of stakeholder feedback and new technological developments.

The main objectives of the conference, which was open to all interested stakeholders, were to present the preliminary results of the ex-post evaluation of the Directive, and to consult with a variety of stakeholders in order to obtain their views on issues related to the improvement of road safety. 63 participants registered for the conference, representing 58 Member State ministries as well as relevant organisations from 17 Member States or which operated EU-wide. The full minutes of the workshop can be found in a separate document. In this document we focus on the general methodology and the main results that were obtained with respect to specific areas of further development.

Methodology of the conference

A conference background paper (annexed to the ex post evaluation) was sent out to all participants upon registration. It outlined the background and purpose of the study, and provided participants with detailed information on the key topics which were to be discussed during the event.

The Conference comprised four thematic sessions that addressed the following aspects respectively:

- Review of the preliminary study results
- Vulnerable Road Users in relation to the Directive
- Role of Intelligent Transport Systems in the Directive
- Measurement of the safety performance of the roads.

Each session started with a 10-15 minute introduction by an expert followed by an interactive mapping exercise. The first session was introduced by the consortium and sessions 2-4 were introduced by professor George Yannis of the National Technical University of Athens. For each

of the sessions, an exercise sheet with questions (which were also included in the conference background paper) was distributed to the participants. While listening to the presentation the participants were asked to think about the questions. After each presentation there was an interactive session. During this session participants were invited to first consider the questions individually, then to do so in groups of two and finally to do so in groups of four. At the end of the session, each group had to present the main conclusions to which their discussion has led. The written sheets were also collected so as to keep track of all the possible input.

The objective of these sessions were:

- To invite stakeholders to comment on the results of the survey
- To invite stakeholders to map issues/topics of importance for road safety with regards to VRUs, ITS and safety performance measurement.

Results from the conference with respect to areas of further improvement

The contributions with respect to the topic of VRU in relation to the Directive were mixed. While some participants indicated that the Directive already mentions VRU, others saw a need to introduce procedures that are dedicated to VRU, or that are customised to fit the different VRU and to fit the different types of roads. In terms of data – performance – knowledge, there was a strong support to collect **data** dedicated for VRU; to evaluate safety performance; and to develop knowledge dedicated to VRUs, by exploiting existing knowledge. Other topics raised that were brought up were the need for appropriate road design **standards** in relation to VRU; the introduction of minimum standards; and the concept of forgiving roads for VRU.

With respect to the role of ITS in the Directive, the general conclusion to which the discussion led was that ITS (especially V2I connectivity) are an innovation, and they are the future. Nevertheless, legislative steps should be cautious and in parallel with the deployment of ITS and the relavant Directives. ITS can play varied roles: as applications that support safer traffic, as a tool that support road infrastructure safety management and as a tool for the collection of necessary data. A series of specific topics were out: ITS **harmonisation** and standards are needed and a process should be put in place; **data protection** should be enforced in all processes; infrastructure related ITS should also be audited and **evaluated.**

With regards to the measurement of the safety performance of roads, there is a clear need for more detail in the measurement of the safety performance of roads. This enhanced detail would function as a major support tool for the management procedures of the Directive, but it would also function to support the accountability of authorities. More data (accident, exposure, performance indicators) should be collected and this should be done with sufficient frequency. This data could possibly include the cost of measures and accidents for cost-benefit/effectiveness analyses, including common data collection methods as well as facilitated and harmonized accession to data.

Conclusions from the stakeholder conference

During the conference, the focus lay on three themes: vulnerable road users, ITS and the measurement of safety performance. With respect to the VRU, an acknowledgment was made that they are indeed mentioned in the Directive; at the same time, it was emphasized that there is a need to take them more fully into account. Although the scope of the Directive discussed is the TEN-T network, in which the dominant form of traffic is not that of VRU, there is certainly room for

further reflection with respect to education, procedures, speed management, as well as for the sharing of best practices. In principle, there was support for ITS, but there was also a clearly expressed sense of caution by a number of participants. In some areas the market might outperform legislation. On the other hand, all ways of promoting the sharing of the different types of information that contribute to road safety should be considered. With respect to the measurement of road safety performance, the participants appreciated the fact that this sort of ranking requirement was put into place. They did, however, identify a need to further develop and harmonize this type of measurement, and to make data (data on accidents, cost- benefit analyses of measures, etc.) more accessible and understandable for a variety of purposes.

2.4 Ex post evaluation

The ex post evaluation, which is described in more detail in a separate document, assessed the operation of the Directive in light of eight evaluation criteria. This evaluation considers a wide range of issues relating to the **implementation** of Directive 2008/96/EC on road infrastructure safety management, as well as the **efficiency** and **effectiveness** of mechanisms and structures that were put into place to support its implementation. Among the crosscutting themes which were examined were the criteria of **utility**, **sustainability** and **European added value**. Together, these criteria were used to determine the extent to which the Directive has truly been able to respond to the initial needs and problems of the target beneficiaries and European citizens, the extent to which positive changes that can be attributed to the Directive may be expected to continue to have an effect and whether or not EU level interventions have led to benefits that exceed those that would have been achieved had Member States acted independently. One of the issues that was considered was whether the objectives of the Directive continue to be relevant to the needs, problems and issues they were designed to target. Finally, the extent to which the Directive can be **coherent** with the deployment of ITS technologies, in particular, for the communication between the vehicle and the infrastructure.

Implementation

There is evidence that RSIA and RSA procedures have mainly been integrated in pre-existing national schemes. A similar perspective is offered for the procedures that are in use on the road network in operation (NSM and RSIs). In general, the integration of the new requirements stipulated by Directive 2008/96/EC in the pre-existing national frameworks chiefly occurred in Member States where procedures were already established before the Directive was adopted.

The different RISM procedures were not found to have a significant influence on the planning phase. This is especially true for those countries where the procedures were already in place. In those MS where they were not established the overall impact on timing is also expected to be low as, within the Direcitive, the application of the procedures is targeting larger projects which already have a relatively larger time frame and as some of the procedures can be done simultaneously with other procedures such as the environmental impact assessment.

Member States, with only a few exceptions do not earmark funds to carry out the RISM procedures. The costs are genarlly incorporated in the overall costs of the road project investments.

Interestingly, at least one RISM procedure is applied beyond the TEN-T road network in almost all Member States. RSAs are the most applied procedure to non-TEN-T roads. The extent to which RISM procedures are applied to non-TEN-T roads is substantially variable, mostly because of the

different level of compulsioriness of their application. The type and/or the hierarchical level of the roads are the main criteria for selected sites on the non-TEN-T road network to be audited.

Finally, Member States encountered no specific barriers in the process of transposing and applying the obligations that were stipulated by the Directive. This was the case for those EU countries in which procedures were already in place and functioned properly before the Directive was even adopted, so that only minor changes had to be implemented to align the pre-existing legislation with the Directive. The following elements were mentioned as the main factors that have hampered the implementation of the Directive: a lack of institutional, administrative, financial or technical capacities to apply the Directive, or an apparent incompatibility between the pre-existing normative framework and the new requirements of the Directive.

Relevance

Directive 2008/96/EC has led to an improved and more consistent regulatory framework for spreading the use of the RISM procedures compared to the prior system of national legislation. It has brought the RISM system to a higher level of uniformity across MS. However, this still need to be extensively secured at EU level. This motivates why the objectives of the Directive are still relevant and fit-for-purpose when considering the overall EU objectives in terms of improved road safety.

Effectiveness

Evidence is given that the implementation of Directive 2008/96/EC has led to improvements in many Member States. These have been reported both in Member States/Regions in which these procedures were in place before the implementation of the Directive and those in which they were not.

As for the social costs and the possibility of a uniform consideration of such costs, no information has been found to analyse the data collected through the questionnaire, the literature review and the interview programme which was conducted. Furthermore, there is little evidence that Member States have been able to provide information as to whether or not and in what way planning, design and construction stages to date have been affected by Directive 2008/96/EC.

With regards to the exchange of good practices, the level of exchange is satisfactory since the majority of Member States are active in this respect. Nevertheless, most of them have not reported any specific improvements as a result of such an exchange of good practices. This stresses the need for the Directive to further incenitivize the monitoring and exchange of information between Member States.

Moreover, formal training and examination procedures are conducted in almost all Member States (in particular for RSAs and RSIs). The requirements for the qualification of auditors differ across Member States, but a set of educational and professional criteria are commonly requested so that procedures may be performed more effectively. However, training programmes and certification requirements still differ widely in tersm of duration and contents. This can hinder the possibility to implement coherent safety procedures on the whole road network, at MS level, as well as at EU level.

Sustainability

In general terms, Directive 2008/96/EC has encouraged the introduction of a European-wide approach to road infrastructure safety management. This has encouraged national authorities to adopt a new way of thinking about, and dealing with, road safety. Moreover, national authorities have become more capable and they have been encouraged to adopt a more systematic approach to safety management of roads. All procedures are now part of national road infrastructure safety management systems and, remarkably, they have been streamlined, have been standardized and have been applied more frequently.

However, the on-going sustainability of the Directive depends on a stronger and more consistent harmonization, so that Member States will use the evaluation tools by relying on shared assessments and benchmarking methodologies.

Coherence

It is generally accepted that ITS systems are an asset for the whole infrastructure development and should be part of the assessment that is performed during the implementation of the road infrastructure safety management procedures that were stipulated by the Directive. Moreover, the infrastructure should also allow for the use of ITS.

The Directive itself does not set out specific instructions on how ITS should be deployed across EU Member States. Moreover, industry does not believe that there is a strong link between this Directive and ITS. Hence we conclude that the Directive on RISM does not really influence the deployment of ITS in a negative or in a positive way. Nevertheless, the four areas of information about infrastructure safety, the use and maintenance of infrastructures, safe design of infrastructures and traffic management can be envisaged where deployment of ITS can produce benefit on the infrastructure and where synergies with Directive 2008/96/EC can apply.

In general, other Directives such as the ITS Directive, the INSPIRE Directive and the OPEN DATA Directive would have a stronger impact on the deployment on ITS.

Utility

It is difficult to directly assess the benefits that are potentially generated by Directive 2008/96/EC; analogous to the reasoning made for costs (see below), it is significant that only a limited number of Member States measures the benefits for all or some procedures. However, evidence provided by Member States by way of the survey demonstrates that they did appreciate having a systematic approach to road safety infrastructure management.

On the other hand, the literature focuses mainly on the effects of the various individual procedures rather than on the effects of the Directive as a whole. Based on the literature, there is a reduction in the number of accidents in a range of between 10% and 20% % compared to a situation in which procedures are not applied. This means that the effect on road safety would be higher in countries that did not have procedures in place. The results from the statistical analysis confirmed that there is a high correlation between a lower fatality rate and the fact that one has put road safety procedures into place.

Efficiency

The majority of Member States have not tallied the costs for any of the procedures. However, costs associated with the follow-up of safety assessment have been reported as the most significant cost category involved in the application of RISM procedures. The administrative burden generated by the Directive is mainly related to the costs for administering (launching and performing) RISM procedures. Administrative costs account for nearly one-fifth of the global cost involved in the application of RISM procedures.

In general, the application of the Directive is still considered to be too recent, so that it is difficult to begin to understand whether it has led to a more efficient and cost saving planning and management of the network. In addition, RISM procedures are only a part of the broad spectrum of road safety tools. This implies that it is not always possible to clearly distinguish the changes in costs and benefits associated with all RISM procedures or associated even only with a few.

Considering the benefits, the literature reviewed indicates that these procedures are cost effective (in particular for RSA). In general terms, the reduction in the number of road fatalities/injured victims can be considered as the main benefit of the application of the Directive.

EU added value

Directive 2008/96/EC is considered to be a major step forward in promoting a change in the way RISM procedures are applied in the Member States. The new regulatory regime introduced a pro-active harmonised approach to road infrastructure safety problems within a clear timeframe. The expectation is that this will lead to a reduction in costs and a more efficient use of resources.

Despite all this, in those cases in which procedures were already in place before the Directive was an introduced, no significant change to the procedures or to the frequency of their application was reported. Notwithstanding this, the Directive has provided a prop for the generalised used of the RISM procedures, encouraging a common "language" for their take-up. This result would not have been achieved leaving the MS acting alone, in particular in those countries which had not established the procedures before the adoption of the Directive.

Conclusions from the ex post evaluation

The ex post evaluation showed that while the Directive 2008/96/EC has only been in force for five years, it appears to be a substantially successful directive. As a whole, the Directive has certainly triggered a different way of thinking and dealing with road safety management. This is first of all due to the fact that it has encouraged a generalized use of the RISM procedures which are now established in all Member States and which are based on a minimal set of compulsory rules for the management of the TEN-T roads (in many cases also extended to the not TEN-T roads). It is equally important that the Directive provides a "common language" for carrying out road infrastructure safety management which relies upon a harmonized legislative framework. At a national level, the Directive has instigated a normative and operational process that would not have happened in such a widespread manner without EC intervention. Given the relatively recent implementation it is still relatively early to assess the effects on road safety quantitatively and it might take some more time to really see the effects in reality.

The main limitations of this Directive relates to

- The limited scope of its application, i.e. this piece of EU legislation only applies to the TEN-T road network and not to non-TEN-T roads. The latter provide a higher potential for the improvement of road safety since the majority of accidents occur on these roads (cf. further). The possibility of extending the requirements stipulated by the Directive to non-TEN-T roads as well is left to the discretion of Member States. Among the Member States whose legislative framework foresees the application of the RISM procedures to non-TEN-T roads, the following is the case: for half of them such application is voluntary for RSAs, RSIs and NSM, while for two thirds of them it is mandatory for RSIAs.

- The differences between the actual implementation of the procedures in real life, although this freedom also allows the Member States to adapt procedures to their needs.

- The fact that there is no EU-supported exchange platform for best practices. Today, most of the information exchange happens through CEDR meetings.

2.5 Conclusion

Based on the ex post evaluation, the stakeholder input, the confrontation with the data we are able to draw the following conclusions:

- Most Member States believe that, at this point in time, there are no real issues with respect to the scope and the application of the Directive. This is because the implementation of the Directive is still relatively recent. Moreover, questions arise as to whether there would be enough resources (human and financial) should the scope of the Directive change. Most Member States, and especially those who have less experience with the different road safety management procedures, do recognise that a higher level of cooperation and information exchange is needed. The other stakeholders acknowledge this as well. This exchange of information could take place via an EU-supported platform. Today, most of exchanges of information happen either via the CEDR working group on infrastructure safety or on a bilateral basis.

- The stakeholders do see a need for a revision. They focus on the extension to other roads; on having a clear definition of the procedures, the need for more data (including cost-benefit analyses, before and after analyses) and on a larger focus on vulnerable road users.

- Given the data on the location in which road accidents happen, the demand for the extension to other roads seems valid. However, 20 out of 26 Member States who replied to the survey indicated that they had already extended the use of (some of) the procedures to other roads.

3 Areas for further analysis, methodology and baseline

In this chapter we first discuss the areas which will be further investigated. In chapter 4 these themes will be further assessed given the methodology set out in the next section. In order to make this analysis a baseline needs to be established. This baseline focusses on the expected evolution in traffic safety should no changes be made to the current Directive.

3.1 Areas for further analysis

Following the discussion in chapter 2 and information received by the Commission[11] the following areas will be further investigated:

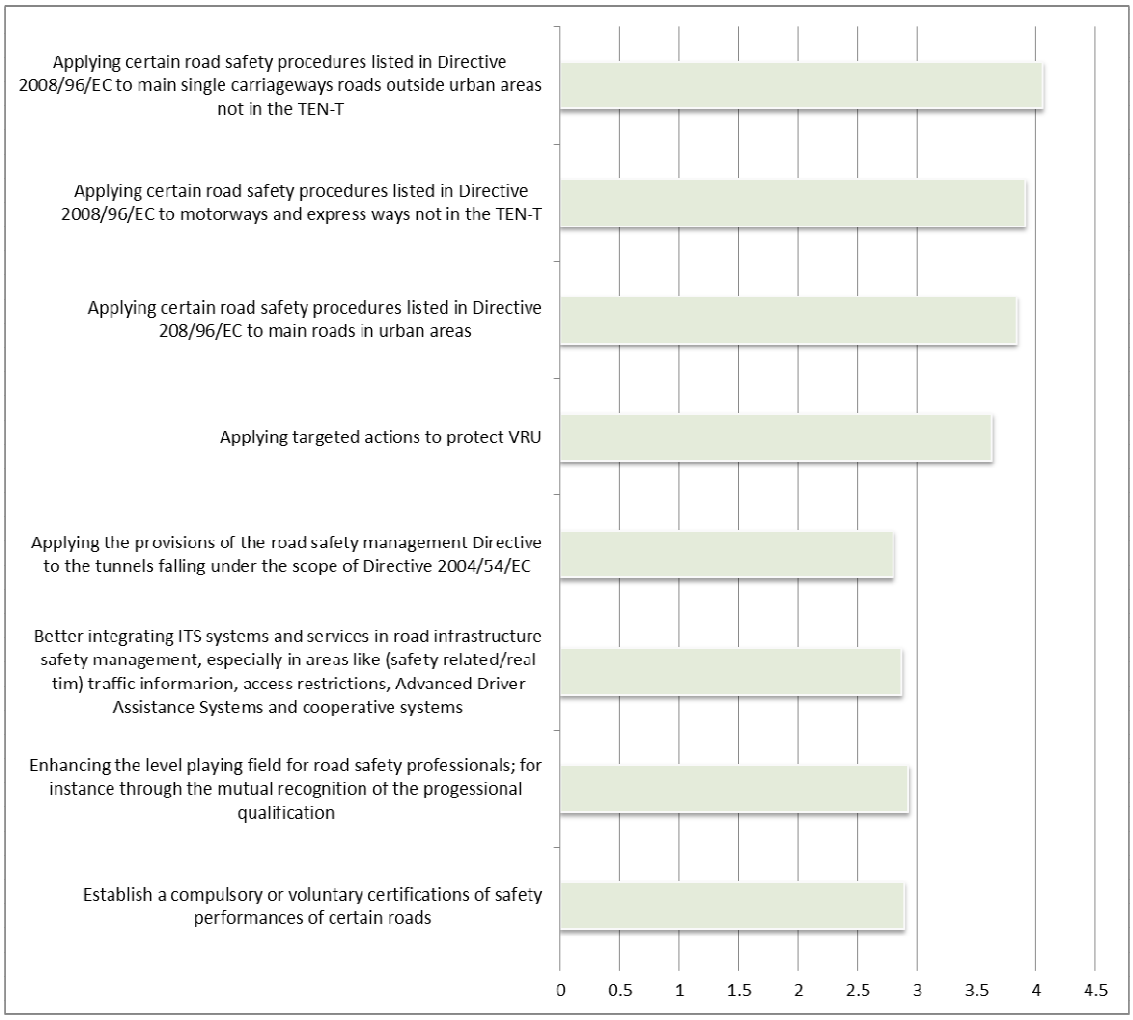
1. **Extending** the scope of the Directive to a) main roads (urban areas, regional and national network not in the TEN-T) on a voluntary or compulsory fashion; b) roads which benefit from EU contributions; and c) tunnels that fall under the scope of Directive 2004/54/EC
2. **Reinforcing** the framework through more targeted actions so as to protect **Vulnerable Road Users**, especially cyclists and motorcyclists
3. Introducing (on a voluntary or compulsory basis) a **minimum service level requirement** which entails the compulsory certification of safety performances for every single road.
4. **Increasing the information** communicated to citizens and road users
5. **Improving the monitoring and the exchange of information** between Member States
6. Enhancing the mobility of road safety professional by way of a more **explicit mutual recognition/acceptance** of the auditor training certificate.
7. **The better integration of ITS systems and services** in road infrastructure safety management, especially in areas such as traffic related information, access restrictions, on board messaging and cooperative systems.
8. **Clearer definition** of procedures

In the survey questions, were also raised in relation to this list of themes. The figure below shows the overall judgement of the respondents with respect to area 1, 2, 3 and 6, and it includes a question on applying the provisions of the Directive to tunnels that fall under the scope of Directive 2004/54/EC. It is clear that extending the Directive to other roads that do not belong to the TERN receives the most support and that the highest score is obtained for an extension to single carriageways. Given that within the survey only a minor proportion of respondents (5 responses) have declared that the procedures have not been extended to non-TEN-T roads, it in fact comes as no surprise that support is strongest for "the application of certain procedures to other roads". However, it should be noted that respondents do indicate that perhaps not all management procedures ought to be transferred to the other roads. The issue of funding as well as

[11] During the process of the analysis more options were raised such as the option of introducing harmonisation through uniform rules on speed limits, road signs and signals for the TEN-T, and if possible for other roads beyond the current provisions established by the relevant international agreements, the option of specifying standards for the road safety equipment of roads or the option of analysing which improvements can be brought to current asset management practices. In consultation with the Commission, it was decided not to withhold those options.

the fact that urban and rural roads might fall under local authorities that have less financial resources at their disposition are also mentioned as points which require attention.

Figure 4: Judgment on possible areas for further development



Source: Data based on Member States' questionnaires responses (25 Member States plus Belgium-Wallonia and Belgium-Flanders) and on Stakeholders' questionnaires responses (28 Stakeholders)

Respondents are also supportive when it comes to the need for a more intense focus on VRU, although the scope of their interest sometimes differs. Motorcycle associations state that in current practices, PTW are often overlooked, while other respondents only focus on the categories of pedestrians and cyclists as VRU. In the second case, the relatively high proportion of fatalities in the case of VRU is seen as the main reason that targeted actions ought to be brought to bear in order to protect VRU and as the main reason that the application of the Directive ought to be extended to urban roads. It is also pointed out that VRU should receive adequate attention from the design phase on. Only one respondent stated that VRU are already taken into account in the current Directive. The possible application of the provisions to tunnels and the introduction of Certification received the least support. With respect to the Certification, Member States appeared to be worried about the costs. The Member States that were consulted see the option of extending the scope of the Directive to a closer interaction with ITS tools is seen as moderately relevant.

The table below show the distributions of the replies and makes a distinction between the respondents of the MS survey and the stakeholder survey. Looking at this table we see that, in general, stakeholders give higher scores than the respondents of the MS survey, but that the ranking of areas is more or less the same.

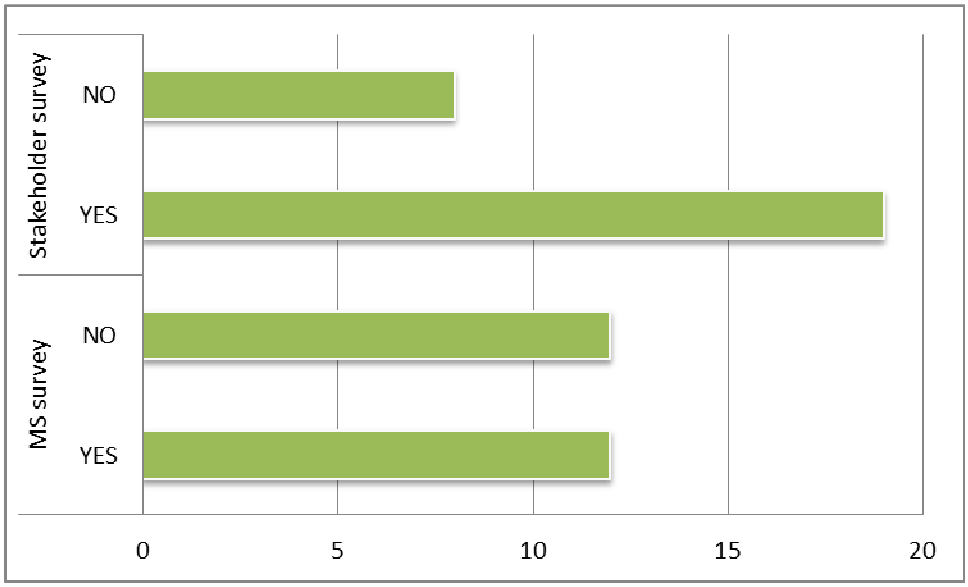
Table 3: Distribution of judgment on a number of areas for further development

Questions	MS survey						Stakeholder survey					
Many MS have extended the scope of Directive 2008/96/EC to other roads. In order to improve road safety, to what extent do you think the options listed below are relevant for your country, on a scale of 1 (not at all relevant) to 5(very relevant)	**1**	**2**	**3**	**4**	**5**	**average**	**1**	**2**	**3**	**4**	**5**	**average**
Applying the provisions of the road safety management Directive to the tunnels falling under the scope of Directive 2004/54/EC	10	4	7	3	3	**2.44**	4	3	11	3	6	**3.15**
Establish a compulsory or voluntary certifications of safety performances of certain roads	7	5	9	5	1	**2.56**	4	2	8	9	2	**3.12**
Enhancing the level playing field for road safety professionals; for instance through the mutual recognition of the progessional qualification	6	5	10	5	1	**2.63**	3	6	5	7	4	**3.12**
Better integrating ITS systems and services in road infrastructure safety management, especially in areas like (safety related/real tim) traffic informarion, access restrictions, Advanced Driver Assistance Systems and cooperative systems (V2X communication)	4	9	7	7	0	**2.63**	4	2	9	8	3	**3.15**
Applying targeted actions to protect VRU	3	5	7	5	7	**3.30**	1	1	7	5	10	**3.92**
Applying certain road safety procedures listed in Directive 208/96/EC to main roads in urban areas	4	5	3	8	7	**3.33**	1	0	3	5	14	**4.35**
Applying certain road safety procedures listed in Directive 2008/96/EC to motorways and express ways not in the TEN-T	5	2	5	4	11	**3.52**	0	2	3	5	13	**4.26**
Applying certain road safety procedures listed in Directive 2008/96/EC to main single carriageways roads outside urban areas not in the TEN-T	4	2	4	5	12	**3.70**	1	0	2	6	14	**4.39**

Source: Data based on replied Member States' questionnaires (25 Member States plus Belgium-Wallonia and Belgium-Flanders) + 28 replies to the stakeholder survey.

Another area deals with the need to increase the information communicated to citizens and road users (option 4 of the list above). The resulst from the survey are mixed and represents two points of view. Supporters state that an increased awareness of risk will have an effect on behaviour and state that if people understand the need for investments in a safer infrastructure, they will be more supportive. Opponents, by contrast, claim that the effectiveness is not proven, that the procedures are too technical for the general public and that signalling black spots might only have a temporary effect. Moreover, it is also mentioned that providing added information might be interpreted as a safety measure in itself, with the risk that the infrastructural safety investments would be foregone.

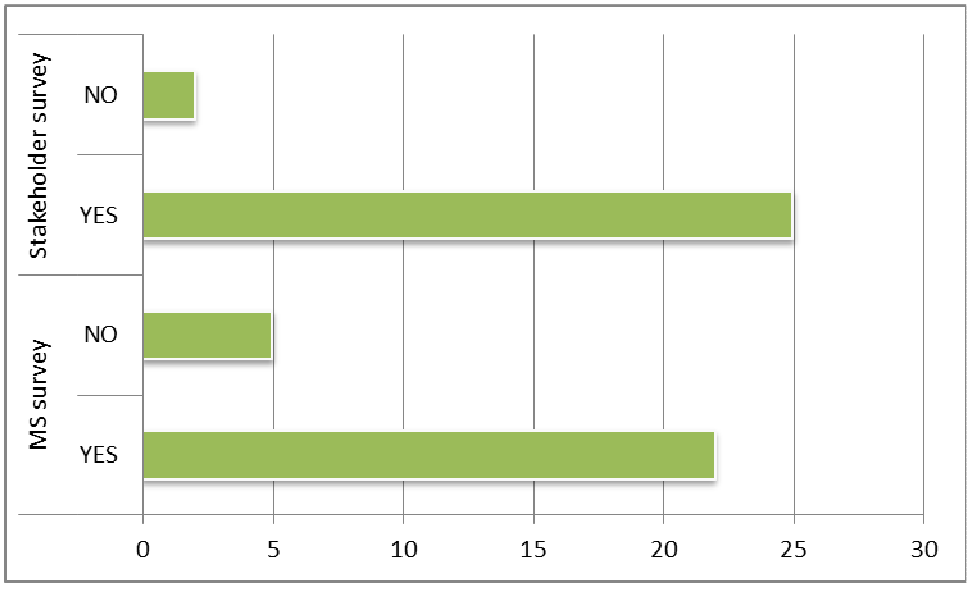
Table 7: Opinion on the effectiveness on RSM of increased communication towards citizens and road users.



Source: Data based on replied Member States' questionnaires (25 Member States plus Belgium-Wallonia and Belgium-Flanders) + 28 replies to the stakeholder survey.

With respect to option 5 – the exchange of good practices – the survey asked if there should be more incentives for the monitoring and exchange of information between MS. The replies can be found in the table below.

Table 8: Opinion on the need for monitoring and exchange of information between MS.



Source: Data based on replied Member States' questionnaires (25 Member States plus Belgium-Wallonia and Belgium-Flanders) + 28 replies to the stakeholder survey.

In general, most respondents are supportive. The exchange of information is seen as a cost-effective way of increasing the efficiency of the Directive and as a benefit for countries with less

experience. Most respondents do note that one has to take into account the particularities of local circumstances (regulatory framework, local context, specific safety problems). The question remains whether this should be compulsory, and if so who will bear the costs for this. The CEDR is seen as a good forum for the exchange of best practices.

3.2 Methodology

There will be a need to adapt the assessment methodology to the type of area under investigation since the 8 areas that were discussed, vary strongly, and go from the need to extend the Directive to more roads to the need to provide more information to citizens and road users. We propose to divide the selected areas for further investigation into two groups and to adjust the assessment methodology accordingly:

- Some areas will have a more or less direct impact on road safety as they focus on extending the Directive to other roads, harmonisation, etc. For this type of policy, the impact on road safety can be calculated quantitatively. This is, for example, the case for areas 1 and 2 and (possibly) also for are 3.
- Other areas of further improvement are focussed rather on increasing the efficiency of the road infrastructure safety management system. This will also indirectly impact road safety, but it is more difficult to assess this link quantitatively. This is the case for the remaining areas. An example is the measure in which an explicit form of mutual recognition is introduced. This will oblige the Member States to analyse the way in which the Directive is applied in other countries and thus leads to an exchange of information. This can result in the application of best practices from other Member States and so increases the effectiveness of the Directive. An effect on safety should follow but this effect would be indirect.

For each of the areas under further investigation the methodology will consist of the following steps:

1. Scenario definition
2. Estimating the size of the target groups
3. Identification of positive and negative effects, including unintended side-effects
4. Calculation, where possible, of the effects of the areas of further improvement.
5. Calculating the economic impacts
6. Calculation of costs and estimation of administrative burden.

The aim is to quantify where possible. Yet, as was mentioned before, for certain areas the assessment remains at a qualitative level. In these cases, steps 4 to 6 are not discussed. In the following paragraphs, the methodology of the calculations is discussed in more detail.

1. **Scenario definition**.

   In order to assess the areas under investigation,often one or more (sub) scenarios need to be constructed for each of them.

   For example, in the case of extending the Directive to other roads it should be clear whether we are talking about all roads, only roads which benefit from an EU contribution, only interurban roads, etc. The goal of this step is to fine-tune the definition of each topic in such a way that there can be no discussion as to what is included and what is not in order to make further assessment possible.

2. **Estimating the size of the target groups**:

   In order to assess safety effects, it is important to know how large the target group is so that one can determine the maximum effect a measure can have. This will be done with the use of the CARE database. The target groups will be calculated starting from a baseline calculated for the year 2020. We assume that scenarios proposed would be effective by then.

   For example, in order to gauge the effects of the extension of the Directive to all motorways, it is important to know how many people are killed or are (seriously) injured on motorways in each country. Of course, not all of these accidents are caused by bad infrastructure, but infrastructure plays a role in almost all accidents (either because it influences the cause or the consequence of the accident). The main goal of this step is to estimate the maximal possible influence of the different areas.

3. **Identification of the possible effects**.

   This step focusses on listing the possible effects of the scenarios, be it positive or negative, quantitative or qualitative, intended or unintended.

4. **Calculation, where possible, of the main effects of the scenarios on the areas of further investigation.**

   This step will be based on literature, the ex post evaluation and the input from the stakeholder consultation. As mentioned before, some of the scenarios will merely have an effect on the efficiency on Road Safety Management itself, while for some of the scenarios it is possible to calculate the direct road safety effects. When an explicit calculation is possible this will be done against the baseline discussed further.

5. **Calculating the economic impact**:

   For those scenarios for which the safety impact can be calculated in a quantitative way, the economic impact will be calculated using key figures on the value of a fatality and the value of a seriously injured. We will use those values which are proposed by (Ricoardo-AEA, 2014). As such, we employ average value of 1.87 million euro per fatality, corrected for the purchasing power of a country. These figures include the value of safety per se and the value of direct and indirect economic costs (Heatco - D5, 2006). The direct cost is

observable as expenditure today or in the future. This includes medical and rehabilitation cost, legal cost, emergency services and property damage cost. The indirect cost is the lost production capacity to the economy that results from premature death or reduced working capability due to the accident. However, direct and indirect economic costs alone do not reflect the well-being of people. People are wiluare willing to pay large amounts to reduce the probability of premature death irrespec-tively of their production capacity. This willingness-to-pay indicates a preference to reduce the risk of being injured or even die in an accident. This aspect is called the value of safety per se, which has been measured empirically as value of a statistical life. The values used can be found in annex 1.

6. **Estimation of the cost and the impact on administrations.**

   Both on the basis of results from the literature and on the basis of WP1 and WP2, we will calculate the costs and impact which the administration can expect as a result of the different scenarios. We do note that the costs of safety audits vary strongly and depend mainly on the size of the project and the phase during which the audits are carried out.

3.3 Baseline scenario

The goal of a baseline scenario is to have a point of reference which can be used to compare policy areas. The baseline we will use, is assumed to be a situation without any further changes to the Directive as it is today. In this work the baseline is focussed on the expected evolution in traffic safety. By using the methodology (a simple time series approach) which is discussed in Annex 2[12] we estimated for each country[13] the expected evolution (up to 2030) in fatalities and serious injuries per road type (urban roads, rural roads and motorways). We make a number of key assumptions to produce this baseline:

- The baseline trend is estimated using relative risk figures (the number of fatalities/seriously injured victims per vehicle kilometre). This is done in order to eliminate possible safety effects that are related to vehicle usage, and not so much to safety measures. This relative risk trend line is then extrapolated to predict the absolute numbers of fatalities/seriously injured victims up to 2030. This is done because most of the information available on safety measures is presented in terms of "numbers of fatalities avoided" and not in terms of "relative accident risk reduced".

- The estimation of the fatality/injury baseline works under the assumption of non-linearity. This means that, the absolute improvement in road safety is reduced from year to year. The idea behind this is that it becomes more and more difficult to improve traffic safety since the most effective and easiest solutions are likely be used first.

- The methodology assumes a "continuation of trends". It is assumed that the potential effects of technologies and legislation is integrated in the estimation of the baseline –

[12] This methodology was also used within the mid term assessment of the ERSAP and within the ASSESS project. It was initially developed by (Bijleveld & Commandeur, 2006).

[13] For each EU member state with the exception of BG, LT as for those countries no data was available. For other countries (IT, EE, FI) only data was available for fatalities and not for seriously inured.

contributing to the overall steady increase in road safety. If the introduction of new technologies and/or legislation would lead to a specific and sudden decrease in accidents an additional correction to the baseline would have to be made. An example of such a measure would be legislation that installs a maximum speed limit of 30 km/h in all urban areas in Europe.

- In relation to the presence of effects related to the Directive, it is assumed that the initial effects of the implementation are included in the baseline estimations. That is to say, this element has been introduced and implemented in the period for which statistics are available. The different areas of further improvement investigated (for example, extension to non-TEN-T roads) will be tested against this baseline. In these cases we will make use of the literature and the results of the ex post evaluation to estimate the theoretical (fork of) the safety effects.

The three main advantages of this method are that

- It can be done for almost all countries of the EU28;
- Data requirements are low;
- It allows us to take into account the influence of other measures (for example influence that is due to the White Paper) and external influences (for example the economic crisis) which influence mobility and thereby traffic safety.

The main limitations of the estimation are linked to

- The uncertainty with regards to future mobility patterns.
- Data availability. The reliability of the estimates depends on the length of the time series which is used and the quality of the data that is used. Shorter time series result in less reliable estimations, which particularly is a problem for the Member States to make their estimation. For some countries (BG and LT), no data was available which differentiated according to road type. For other countries (IT, EE, FI), only data was available for fatalities and not for seriously injured victims. For some countries, the data was not adequate for use in an analysis. Nevertheless, this was a much smaller problem. The table below shows the % of the data available used in the analysis.

  Table 9: % of the data available used in the analysis.

	Fatalities	seriously injured
motorways	97.6%	99.8%
rural roads	100.0%	100.0%
urban roads	100.0%	100.0%

  We refer to the annex 2 for a list of the data and countries included in each analysis.

- The limits of the model and techniques. Using time series as an approach implicitly assumes that all measures that were taken before are continued. For example, if current enforcement practices would decrease, the downwards trend is unlikely to be continued.

Hence it should be emphasized that the predicted reductions will only be achieved by continuing current efforts to improve road safety.

The baseline was constructed per EU country and per road type, and distinguishes between fatalities and seriously injured victims. Detailed results are presented in Annex 2. Our analysis showed that, in general, the model has a good fitness of fit for most countries. Overall, the estimations for the coefficients are significant at a 5% level.

The figures below show the results for fatalities and seriously injured victims on motorways, rural roads and urban roads for the total of all the countries involved. Since not all countries have been included in the analysis due to data limitations one should not compare the absolute numbers with the numbers known for EU28. Moreover, it is difficult to compare the real data with the estimated data as for some countries there is only an estimate for the year 2004, but no real data (for example, EE, CY, LV). We can only make a good comparison for the period between 2006 and 2010.These figures, in general, show that the best estimates are made for motorways and for fatalities.

Figure 5: Number of fatalities on motorways in the EU – real versus predicted.

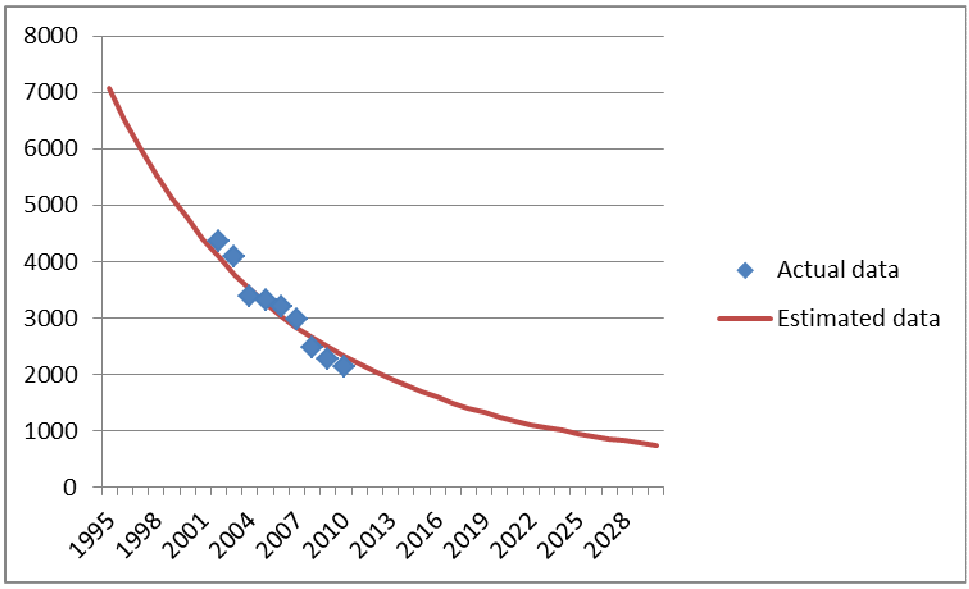


Figure 6: Number of fatalities on rural roads in the EU – real versus predicted.

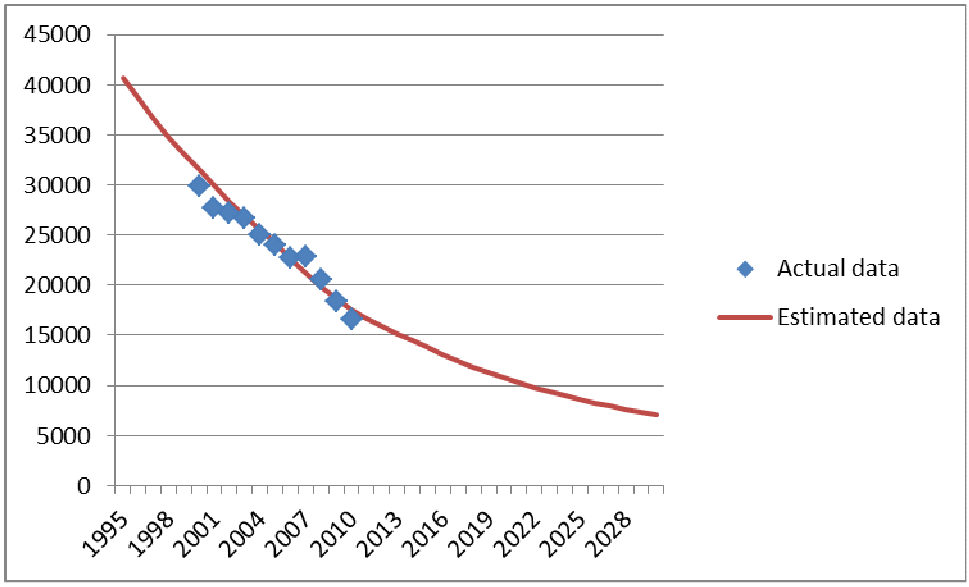


Figure 7: Number of fatalities on urban roads in the EU – real versus predicted.

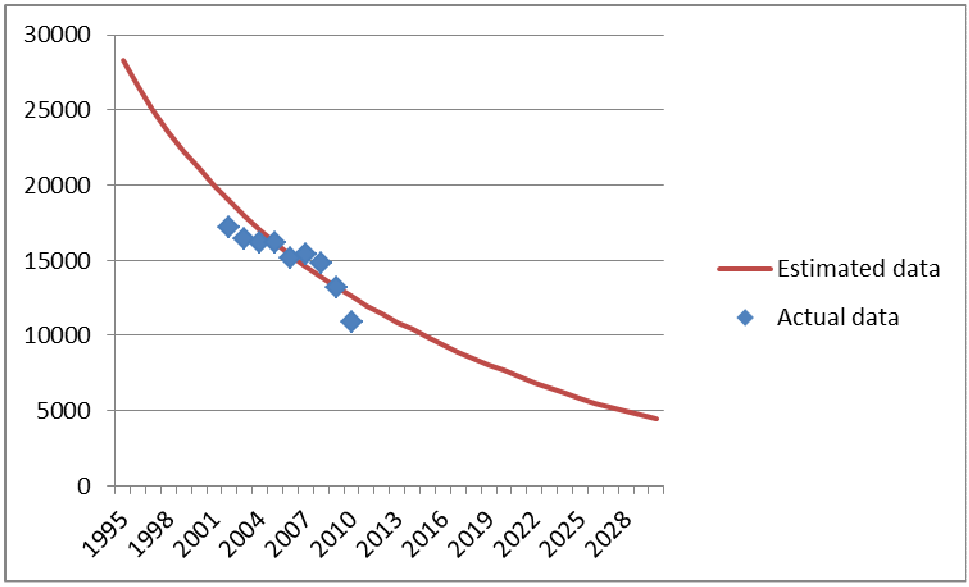


Figure 8: Number of seriously injured victims on motorways in the EU – real versus predicted.

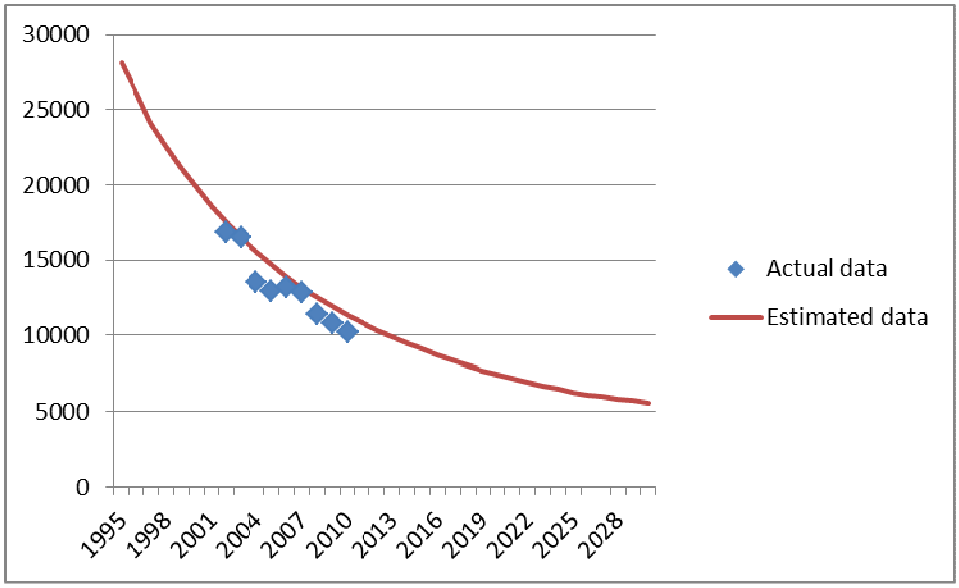


Figure 9: Number of seriously injured victims on rural roads in the EU – real versus predicted.

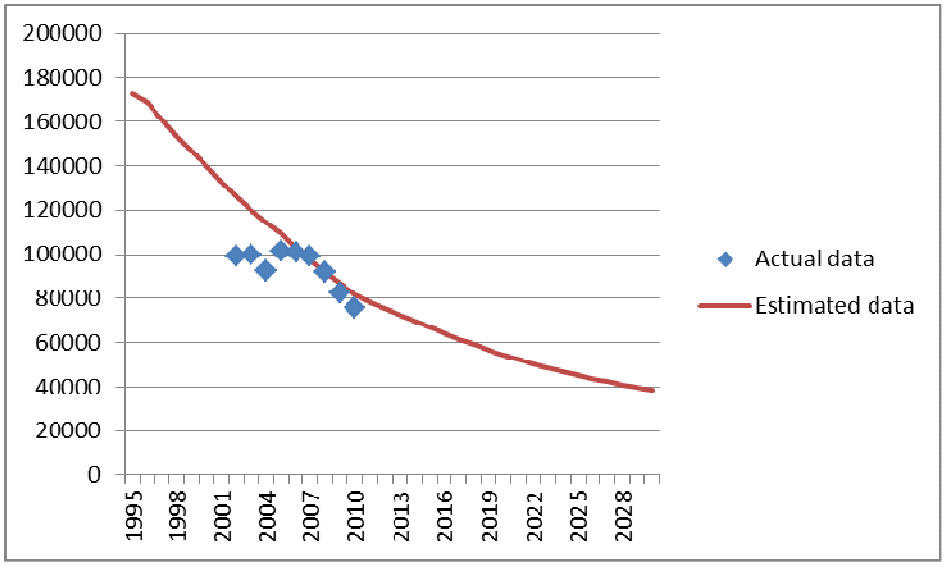
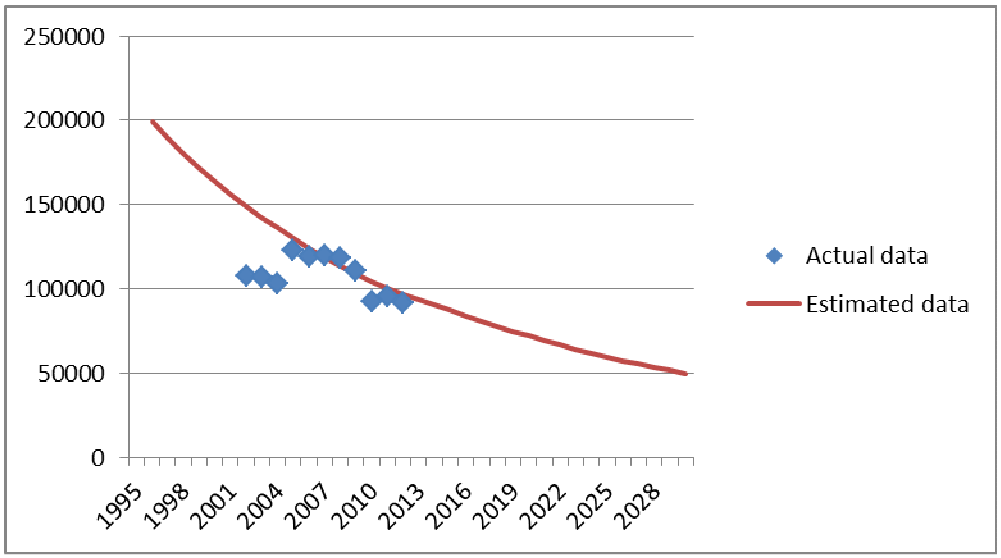


Figure 10: Number of seriously injured victims on urban roads in the EU – real versus predicted.



In order to present a clear understanding of the interpretation of these graphs, we would like to point out that they should be read as follows: " from 1995 to 2030 the baseline indicates that a reduction in fatalities on motorways of 44% between 2010 and 2020 and 67 between 2010 and 2030 would be feasible if existing measures are maintained and if measures that are expected to be introduced are in fact introduced". The table below shows the relevant % for other road types and for seriously injured victims.

Table 10: Expected decrease in fatalities and seriously injured victims according to the baseline calculations

	Fatalities		Seriously injured	
	2010-2020	2010-2030	2010-2020	2010-2030
motorways	-44%	-67%	-44%	-58%
rural roads	-35%	-57%	-30%	-50%
urban roads	-33%	-61%	-23%	-47%

4 Analysis of the main costs and benefits of the areas of improvement

In this section, we make an analysis of the main costs and benefits of the areas which may improve road infrastructure safety in line with the methodology described above.

4.1 Area 1: Extending the scope towards other roads

Today the Directive is only mandatory for the trans-European road network. Member States may also apply the provisions of this Directive, as a set of good practices, to national road transport infrastructure that is not included in the TEN-T.

As discussed in section 2.1, many countries have indeed extended the scope to other roads (only five countries did not extend any of the procedures to other roads), although there is a lot of variance in the way in which this is done.

Moreover, in order to receive loans for roads that do not fall under the TEN-T, the EIB requires that safety audits or inspections must be performed in accordance with the principles of the Directive[14]. Hence, in this way the application of the Directive has already been broadened.

There is one exception. Article 1 of the Directive explicitly state that "this Directive shall not apply to road tunnels covered by Directive 2004/54/EC. Directive 2004/54/EC covers the minimum safety requirements for tunnels longer than 500 meter in the TEN-T. Hence, both Directives have in common that they target the TEN-T. The tunnel Directive provides safety measures regarding the infrastructure and operation as well as information campaigns for users. It also installs several layers of responsibilities (an administrative authority, a tunnel manager, a safety officer, an inspection entity and emergency services), a risk analysis (the Directive requires a minimum safety level and provides various parameters for systematic consideration of all aspects of the safety system), prescriptive safety measures (which need to be implemented up to at least a minimum in order to ensure the minimum level of safety) and procedures for the different planning stages of tunnels, tools for safety tunnel management (demands for safety documentation, collection and analysis of incident data and safety inspections of tunnels (at least every 6 years)).

The survey showed that the extension to other types of roads had a relatively high level of support, with the exception of an extension to tunnels that fall under Directive 2004/54/EC. Some comments were also made as to whether it was necessary to apply all four procedures to all types of roads.

4.1.1 Scenario Definition

This is a type of measures which would entail a direct effect on road safety. However, in order to assess this effect quantitatively, more detailed scenarios must be defined. We propose to assess different sub-scenarios in which the following three elements are most important:

[14] (European Investment Bank, 2011)

- To which types of roads would the Directive be extended?
- Which provisions/procedures would apply to these "other roads"?
- Would this be mandatory or voluntary?

We assume that the four procedures will be applied and focus mainly on the possibilities with respect to road types:

- A: applied to all roads, including urban roads
- B: applied to roads that receive contribution from the EU
- C: applied to tunnels that fall under Directive 2004/54/EC. This gives us 4 sub-scenarios: an extension of the provisions of the Directive

We further distinguish between a scenario that assumes that the extension is voluntary (the A scenario), while the B scenario assumes that this would be compulsory. This gives us four sub-scenarios:

- A1) extension to all main roads (urban area, regional and national network not in the TEN-T) on a voluntary basis.

  Given its voluntary basis, this sub-scenario remains very close to the current Directive. The main difference is the explicit focus on urban areas, which might inspire some Member States to also voluntary extend the provisions to urban roads. Today, when the use of the provisions is extended to other roads, these other roads do not include urban roads.

- A2) extension to all main roads (urban area, regional and national networks that are not in the TEN-T) on a compulsory basis.

  The main differences between this sub-scenario and the current Directive are

  - Extension to urban areas, regional networks and the whole national network
  - The compulsory nature of the extension

- B) extension to all roads which benefit from EU contributions

  This sub-scenario would extend the provisions beyond the TEN-T network to roads which receive funding from any EU fund (EIB, Cohesion Fund, Instrument for Structural Policies for Pre-accession ISPA, European Regional Development Fund ERDF,…). The EIB already requires road safety audits (RSA) and road safety inspections (RSI). This sub-scenario would also require the use of road safety impact assessment (RSIA) and network safety management (NSM). The cohesion funds and ERDF also include funding for the TEN-T network. Hence, these projects are already subject to the Directive.

- C) extension to tunnels that fall under the scope of Directive 2004/54/EC – hereafter referred to as the "tunnel Directive"

In contrast to the Road Safety Infrastructure Management Directive, the information which the Tunnel Directive provides on for example the parameters and the required measures is very specific and detailed. The main consequence of extending the Directive towards to tunnels that fall under the Tunnel Directive would be the impact of the provision with respect to road safety auditors, i.e. the fact that these audits have to be done by an auditor who must have the necessary competence and training (provided for in Article 9 of the Directive).

4.1.2 *Estimating the size of the target groups*

To estimate the size of the target group two sources of information are of importance

- Information on fatalities and seriously injured victims, differentiated according to the road infrastructure (motorways, rural roads, urban roads). If we look at the data analysis (Table 2) we can clearly see that most accidents (93% of all seriously injured and 92% of all fatalities) happen off motorways.

- Information on which countries have already extended the Directive to other roads

The combination of both sources will give us a first, albe it rough, estimate of the number and share of fatalities/seriously injured victims the different scenarios target.

To which extent and to which types of roads is the Directive extended today?

From the Member State survey we learn that 6 countries[15] have extended the use of all four procedures on a mandatory basis. Only 5 countries/regions[16] do not apply any of the procedures to their other roads. There is however a large variance with respect to the use of the different procedures (most countries did not extend the use of all procedures), obligation (mandatory/discretionary) and the type and definition of the roads to which the use of the procedures were extended (all motorways, all main roads, roads with a certain volume, all "strategic roads", etc.). There is no information on the share of non-TEN-T roads that are covered. The table below summarizes for the different EU countries the use of the different procedures on roads that fall outside the scope of the TEN-T network. This table also shows that the RSA procedure is used the most (in 9 countries on a mandatory basis and in 11 countries on a discretionary basis), whereas RSIA is used the least (not-extension in 14 countries).

[15] CY, HU, IR, LT, NL, RO
[16] BE-FL, HR, SE, SL, SK

Table 11: The use of the different procedures outside the TEN-T network.

Extended to other roads	YES				NO	
	mandatory	count	discretionary	count		count
RSIA	AT, BE-W, CY, FI, HU, IR, LT, NL, RO	9	DK, IT, MT, UK	4	BE-FL, BG, CZ, EE, ES, FR, HR, LU, SL, SK, LV, PL, PT, SE	14
RSA	BE-W, CY, FI, HU, IR, LT, LV, NL, RO	9	AT, CZ, DK, EE, ES, FR, IT, MT, PL, PT, UK	11	BE-FL, BG, HR, LU, SE, SL, SK	7
NSM	BG, CY, HU, IR, LT, LV, NL, RO	8	AT, BE-W, DK, ES, FI, FR, IT, MT, UK	9	BE-FL, CZ, EE, HR, LU, PL, PT, SE, SL, SK	10
RSI	BE-W, BG, CY, HU, IR, LT, LV, NL, RO	9	AT, CZ, EE, FR, IT, LU, MT, PT, UK	9	BE-FL, DK, ES, FI, HR, PL, SE, SL, SK	9

Source: Data based on completed Member States' questionnaires (25 Member States plus Belgium-Wallonia and Belgium-Flanders)

Scenario A1

The main difference with the current Directive would be the extension to urban roads. When the extension is put into place, this mostly takes place for motorways, expressways and larger regional roads. None of the replies indicated that it was put into place for urban roads, although this reply might also be caused by the fact that urban roads often fall under a different authority than motorways.

We assume that the same countries, which have already extended the Directive to other roads, would also extend the use of the procedures to urban roads. Hence the table below shows the number of fatalities and seriously injured victims that occur on urban roads in the countries which have already extended the use of procedures toother roads.

Table 12: Target group area 1- scenario A1 – year 2020

Target group	Fatalities		Seriously injured	
		share in total		share in total
Policy A1	7249	37%	74966	53%

Scenario A2

To calculate the target group for scenario A2 we start from the fatalities/seriously injured victims per country and per road type (motorway, rural roads and urban roads). We correct for the % TEN-T which are part of the TEN-T network by using the information in Table 3, since these have already been converted under the current Directive. It is not possible to make this correction for the % of rural roads which are part of the TEN-T network, since there is no information on the length of these rural roads[17]. Next we want to make a correction for the countries which have already extended the provisions of the Directive to other roads, since the effect will be smaller for those countries. Given the limited information we have on the % of the road network that is covered, we assume that

[17] Eurostat distinguishes between motorways and "other roads". In theory the "other roads" can also be subdivided into "built-up/non built up, but in reality this information is only available for a very limited amount of countries.

- in countries which have extended all procedures on a mandatory basis, 100% of the rural and motorway network is already covered by the current Directive and thus these accidents are not part of the target group

- in countries which have extended the procedures on a discretionary basis, 100% of the rural network and motorway network is not covered under the current Directive and hence these accidents are part of the target group (with the exception of the motorways falling under the TEN-T)

- for all countries urban roads are part of the target group

Given that we have to make a number of assumptions it is clear that the general idea is to get an order of magnitude. Hence, the % is more important than absolute figures. The table below shows that the potential of this scenario is very high – even for motorways

Table 13: Target group area 1- scenario A1 – year 2020

		Fatalities			seriously injured		
		total in 2020	Target group	share	total in 2020	Target group	share
EU	Motorway	1244	462	37%	7107	2450	34%
	Rural	10766	8562	80%	54581	45102	83%
	Urban	7656	7656	100%	78961	78961	100%
	Total	19666	16680	85%	140649	126513	90%

Scenario B

The idea behind this scenario would be that the application of the provisions (or at least of some of the procedures) would be a condition to receive funding/loans from EU institutions. The potential of this scenario depends on the funds which will be allocated to road infrastructure in the future. Given that the EIB already requires the use of some of the procedures, the main potential of this scenario lies with the km of roads financed via the Cohesion Fund and the ERDF. These roads are not part of the TEN-T[18]. From the available documentation it is not clear how many km of roads that are not part of the TEN-T would be financed in the future using EU funding. If we assume that the same allocation mechanisms will be in place as they were during the period between 2014 and 2020, we estimate the target group to be as follows:

- For the period 2014-2020, funding amounts to 351 billion Euros[19].

[18] The Cohesion Fund also plays a role in financing the TEN-T (Connecting Europe Facility) and Trans-European transport network. Projects financed by the Cohesion Fund are to comply with the guidelines for trans-European transport networks adopted by the Council and the European Parliament. However, it may also finance road infrastructure outside the TEN-T network (http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32006R1084&from=EN).
ERDF can also invest in transport, including the improvement of trans-European networks and links to the TEN-T network; integrated strategies for clean transport which contribute to the improvement of the access to and quality of passenger and goods services, to the achievement of a more balanced modal split, to the promotion of intermodal systems and to the reduction of environmental impacts http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32006R1080&from=EN

[19] http://ec.europa.eu/regional_policy/what/future/index_en.cfm#_ftn1

- In this period 26 billion would be used for the TEN-T network. This is 1.4 times less than in the period 2007-2013 when 38.61 billion or 11% of the total budget was spent on the TEN-T network.

- In 2007-2013, 12% of the total budget went to road projects (including the TEN-T). We assume that for the next period 12%/1.4 would go to roads (correcting for the lower attribution to the TEN-T- cf. above). This would mean that 30 billion euro would go to road projects.

- In 2007-2013 half of the budget for the TEN-T went to road. This would mean 0.5*26 billion or 13 billion euro.

- We subtract 13 billion from the 30 billion (=17.08 billion) to calculate the theoretical investments in road projects in 2014-2020 which are not part of the TEN-T network.

- The ex post evaluation of the cohesion fund (2003-2006) estimated that one km of road financed costs about 8 million euro. This would mean that 2135 km of road – not part of the TEN-T would be financed by the EU.

- Using the accident risk on motorways (0.031978 as an average for the EU) this amounts to a potential of 68 deaths and 380 seriously injured victims.

This is, of course, a rough estimate, but it does show that the target group of this scenario would be much smaller than that of scenario A.

Scenario C

The target group of this scenario would be the number of fatalities in tunnels that fall under Directive 2004/54/EC if an effect on safety is to be expected. This is about 1300 km of tunnel[20]. On average (taken over the period between 2006 and2011), and based on data for a selection of countries involved[21] there have been 2064 accidents in the tunnels that fall under the Directive. There is not enough information to say anything about the number of fatalities and seriously injured victims. The potential risks that are prevalent in road tunnels need to be taken seriously, but they should not be allowed to give rise to panic. Tunnels are actually safer than other roads in light of the accident risk per million vkm[22]. On the other hand, if an incident occurs in a tunnel, the impact is often much greater than on open stretches of road. However, since there is no information on the frequency of catastrophic events, it was -in the past, impossible to calculate the effect of the tunnel Directive[23]. This also means that it would be difficult to calculate the target group of the extension of the provisions of the Road Safety Infrastructure Directive to the Tunnel Directive. Moreover, given the detailed descriptions with respect to safety regulation, and the indication that the main influence would be the use of trained and certified road auditors, it is uncertain if the safety effect would be significant.

[20] http://ec.europa.eu/transport/road_safety/topics/infrastructure/tunnels/index_nl.htm

[21] Data for Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Slovenia, Spain, Sweden and the UK. (based on TRT analysis of documents in the CIRCABC repository)

[22] (United Nations, Economic and Social Council, Economic Commission for Europe, 2001)

[23] (T&E and ETSC, 2003)

4.1.3 *Identification of positive and negative effects, including unintended side-effects*

Within this section we briefly touch upon the main benefits and costs to be expected. In other sections we will go into more detail with respect to the expected safety effects and the costs.

Benefits

- Quantitative
    - Improved road safety on roads that fall outside the scope of the TEN-T
    - Limited effects on mobility –due to improved road safety
    - Limited effects on environment – due to improved road safety
- Qualitative
    - Consistency over the network. Today some parts of the motorways fall under the Directive and others do not, even as the driver does not know if he is or is not driving on a TEN-T road
    - Integrating the Tunnel Directive within the RSIM Directive would lead to a higher coherence. The Tunnel Directive anticipated the more general one on road safety, driven by tremendous accidents that occurred in road tunnels at the end of the Nineties. For this reason it includes also some detailed provisions to be transposed into the various national legislations. However, a more coordinated approach to road safety, for example by merging the two directives, would surely bring to a more coherent legislative framework. It would lead to a coherent and integrated approach to road safety on stretches of road including tunnels, bridges and normal roads. Furthermore coherence can be evaluated against transport policy and its objectives. In that case both Directives were (at the time of approval) and still are coherent with the objectives of reduction of externalities (mostly casualties, injuries).

Costs

- Administrative costs of changing the national legislation, adapting the guidelines, courses, etc.
- Increase in costs for the government for carrying out the procedures

Possible hurdles[24]

- Need for a sufficient amount of qualified auditors
- Limited budget

[24] The first three hurdles are also mentioned as main barriers to conducting RSA on secondary roads in (Pilot4Safety, 2012). The fourth one is based on (DACOTA, 2012).

- Numerous responsibilities for different road types, which make a standardized approach complicated
- There is a problem with the classification of roads, since the design varies between countries
- Applicability of the current Directive to urban areas
- Selection of procedures to be used on other types of roads
- Small support for the extension to the tunnel Directive

4.1.4 *Calculation, where possible, of the safety effects of the scenario.*

We can estimate the safety effects for scenarios A and B. It is not possible to quantitatively assess the effects of scenario C, i.e. the extension to tunnels that fall under the scope of the Tunnel Directive. There are two reasons for this. Firstly, there is not enough information to say anything about the number of fatalities and seriously injured victims. Secondly, given the very detailed nature of the Tunnel Directive when it comes to safety provision it remains uncertain if the RSIM procedures would lead to an additional safety effect. No research exists on this matter.

The impact assessment of Directive 2008/96 estimated that 400 lives per year could be saved if safety management was applied to motorways. An additional 900 lives could be saved every year if it was applied to the main road network, i.e. interurban roads and national roads, excluding motorways. As a result, it was estimated that the application of a series of procedures to all motorways and main roads of the EU27 would reduce the number of fatalities by 1 300 every year.

The literature, which is discussed in more detail in the ex post evaluation- mainly focuses on the effects of the individual procedures rather than on the Directive as a whole. Based on the literature review it was estimated that the range in the reduction of accidents would likely be between 10-20% compared with a situation in which the procedures would not be applied. This means that the effect on road safety would be higher in countries that did not have procedures in place. We use a careful estimate of a 10% reduction. This is in line with the findings of Dumas (2000)[25] which state that "It is well established that managing roads and traffic to basic safety management principles in urban areas can produce overall crash reductions of at least 15% even in well-established networks." Depending on the scenario this reduction will apply to different types/shares of roads.

Note that the calculations are made using the figures estimated for 2020 in the baseline. This means that, since not all countries are included in this baseline- there will be a small underestimation.

Scenario A1

For this scenario we apply the 10% reduction to fatalities/seriously injured victims on urban roads in 2020 as estimated in the baseline. This % is only applied to those countries which had already extended (some of) the provisions to other roads. In total this policy scenario could lead to a 4% reduction of fatalities and a 5% reduction of seriously injured victims. Note that this calculation assumes that today the procedures are not yet used on urban roads.

[25] Referred to in (DACOTA, 2012)

Table 14: Estimated safety effect of scenario A1 -2020

		Fatalities			seriously injured		
		total in 2020	Potential reduction	share	total in 2020	Potential reduction	share
EU	Motorway	1244	0	0%	7107	0	0%
	Rural	10766	0	0%	54581	0	0%
	Urban	7656	725	9%	78961	7497	9%
	Total	19666	725	4%	140649	7497	5%

Scenario A2

For this scenario we apply the 10% reduction for all fatalities and seriously injured victims to the target group as estimated above. Hence we do take into account that part of the network is already covered by the Directive and by the voluntary extension. The total potential reduction is 1.668 fatalities which are of the same order of magnitude as the initial estimation. Compared to the time when the previous assessment was made, road safety has increased and the baseline assumes that this will continue. It is logical that the total of motorways and rural roads (902) is smaller than the initial estimate (1300)

Table 15: Estimated safety effect of scenario A2 - 2020

		Fatalities			seriously injured		
		total in 2020	Potential reduction	share	total in 2020	Potential reduction	share
EU	Motorway	1244	46	2%	7107	245	3%
	Rural	10766	856	5%	54581	4510	8%
	Urban	7656	766	7%	78961	7896	10%
	Total	19666	1668	8%	140649	12651	9%

Scenario B

The estimated target group of scenario B was about 68 fatalities and 380 seriously injured victims. If we assume a potential reduction of 10% this would mean that the effect would be marginal with an estimated reduction of about 7 fatalities (0.04%) and 38 seriously injured victims (0.03%). As there is no information on the typology of the roads that will be invested in. We cannot differentiate between road types.

4.1.5 Calculating the economic impact

As explained before the economic impact is estimated by multiplying the number of fatalities and seriously injured victims prevented within a scenario with the economic cost of a fatality/seriously injured victim. This is done per country and for scenarios A1 and A2. The effect of scenario B is too small to be significant. The tables below show the result at the EU level for the year 2020. As traffic safety improves over time, the economic impact will be lower in 2030 than it will be in 2020.

Table 16: Scenario A1 – Economic valuation of the safety impact - 2020

		Fatalities	seriously injured
Economic impact (million Euro)		2020	2020
EU	Motorway	0	0
	Rural	0	0
	Urban	1244	2014
	Total	1244	2014

Table 17: Scenario A2 – Economic valuation of the safety impact - 2020

Economic impact (million Euro)		Fatalities 2020	seriously injured 2020
EU	Motorway	93	72
	Rural	1628	1293
	Urban	1321	2125
	Total	3042	3490

In scenario A1, about 3.2 billion Euro would potentially be saved in the year 2020; in scenario A2 this would amount to about 6.5 billion Euro.

4.1.6 *Calculation of costs and estimation of administrative burden.*

The total costs of the different scenarios are difficult to assess as there is a large variation in the unit costs of the different procedures. The ex post evaluation provides more details, but, in sum, we can say that the costs of the different procedures are as follows:

- RSIA: cost per project <1% of the total cost of a project except for the largest projects
- Audit: average of 8500 €/km road (ranges between 300-50.000 €/km)
- RSI: average of 8700 €/km road (ranges between 150-50.000 €/km)
- NSM: average of 230 €/km road (ranges between <100-700 €/km)

Most of the costs come with the follow-up of the safety assessment. (45% of the costs are linked to the follow-up; 32% to the costs of executing the procedure and 21% to administrative costs)[26].

The total costs will depend on the frequency, the km of road,… to be assessed and on the km and possibly on the type of roads included in the scenarios. It is not possible to calculate the total costs of the scenarios compared to the baseline as there is no information available nor on frequenties nor on the total costs made in the baseline.

The number of km of road which should be assessed under the different scenarios does give an indication of the expected increase in costs. As there is no information on the km of urban roads (cf. discussion above) we cannot calculate this number for scenario A1. Within scenario A2, using the same assumptions as for the safety calculation[27] this scenario would mean that an additional 30.000 km of motorway (or 41% of the total EU motorway network) would be included and 3.800.000 km of "other roads" (or 84% of the total "other roads" network). For scenario B we estimated the additional number of km to be assessed to be 2.135 km. Within scenario C, we would add 1.300 km of tunnel.

[26] Source: Data based on Member States' questionnaires responses (25 Member States plus Belgium-Wallonia and Belgium-Flanders)

[27] For countries which have mandatory extended all procedures, 100% of rural and motorway network is already covered in the baseline and for countries wich have discretionary or not extended the procedures, we only take into account the % of TEN-T road network in the baseline. Urban roads and rural roads are taken together in "other roads" as there is no information available distinguishing between those road types.

However, costs will not increase linearly with the number of km. Literature[28] does not distinguish costs with respect to the type of roads but estimates are usually given as a % of the project costs (cf. above). Assuming that the projects are smaller on urban and rural roads, this would mean that the absolute costs of performing the different procedures would be lower on this type of roads.

Given the increase in the number of km to assess, tt is clear that the costs for scenario A2 will be the highest, followed by the costs of scenario A1. Given the number of km likely to be included in scenario B, the costs will be less important. The costs are the lowest for scenario C as the number of km is limited and the main difference would be the use of a certified road safety auditor.

The administrative burden generated by the Directive is essentially related to the costs for administering (launching and performing) the procedures under the provisions of Directive 2008/96/EC. The administrative costs account for nearly one fifth of the global cost involved in the application of the road infrastructure safety management procedures. Given that countries have already developed RSIA, RSA and RSI manuals and procedures, the administrative costs of changing the Directive is lower than the cost of introducing the Directive in a country without procedures.

4.1.7 *Conclusion*

This first analysis showed that there is a large potential for lives to be saved if the Directive would be extended to other roads. However, the costs and administrative burden should not be underestimated. An important question remains whether this extension should be made mandatory within the Directive given that the majority of the countries have already opted to apply (some of) the procedures to other roads. A possible compromise would be an extension to all motorways. The safety effect would still be high and it would create a consistent safety level for the drivers who cannot distinguish between motorways which are part of the TEN-T and motorways which are not. In those cases in which countries opted to extend, this is also the type of road to which the extension was made. Another compromise could be not to require the use of all four procedures but only of a selected number. The RSA seems to be the most used and accepted measure.

4.2 Area 2: More targeted actions towards VRU

Vulnerable Road Users (VRU) are to be understood as non-motorised road users (cyclists and pedestrians), and as powered two-wheelers (Powered Two-Wheelers or PTW). The Directive addresses VRU only in general terms, as a part of the procedures of Road Safety Impact Assessments, Road Safety Audits and Inspections, and Network Safety Rankings. No specific instructions are provided in the Directive on the way in which VRU ought to be taken into consideration. The Directive can play a role by establishing a practice in which technical standards for design, construction and maintenance are developed to meet the needs of VRU in general.

4.2.1 *Scenario Definition*

The general idea is to reinforce the framework by adding more targeted actions that serve to protect VRU, especially cyclists and motorcyclists. We distinguish between 4 possible scenarios which

[28] As discussed in the ex post evaluation

differ with respect to the application (extension to other roads or not) and level of reinforcement (informative or prescriptive).

The Directive applies compulsorily only to the TEN-T network, which is mainly comprised of motorways and expressways. These are not open for use to cyclists and pedestrians. Therefore, given the current application the benefits for cyclists and pedestrians are limited and PTW are the most affected group. We take two possible scenarios with respect to the application of the Directive:

1) No extension to other roads.
   If the provisions of the Directive are not extended to other roads, although the TEN-T network also includes non-motorways (**Error! Reference source not found.**), this would mean that the main focus group would be the PTW.
2) Extension to rural and urban roads
   If the provisions are also extended to urban and rural roads (cf. area 1) this would mean that all VRU (PTW, cyclists, pedestrians) would be targeted.

With respect to preventive action, certain particular safety conditions for the design of infrastructure (Road Safety Impact Assessment and Road Safety Audit) or for the improvement of existing infrastructures (Road Safety Inspections) could be developed. This could also include the application of ITS tools to provide information on the current condition of road infrastructure. Technical standards that take into account the needs of vulnerable road users (e.g. quality of road surface, road markings) could be developed further. With respect to forms of mitigation the principle of "forgiving roads" may be further applied by, for instance, detecting and replacing unsafe parts of the infrastructure which frequently lead to accidents or which lead to serious accidents. The direct effect would depend on whether or not more information on which actions can be done could be provided or on whether or not the Directive would prescribe certain actions:

A) Informative
   By using the term 'informative' we mean that more information would be provided on the way in which VRU can be taken into account. This could be done via workshops, through the development of guidelines, good practices, etc. This would allow countries to select those measures which best fit their roads. On the other hand, there would be a limited to no direct effect.
B) Prescriptive
   Certain safety requirements which target VRU, and which have showed a positive CBA could be integrated directly into the Directive. An example in this respect would be PTW-friendly guardrails. This would directly affect the safety of VRU, but it gives less freedom to the countries to make their own choices.

Actions A and B form the subscenarios of scenario 1 and 2.

4.2.2 Estimating the size of the target groups

Subscenarios A and B are not distinctive with respect to the possible target group. Scenarios 1 and 2 are. In the EU VRU represented approximately 32% of all road victims in 2012[29]. Moreover, PTW accounted for 15% of all road fatalities, but only for 2% of road users. The decrease of PTW in traffic fatalities has also been slower than the overall decrease in traffic accident fatalities and it is

[29] Source: CARE database

a growing concern, since these accidents often involve young people[30]. (DACOTA, 2011) gives a good overview of the factors which influence the accident risk of pedestrians and cyclists. Speed is a key factor, but, especially in rural areas, road design also plays a role.

Scenario 1

Since today it is mainly motorways that are included in the TEN-T network we first focus on all VRU which have an accident on a motorway by multiplying the shares of accidents with VRU in 2010 with the expected fatalities/seriously injured victims in 2020[31]. This will give us an upper limit of the potential target group. To estimate the lower limit, we take into account the share of the TEN-T network in the motorway network. Since this excludes accidents that happen on the TEN-T network but which do not happen on not motorways, this could be seen as a lower limit.

Table 18: Target group area 2 - scenario 1 – year 2020

		Fatalities			seriously injured		
		total in 2020	Potential reduction	share	total in 2020	Potential reduction	share
EU	Motorway - min	1244	110	9%	7107	363	5%
	Motorway-max	1244	252	20%	7107	730	10%
	Total - min	19666	110	0.6%	140649	363	0.3%
	Total - max	19666	252	1.3%	140649	730	0.5%

Scenario 2

Within Scenario 2 the application of the Directive is extended to all other roads. In the discussion of area 1- scenario A2 we concluded that in consequence, by 2020 about 16.680 fatalities and 126.513 seriously injured victims would fall within the target group. This would be the same in this scenario. The difference with area1-scenario A2 is the additional focus on VRU. To estimate the target group we have calculated the relative share of fatalities/seriously injured VRU in 2010 and multiplied these shares with the expected accidents in 2020. VRU make-up 45% of all fatalities, and they make up a particularly high share in urban accidents.

Table 19: Target group area 2 - scenario 2 – year 2020

		Fatalities			seriously injured		
		total in 2020	Potential reduction	share	total in 2020	Potential reduction	share
EU	Motorway	1244	252	20%	7107	730	10%
	Rural	10766	3453	32%	54581	17836	33%
	Urban	7656	5202	68%	78961	54977	70%
	Total	19666	8907	45%	140649	73543	52%

[30] (ERSO, 2013) - Motorcycles and Mopeds

[31] Hence, this calculation assumes that the shares with respect to the type of user are involved remains constant, which will most likely not be the case.

4.2.3 *Identification of positive and negative effects, including unintended side-effects*

Benefits

- Quantitative
    - Improved road safety for VRU, in particular within the prescriptive scenarios.
    - In scenario 2 there is also a safety effect for all road users due to the extension. Care has to be taken not to double count the effects of this scenario.
- Qualitative
    - Improved effectiveness of the Directive for VRU
    - A better knowledge of the design criteria for the different users groups[32]

Costs

- Costs of developing guidelines, organizing workshops, etc. The typical cost of an online database includes the costs of having a server, the necessary software and the staff to set up and maintain the system[33]. This cost is estimated at around 5000 euro capital cost and a yearly cost of around 5000 euro. For a regular yearly conference/workshop the costs are estimated to be around 4.600-9.100 euro[34].
- Costs of carrying out the procedures, measures prescribed. It is not possible to calculate the total cost of this. For information on the unit cost of the different procedures we refer to Section 4.1.

Possible Hurdles

- Within the prescriptive scenarios: the prescription of measures does not take the particularities of each individual country as much into account

[32] It is generally not recognised that the design criteria for PTW should be different than those applied to cars. Riders are more vulnerable to imperfections in the road surface and special requirements must therefore be put into place ((PROMISING, 2011)

[33] We foresee a cost of 5000 euro for the server, for setting up the database and for developing the website, if we assume that the information is readibly available (derived from unit costs stated for an information service (www.itscosts.its.dot.gov)), 2% of this for the maintenance and operation and 5000 euro for labour cost. For labour we assume 0.5 FTE to maintain the website and an hourly wage of 7.3 euro (calculated based on data available from Eurostat on the average gross annual earnings in the business economy (2008-2011)).

[34] We foresee a logistic costs of around 60 euro/person attending, travel costs for the invited speaker (600 euro), 5 working days administrative work at 500 euro/day.

4.2.4 *Calculation, where possible, of the safety effects of the scenario.*

Scenario 1A

This scenario assumes that the Directive would focus more on VRU, without prescribing any concrete procedures and measures. Given that it is also assumed that the Directive will not be extended, the main target group would be the PTW.

In general, it is difficult to quantify the effect of an increase in attention and information. (SWOV, 2013) states that public information without enforcement has little effect. However, no information was found on what the effect would be of an exchange of information between administrations and practitioners. One could expect that this effect would be larger than the effect of a public information campaign and that the effect would be larger in countries with less experience. However (SUPREME, 2007) stated that, prior to the implementation of the Directive,the exchange of best practices through research projects, working groups, conferences and workshops had been going on already for several years in the EU and in the international arena. Nevertheless, no general improvement in road infrastructure safety performance was registered. Combined with the fact that the scenario has a target group which is around 1% of all fatalities, this would suggest that the direct safety effect of scenario 1A would be relatively small.

Scenario 2A

In this scenario the effect would be largely due to the extension of the application of the Directive to other roads. In the discussion of area 1 the effect of the extension was estimated to lead to a reduction of around 4% of fatalities and 5% of seriously injured victims. The focus on VRU could create an additional safety effect, but although the target group would be much larger, the direct effect that is expected is still estimated to be small.

Scenario 1B

In the prescriptive scenarios, there will be a direct effect on road safety, although its magnitude would greatly depend on what exactly would be prescribed. (PROMISING, 2011) made a CBA of 20 measures and showed that the facilities for pedestrians and cyclists exceed their costs by a wide margin. In (DACOTA, 2011) it is shown that road design measures which are linked to area wide speed reductions have a high level of effectiveness (decrease of 10% in fatalities and 60% in patients per km of road). (Tziotis, 2000) estimated that the mass implementation of safety treatment programmes (eg. the broad application of shoulder sealing edge lining, etc.) could lead to a reduction of 20% in accidents. Given the focus in this area on VRU we multiply this 20% potential reduction with the target group for scenario 1 as an upper limit. We use a reduction of 10% to estimate the lower limit. The table below shows the results. We see that this measure could reduce the number of fatalities on motorways by around 1 to 4%, but that, in total, the effect is negligible.

Table 20: Estimated safety effect of scenario 1B - 2020

	Fatalities					seriously injured				
	total in 2020	Potential reduction (10%)	Potential reduction (20%)	share	share	total in 2020	Potential reduction (10%)	Potential reduction (20%)	share	share
Motorway - min	1244	11	22	1%	2%	7107	36	73	1%	1%
Motorway-max	1244	25	50	2%	4%	7107	73	146	1%	2%
Total - min	19666	11	22	0.1%	0.1%	140649	36	73	0.0%	0.1%
Total - max	19666	25	50	0.1%	0.3%	140649	73	146	0.1%	0.1%

Scenario 2B

In this scenario two areas are actually combined: the extension to other road networks and the prescriptive focus on VRU. Literature on the way in which to estimate the combined effect of measures is scarce. (Elvik, 2009) 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. 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 would assume a smaller reduction in accidents of 44% or (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. (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. As the common residual model forms a compromise, we will use this model in further calculations. In this case, this means that we assume that there is, for VRU, an additional effect of (1-(1-0.1)*(1-0.1)) -10% = 9% and an upper limit of (1-(1-0.1)*(1-0.2))-10%=18%. This is then multiplied with the target group, taking into account that there has already been an effect due to the extension. The table below shows the net effect of focussing on VRU while extending the provisions to other roads.

Table 21: Estimated safety effect of scenario 2B – 2020

	Fatalities					seriously injured				
	total in 2020	Potential reduction (9%)	Potential reduction (18%)	share	share	total in 2020	Potential reduction (9%)	Potential reduction (18%)	share	share
Motorway	1244	7	14	1%	1%	7107	18	37	0%	1%
Rural	10766	229	458	2%	4%	54581	1166	2333	2%	4%
Urban	7656	421	843	5.5%	11.0%	78961	4453	8906	5.6%	11.3%
Total	19666	657	1315	3.3%	6.7%	78961	5638	11276	7.1%	14.3%

4.2.5 Calculating the economic impact

Just as the safety effects are only quantified for the B scenarios, this is also the case for the economic impact. Just as before we multiply the savings in fatalities and seriously injured victims with their respective value. The tables below show the result for the two boundary estimates (lower limit – 10% reduction and upper limit -20% reductions).

Table 22: Scenario B1 – Economic valuation of the safety impact – 2020

Economic impact (million Euro)		Fatalities		seriously injured	
		2020		2020	
		lower bound - 10%	upper bound -20%	lower bound - 10%	upper bound -20%
EU	Motorway	22	98	11	41
	Rural	0	0	0	0
	Urban	0	0	0	0
	Total	22	98	11	41

Table 23: Scenario B2 – Economic valuation of the safety impact - 2020

Economic impact (million Euro)		Fatalities 2020		seriously injured 2020	
		9%	18%	9%	18%
EU	Motorway	14	28	5	11
	Rural	435	870	336	672
	Urban	734	1469	1209	2417
	Total	1183	2367	1550	3100

4.2.6 Calculation of costs and estimation of administrative burden.

The costs of an increase in targeted actions towards VRU that rely on a more information-based approach mainly consist of the costs of organising dedicated workshops, setting up guidelines, maintaining a database, etc. Since there is already a lot of existing work to build on (e.g. SEROES, PIARC, the CEDR group, etc.), the costs of such a measure should be fairly limited. The costs of organizing a workshop would be in the range of 4.600-9.100 euro[35] depending on the number of attendees. In addition one has to take into account the opportunity cost of the persons attending. This would amount to around 500 euro per person per day. The cost of setting up a database that includes infrastructure measures and directives targeted towards VRU would be in the range of 5000 euro as a capital costs and a yearly maintenance cost of around 5000 euro (including labour).

The main cost for each of the scenarios would lie in the measures taken as a consequence of the procedures. This cost will vary greatly in relation to the measures taken and in relation to the current practice in the different countries.

For the scenarios which assume that the Directive is extended to other roads, the costs will largely be due to this extension. The difference between 2B and 2A is expected to be small unless more expensive countermeasures are prescribed than those that would be installed otherwise.

4.2.7 Conclusion

In this area the focus lay on more targeted actions that focus on VRU. Given the current application of the Directive, this would mean more targeted actions that focus on PTW. PTW form an important group in traffic accident data and, more importantly, the number of accidents with PTW is still increasing over time. However, scenarios which limit the application of the Directive to the TEN-T and which are of a more informative character are unlikely to have a large effect. The extension of the application to other roads alongside the simultaneous targeting of VRU would have a much greater safety effect, although this effect would come at a much greater cost. The prescription of measures is more likely to have a greater effect on road safety, given that the correct measures are chosen, but it does not take into account the particularities of roads in the different countries.

[35] We assume a logistic costs of around 60 euro/person attending, travel costs for the invited speaker (600 euro), 5 working days administrative work at 500 euro/day.

4.3 Area 3: Measurement of the Safety Performance of the Roads

To date, the Directive does not contain any provisions on the measurement of the safety level of a road. Instead, the Directive provides a framework to ensure that safety is adequately addressed during the road lifecycle (by way of Road Safety Impact Assessment, Road Safety Audits, and Network Safety Ranking and Management).

The measurement of the safety performance of road infrastructure may be developed in different ways:

- By defining key performance indicators that target to certain road users
    - Accident-based indicators: number of accidents, number of fatalities, accidents per vehicle km, fatalities per vehicle km, etc.
    - Speed data: average speed, operational speed, etc
- By applying a risk assessment method to predict the likelihood of an accident in a given time and place. Different methodologies are possible, for example the ones developed within the following projects Whiteroads (focussing on locations of white spots on the TEN-T network in order to get a checklist of characteristics of good infrastructure), Euro Safety Atlas (which maps the safety of the major roads), IASP (which has as its goal to identify dangerous locations and to rank measures which improves safety), RANKERS (which has as its goal to develop scientifically researched guidelines on road infrastructure safety) and EURORAP (I and II) (which among other things, provide a safety ranking, risk factor attributes sheets, risk mapping of roads, and country analyses).

4.3.1 Scenario Definition

A first scenario assumes that the Directive will prescribe that the safety performance of the TEN-T road network should be measured, but will not prescribe a specific methodology. This follows the spirit of the Directive which only states that certain procedures should be put into place, without the obligation of following a specific methodology.

A second scenario introduces the possibility of receiving a certificate if a certain level of safety is obtained. This would require that the measurement of safety would be done in a manner that is consistent over all countries. This would prove difficult if the methodology is not prescribed. Another important aspect would be the determination of the safety level required to receive a certificate. This scenario could be compared to the EURORAP practices, which ranks roads by using a star rating. This certification could be used on a voluntary or on a mandatory basis.

4.3.2 Estimating the size of the target groups

The measurement of road safety and the possible certification is linked to those roads which fall under the Directive, i.e. the TEN-T network. The target group would be all users travelling on the TEN-T network. Given that we do not have information on the accidents that happen on the TEN-T network, we focus on the motorways, taking into account the relative share of the TEN-T network in the motorway network. Hence, we do not take into account accidents that happen on

non-motorway TEN-T roads nor the fact that more accidents might happen on part of the motorway network that does not fall under ths scope of the TEN-T.

Table 24: Target group area 3 – year 2020

	Fatalities			seriously injured		
	total in 2020	Target group	share	total in 2020	Target group	share
Motorway	1244	685	55%	7107	3410	48%
Rural	10766	47	0%	54581	170	0%
Urban	7656	0	0%	78961	0	0%
Total	19666	732	4%	140649	3579	3%

As with the current Directive it is possible that Member States would extend this practice to the remaining road networks. It makes more sense to measure the safety performance of an entire road than only of those stretches that are part of the TEN-T network. This would greatly extend the scope of this area.

4.3.3 *Identification of positive and negative effects, including unintended side-effects*

Benefits

The safety impact of the measurement of the safety performance of roads and the possibility of attaching certificates to it mainly depends on what happens with the results. For both scenarios, the same benefits are expected, although the effects are likely to be much smaller in scenario 2. In general it

- Will serve as a benchmark, which in turn will provide an incentive to improve[36]
- Will allow for an understanding of the level of risk built into the network
- Will provide a basis for targeting high risk sections for improvement before an accident can take place
- Will provide information to drivers so that they can adapt their behaviour
- Will help in setting objectives.

Given the nature of the scenarios it is not possible to assess the direct effect of having a measurement of safety performance on safety.

Costs

The cost of measuring the safety performance of roads greatly depends on the method that is used. In general, we distinguish between the following costs:

- Cost of developing a methodology, in case one opts for a non-existing method

[36] (PROMISING, 2011)

- Data collection: a method which relies purely on accident and traffic data will be much cheaper than methods which use video recordings, live measurement or measuring vehicles.

- Training costs for the people in the field who need to be trained. The costs of training could amount to 400-500 euro per person[37], to which the opportunity cost of their attending the training must be added

- Time spent on calculating the measurements, reporting, etc.

- The costs of the certification of the roads.

Apart from the costs of development, these would be recurring costs ,since measurements have to be kept up to date.

A secondary set of costs would be the costs linked to the measures implemented to improve rating, and thus road safety. Hill, J & C. Starrs (2011)[38] state that the average costs per km of increasing the safety rating of a road with 1 star (this is higher than the costs of measuring as it also includes actions) amounts to 200.000 pounds for a single carriageway, 350.000 pounds for a dual carriageway, 275.000 pounds for a mixed carriageway and 500.000 pounds for a motorway. For the UK, the benefit would be 600 lives/year or 34 billion pounds over 20 years (this would be a decrease of 40% in fatalities and 30% in injuries). The capital investment would be 8.2 billion pounds over 20 years, leading to a benefit-cost ratio (BCR) of 4.

Possible Hurdles

Apart from the scenario to extend the Directive to tunnels that fall under the Tunnel Directive, this scenario received the lowest score, and was rated especially low by the Member States. Concerns were raised with regards to the possible costs linked to a certification programme. Countries with less experience with the procedures that are currently in place in the Directive felt that they first needed more time to get familiar with the procedures before going on to add other tools to it.

4.3.4 Conclusion

The measurement of the safety performance of roads and the possibility of linking a certification to this type of measurement would allow for the possibility of benchmarking between countries. This would provide an incentive to increase the safety performance, since the citizens of countries can easily make a comparison between their own country and other countries. However, in order to put into place a form of certification, a shared methodology would be required. This would go against the current spirit of the Directive which leaves much freedom to the countries in the implementation phase.

[37] Based on the costs for following 4 courses to work with the RAP methodology. http://capacity.irap.org/training/rap-courses . This is in line with the costs for the periodic training of professional drivers which ranged between 57-786 euro.
[38] (Hill, 2011)

4.4 Area 4: Increasing the information communicated to citizens and road users.

The current Directive includes communication towards the public in the Safety Rankings and Management: "Member States shall ensure that road users are informed of the existence of a high accident concentration section by appropriate measures."

The survey showed that currently, almost all countries (23 out of 27) are informing road users about the presence of black spots. Such communication chiefly occurs through internet websites (15 responses out of 26), signposting and variable message signing (VMSs) (6 responses) and other means such as regular publications or other media tools. The effectiveness of the communication tools, however, is not homogeneous. While signposting and the use of VMSs are effective methods for relaying black spots (because the information given to road users is timely), internet based communications (websites and PDF reports), as well as printed publications, cannot be considered in the same way. For this reason, we can conclude that only few (6) Member States/Regions inform road users about high accident concentration sections in an effective manner.

Although they affirm (50% out of 26 responses excluding Croatia) that increasing the information which is communicated to citizens and road users (for example with respect to black spots and general recommendations) would improve the effectiveness of road safety management, an assessment of the comments which the stakeholders have made suggests that they have varying opionions about the specific benefits that could be achieved in this area. Though responses from stakeholders have generally argued that communication is important to increase the understanding of problems, of solutions and of good behaviour,[39] they have also highlighted that information and awareness are effective- only if they lead to a change in users' behaviour.

4.4.1 Scenario Definition

Apart from information on so called black spo, the Directive could also foresee an obligation of informing the citizens on the outcomes of the other procedures, on the methodologies that are used and on the measures which are taken as a consequence of the outcome of the procedures.

4.4.2 Estimating the size of the target groups

As for area 3, the main target group would be the drivers travelling on the TEN-T network. However, as with the current Directive, we can expect that Member States would voluntarily use the same practices on the remaining roads. If the increase in information would lead to an increase in general awareness, the general public as a whole would make up the target group.

4.4.3 Identification of positive and negative effects, including unintended side-effects

Benefits

It will increase public awareness, the pressure to increase road safety infrastructure and the pressure to apply the road infrastructure safety management system not only to the TEN-T roads, but also

[39] Comment made by the grouping of IFIs (online survey).

to other roads. However, to achieve this permanently and sustainably by way of information is difficult. It requires a very targeted and sustained effort to complete a complex process that consist of various steps (Road users receive information, Road users understand the information, Road users' attitudes start to change, Road users' behaviour starts to change) before one finally sees that behaviour has changed on a sustainable basis.[40] The (SWOV, 2013) states that public information without enforcement has little effect. This does not imply that it should be left undone. It has a demonstrable contribution to increase of knowledge and a change in attitude. It also can contribute to the acceptance of unpopular measures. (DACOTA, 2012) estimates that dynamic traffic management systems (e.g. variable message signing) could reduce all injury crashes by 5-20% and fatal crashes by 10-25%, but also that the impact depends on the quality of the system. iMobility[41] state that local danger warnings improve road safety by making drivers more aware of incidents and of other problems that lie ahead. They estimate that injury crashes might decrease by 1-5% and fatal crashes by a slightly higher percentage.

Costs

The cost of this scenario again depends on the actual implementation. Variable message signing would be more expensive than signposting (which needs to be regularly updated), while choosing to provide the information on a website would be most cost-efficient, but also less effective.

The cost of a fixed message sign is about 23.000-35.000 euro (capital cost) with a yearly operating and maintenance cost (O&M) of 1.400 euro. The cost of a dynamic message sign is about 28.500-70.400 euro capital cost with an O&M cost of 1.400-3.500 euro. A portable dynamic message sign costs around 11.100-14.600 euro (capital cost) and 300-1.100 euro yearly on O&M[42].

The median production cost of a road safety advertisement campaign ranges from 7.000 (simple talking head advertisement) to 300.000 euro (cinema verite type execution featuring graphic crash scenes)[43].

Possible Hurdles

Currently, the Directive already foresees the provision of information to the road users on the topic of black spots. However, only 6 replies indicated that this was done in the most effective way possible (i.e. on the spot). As such, the question is whether the inclusion of more information requirements in the Directive will lead to a more efficient form of communicating information.

4.4.4 *Conclusion*

In general, the literature agrees that the direct safety effect of providing more information to citizens and road users is very limited if not complemented with enforcement. However, doing so does increase general awareness and might increase the pressure to use safe infrastructures. Moreover, the costs of doing so are relatively small.

[40] Comment made by the grouping of IFIs (online survey).
[41] www.esafety-effects-database.org
[42] Calculations based on the costs database available at www.itscosts.its.dot.gov , converted to euros using oanda.com
[43] www.carrsq.qut.edu.au

4.5 Area 5: Monitoring and exchange of information

Currently, the Directive (Articles 10 and 11) already foresees the exchange of best practices

- "In order to improve the safety of roads within the European Union that are not part of the trans-European road network, the Commission shall establish a coherent system for the exchange of best practices between the Member States, covering, inter alia, existing road infrastructure safety projects and proven road safety technology."

- "The Commission shall facilitate and structure the exchange of knowledge and best practices between Member States, making use of the experience gained in existing relevant international forums, with a view to achieving continuous improvement of safety management practices concerning road infrastructures in the European Union."

Today, this exchange of information mainly takes place via the CEDR working group and the Committee on road infrastructure safety management. From the survey it became clear that especially those Member States which have less experience with the different procedures still want more exchange of information. Moreover, it might be useful to foresee a structured way of information exchange for the road safety auditors as well. Ripcord-Iserest (2007)[44] state that the exchange of knowledge and experience between auditors should be encouraged and even be made obligatory.

Another message that came out of the ex post evaluation was that there was little information available on which to base the evaluation. Closer monitoring could possibly solve this. The idea would be to propose a provision for a post-implementation review (every two years). This would allow the Commission to collect data on the implementation of the Directive. Today this happens with the regulation in the area of driving times and rest periods. Member States have to provide insight into the number of checks that are made and offences that are detected. In relation to the road safety management Directive, one might collect data on the costs of the procedures, on the results of using the procedures, on the number of accidents, on the reduction (insofar that a reduction is possible) in the number of accidents due to the use of the procedures, etc.

4.5.1 Scenario Definition

In this context two aspects are of importance:

- The idea of increased monitoring

This can be achieved by way of the obligation of periodic reporting on the status of the implementation of the Directive, on the results of the road safety rankings, and on the results of the audits and inspections. In addition more information on the costs of the procedures, on the number of accidents, and on changes in accident rates could be collected.

- Exchange of information

[44] Ripcord-Iserest (2007) RSA requirements for a training curriculum for the education of auditors and validated measures to improve traffic safety.

The idea is that the Commission shall facilitate and structure the exchange of knowledge and best practices between Member States, making use of the experience that is gained in existing relevant international forums, with the goal of achieving a continuous improvement of safety management practices in the European Union that relates road infrastructure. The exchange of information can take many shapes, all of which can be effective:

- Provision of an online database with best practices.
- Best practice guidelines.
- Regular meetings, during which preferably one specific at a time is discussed. A possible topic could be VRU – linking this scenario to area 2. The people that attend could be representatives of the Member States, but it could also be useful to organize a yearly conference for practitioners in the field.

This could be done for all procedures, but might also be focussed only on one specific procedure, the road safety audit. In the case of the road safety auditor, this information exchange could be a part of the periodic training that is required to hold on to the road safety certificate.

4.5.2 Estimating the size of the target groups

The target group would be the people travelling TEN- T roads and other roads which have been included, on a voluntary basis by the different Member States.

4.5.3 Identification of positive and negative effects, including unintended side-effects

Benefits

This measure is aimed at exchanging knowledge and monitoring current practices. Hence, we do not expect a direct effect on safety. (SUPREME, 2007) stated – that before the implementation of the Directive the exchange of best practices through research projects, working groups, conferences and workshops had already been going on for several years in the EU and in the international arena. Nevertheless, no general improvement in road infrastructure safety performance has been registered. (PROMISING, 2011) states that "an exchange of expertise and experience is not helpful when it guides process-related thinking. It is impossible to copy solutions form one country to another and even from one city to another. Principles and guidelines can help parties involved in finding solutions in their own context. Good examples should provide further inspiration and demonstrate attractiveness of solutions". Hence this measure is expected mainly to increase the efficiency of road safety management. The following positive effects are to be expected.

- Quantitative
  - Access to broader range of data and datasets;
  - Deliver cost savings by avoiding duplication of efforts and sharing research outcomes/best practices across a wider base of potential users;
  - Ultimately contribute to efficiency savings or increased effectiveness.

- The reporting on the status of the implementation will mainly have a self-enforcing effect.

- Qualitative
  - Enable decision making or planning through better intelligence
  - Generate EU added value
  - Structures the exchange of good practice
  - Create a networking effect (point-to-point contacts) that enables cooperation to take place
  - The monitoring will allow for a better evaluation of the Directive.

Costs

The costs of this measure depend on its practical concretisation. Will the exchange of information take place via a web based tool or via seminars/conferences? If seminars are used, how many will be organised, etc. The typical cost of an online database includes the costs of having a server, of the necessary software and of the staff to set up and maintain the system[45]. This cost is estimated at around a 5000 euro capital cost and another yearly cost of around 5000 euro. For a regular yearly conference/workshop costs are estimated at around 4.600-9.100 euro[46].

An important administrative cost would fall on the Member States in the form of the cost of reporting. This cost would mainly be comprised of labour costs and will increase in relation to the complexity of competences in a country. Moreover, data gathering might prove difficult. For example, the costs of the road management procedures today are often not allocated separately but included in the overall project.

Possible Hurdles

As with any form of information exchange one has to consider if the best practices are in fact transferable to other situations or regions. The context, i.e. the transport, political, technical, economic and cultural environment will determine which solution fit best locally, regionally and nationally. Principles can be applied but must be transformed into concrete measures[47].

Information exchange is taking place and the survey showed that while some requested a higher rate of information exchange others indicated that enough was already being done. It is important that the work done during other meetings (CEDR working group and the Committee on road

[45] We foresee a cost of 5000 euro for the server, setting up the database and developing the website – assuming that the information is readibly available (derived from unit costs stated for an information service (www.itscosts.its.dot.gov)), 2% of this for the maintenance and operation and 5000 euro for labour cost. For labour we assume 0.5 FTE to maintain the website and an hourly wage of 7.3 euro (calculated based on data available from Eurostat on the average gross annual earnings in the business economy (2008-2011)).
[46] We foresee a logistic costs of around 60 euro/person attending, travel costs for the invited speaker (600 euro), 5 working days administrative work at 500 euro/day.
[47] PROMISING (2001)

infrastructure safety management) and in other projects and other instances is not duplicated. PIARC, for example offers already a knowledge base and organizes workshops and seminars. (Ripcord-Iserest D4, 2005) (Ripcord-Iserest D9, 2005) (Ripcord-Iserest D6, 2007) provide best practice guidelines and best practices for RSA, RSI and NSM as well as a freely accessible database that contains best practices for secondary roads (SEROES). (PROMISING, 2001) (although this project is older it is still referred to) gives an overview of the cost-benefit analysis of 20 measures which improve the safety of VRU. (IASP, 2003) focusses on RSIs and defines methods and procedures for the analysis of the actual safety conditions of a 2-lane rural road. Pilot4Safety (2013)[48] aims to apply the Directive's approaches related to training and certification of Road Safety Experts for the application of RSA and RSI procedures to selected secondary regions. This will be done by sharing good practices. This indicates that it is probably a better option to start from what is available and analyses whether it is used, if it is used effectively and how the use of existing sources, instances could be ameliorated.

Given the administrative costs and the possible difficulties in data gathering related to the monitoring, there might be limited support from the Member States.

4.5.4 Conclusion

The exchange of information between professionals might be an effective way to improve road safety at a limited cost and there is a demand for this from less experienced countries. The main question would relate to the way in which to organise this information exchange effectively, considering the fact that there is already a lot of information available. As such, it might be preferable to first analyse why the exchange of information is not working as good as it ought to.

A closer monitoring of the resources spent and of the results would ease the evaluation of the Directive in the future. However, it will require a lot of effort from the administrations of the different Member States.

4.6 Area 6: More explicit mutual recognition/acceptance auditor training certificate

The current Directive article 9 discusses the appointment and training of auditors. The main elements of this article are:

- The establishment of a training curriculum for RS auditors
- When road safety auditors carry out functions under this Directive it is required that they undergo an initial training for which they are awarded a certificate of competence upon completion, and periodically take part in further training courses.
- Member States shall ensure that road safety auditors hold a certificate of competence.

However, the Directive does not impose the requirement that auditors are mutual recognized in other countries. The figure below shows that 63% accept auditors with a certification from another Member State while 33% do not. The main reason certain Member States refuse to accept certifications from another Member State lies in the idea that a specific understanding of local circumstances and particularities is needed in order to conduct a good RSA.

[48] http://pilot4safety.fehrl.org/

Table 25: Acceptance of auditor-training certificates from other MS

	YES	NO	No info
acceptance of auditor-training certificates from other MS	17	9	1

Source: Data based on replied Member States' questionnaires (25 Member States plus Belgium-Wallonia and Belgium-Flanders)

4.6.1 Scenario Definition

The Directive could put into place an obligation to accept auditor-training certificates that are issued by another Member States. In order to take into account the particularities of the country, a specific training might be designed and form a part of the periodic training courses. This scenario does not foresee prescribing specific training curricula, although it might provide some guidelines with regards what subject matter should be included in a course so as to ensure a high quality, or with regards to what should be the preliminary requirements, etc. [49].

4.6.2 Estimating the size of the target groups

A more explicit mutual recognition/acceptance of the auditor training certificate does not directly impact road safety. As such, a calculculation of the target group is less relevant. In theory all road users travelling on roads which are subject to road safety audits would be affected should the mutual recognition increase the efficiency of the road safety audit which are performed.

4.6.3 Identification of positive and negative effects, including unintended side-effects

Benefits[50]

Qualitative

- Enhance the consistency of training standards, ensure common interpretation of the RSA procedure and harmonised ways of working
- Potential for road safety knowledge transfer between auditors on RSA process and practice
- Increased experience of multi-national RSA teams working together and pan-European safety levels being improved
- Objective evaluation, no influence of regional factors
- Positive, but small, influence on labour mobility

[49] Ripcord-Iserest (2007) gives guidelines for the training curriculum for the education of auditors. The project Pilot4Safety (2011) is also targeting at a common EU curriculum for road safety experts for RSI and RSA courses and the Euro-Audit project (2007) also provides a European Road Safety Auditor training syllabus.

[50] Some of these benefits are based on the replies given by authorities in Pilot4Safety (2014)

Quantitative

- Potential cost savings associated with the optimisation of training offers

Costs

An explicit recognition of the road auditor certificate would require the possibility to check the quality of the training that is given in the other countries. This could be done by using a certificate for the training centres of auditors. These costs could be compared to the costs of the certification of training centres and quality control for professional drivers (Directive 2003/59/EC). This cost was estimated to lie in the broad range of € 5 to € 14 million for the certification of 14.843 training centres[51].

Possible Hurdles

The majority of the countries already accept certifications from other Member States. The countries which do not accept certifications from other Member States mainly do so because they believe that the auditor should have a thorough understanding of local practices and rules. (Pilot4Safety, 2012) shows that it is important for the authorities that the level of education is of the same standard, that language should not be a barrier and that local requirements and guidelines for (building) infrastructure are known.

4.6.4 Conclusion

Currently, the Directive does not foresee an explicit recognition of the certification of road safety auditors. The survey showed that in 63% of the cases certificates from other Member States were accepted. If the mutual acceptance of certificates that are handed out by other Member States would become an obligation, this would mean that it would mainly affect those countries which currently do not yet accept the certification of other Member States. The main benefits would be the increase in efficiency of the procedure, the possibility of exchanging information, and possible savings on the costs of the training. If this would be accompanied with the obligation to follow a certain training structure which has proven to be more effective this would increase the efficiency of RSA in all countries. The main cost would be the administrative costs of certifying the training centres. The main hurdle seems to be the required knowledge of the local situation, guidelines and practices.

4.7 Area 7: Better integrating ITS systems and services

Intelligent Transport Systems (ITS) refer to systems in which information and communication technologies are applied in the field of road transport, including infrastructure, vehicle and users, and in traffic management and mobility management, as well as for interfaces with other modes of transport, and this in order to make safer and more coordinated use of transport networks.

There is substantial agreement that ITS systems are an asset for the whole infrastructure development and the whole traffic system. The OECD (2003) claimed that ITS safety technologies can potentially reduce the total number of road crash injuries and fatalities by 40%. For some

[51] The estimated number of training centres involved in the training of professional drivers in the EU is 14,843. We do not have information on the number of training centers involved in the training of road safety auditors.

measures such as dynamic traffic management and hard shoulder running[52] estimates go even to a 60% reduction in accidents[53]. Recently ITS have taken a prominent place in EU transport policy, and more specifically in the road safety policy orientations for 2011-20, which aim to promote and accelerate deployment of innovative technology in order to improve road safety[54].

ITS-Cooperative systems allow for communication between vehicles (V2V), from vehicles to road infrastructure (V2I) and between infrastructure (I2I) – thereby enabling travellers to remain connected at all times – have all the potential to accelerate deployment of advanced driver assistance systems.

Within the framework of the RSIM Directive, ITS and infrastructure are linked in a two-way relationship:

1) The road safety of infrastructure can benefit from the use of ITS

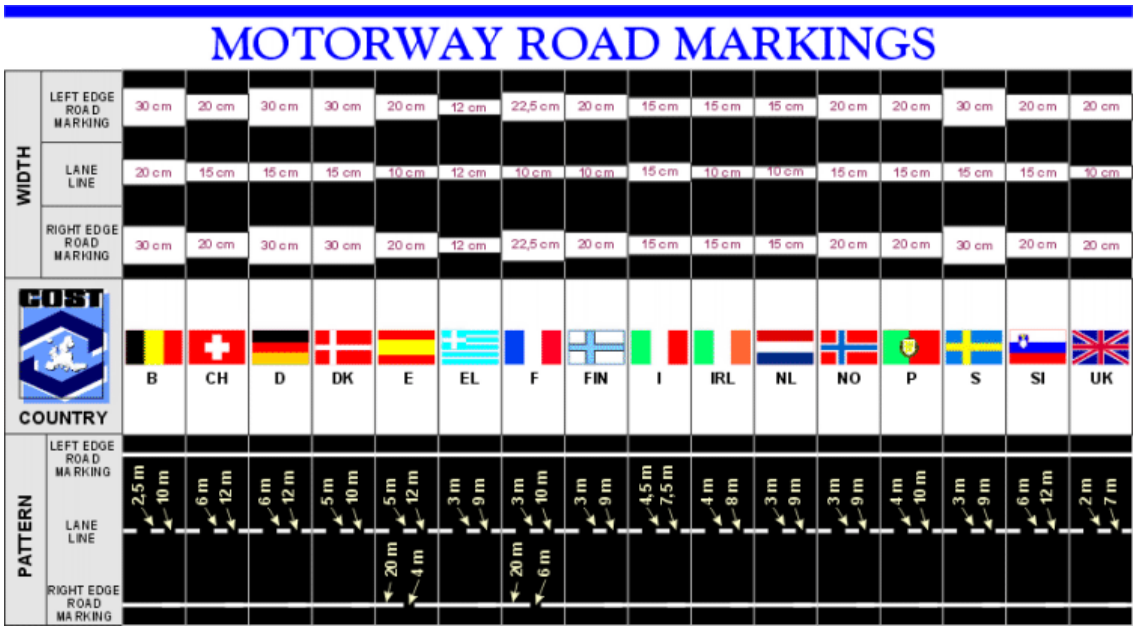
2) Road infrastructure can support the deployment of ITS applications.

With respect to the first point, ITS can improve the performance of infrastructure, quicker and less expensive and with lower or no environmental impact compared to building new infrastructure[55]. ITS that enhance road safety infrastructure safety include: traffic events detection, traffic data collection, accident data collection, accident prevention, real time provision of traffic weather or event information, information on the current condition of the road, etc. Moreover, linking ITS more directly to the Directive, one could also use ITS as a tool supporting road infrastructure safety management. For example, sensors, both insitu and moving sensors (probe vehicles) could be used to get new information that can be added to traditional monitoring systems. This new information is also of dynamic nature and hence can be used for real time warning support. Another example is the use of sensors to monitor the structural condition of, for example, bridges. Information on the location of a low friction road section, and hence with an extended brake distance, could be derived from extended floating car data and this information could be given to both the road user and the road operator (INTRO, 2008). In summary, ITS could provide information which will improve road safety both to the user and to the road operator.

With respect to the second point, there are many ITS applications which can only be effective if the infrastructure is suited for this. For example, a lane departure system can only work, apart from a reliable detection system, if the road markings are clear and comply with certain standards. Even within the European Union, road markings differ from country to country as can be seen from the figure below which might hinder the efficiency of lane departure systems. Speed alert systems might be based on speed maps, but could also be "read" from the posted signalling signs. Again this would require a certain standardisation with respect to the shape, the size, the hight and the placing of the signalling which goes further than currently agreed upon.

[52] Allowing to drive on the hard shoulder when incidents and/or sever congestion is detected.
[53] (Easyway, 2010)
[54] http://ec.europa.eu/transport/road_safety/pdf/news/nl8_en.pdf
[55] http://www.easyway-its.eu/highlights/easyway-programme-2007-2020-and-its-projects

Figure 11: Motorway Road Markings



Source: http://cordis.europa.eu/cost-transport/src/cost-331.htm

Related to this is the question of standardisation of the road infrastructure itself. At the time of writing, different norms apply to road equipment[56] (CEN/TC 226) and road materials[57] (CEN/TC 227). This fits within the provisions of the European Construction Products Regulation (3005/2011/EU-CPD). These norms deal only with technical specifications and specify test methods and performance levels based on the driver's need. They provide great improvements to harmonise the European practices in terms of test methods, but they leave each country free to specify the requirement level in terms of performance on its own national network. This implies that differences can occur in terms of the performance requirements on the TEN-T[58].

For example, as of 1 January 2011, all road restraint systems sold within the EU are to be certified with a CE Marking. The introduction of EN 1317 represents a significant change in terms of safety and quality insofar that it establishes an EU market based on performance. In practical terms this means, firstly, that new barriers placed on European Roads can offer guaranteed levels of safety and ,secondly, that the level of guarantee is the same across the whole of the EU. Note that while the EN1317 guarantees common testing methods for road restraint systems across the Member States, it is up to the national government to decide on the level of protection on their network – for example, on the choice of which class barrier to use (these can vary from N1-H4b[59]). As a result,

[56] Crash barriers, safety fences, guard rails, bridge parapets, horizontal road sings, vertical signs (including variable message signs), traffic control, street lighting, noise reduction devices, parking meters

[57] Bituminous mixtures, surface dressing, sprays and slurry surfacing, materials for concrete roads including joint fillers and sealants, hydraulic bound and unbound mixtures, etc.

[58] IMPROVER project, subproject 4, Appendix B Harmonisation of road signs and road marking on the TERN from a safety point of view.

[59] There are different criteria to evaluate the safety performance of a barrier system including structural adequacy (containment level), occupant risk (impact severity), deformation of the system (working width or deflection) and post

European drivers are confronted with varying levels of road restraint system protection on the European motorway network despite the fact that driving conditions are very similar across Europe. ERF (2012) found that the minimum legal requirements on motorways varied between Member States from having a N2 to H2 norm for side barriers, from N2 to H3 norm for the central barrier and from N2 to H4b norm for a bridge barrier.

These differences in norms have an important impact on the potential health outcomes of an accident and, as such, establishing standards for certain road infrastructure elements or making their use mandatory could help improve road safety. The order of magnitude will depend on the different national prescriptions in place today. A more detailed analysis of this topic was out of scope for this project, but as the level of performance of the road infrastructure system as a whole has a significant impact on road safety, it is an interesting case for further research.

Coming back to ITS, this two-way relationship makes it important that there is a good cooperation of all relevant stakeholders including the road safety operators with a view to foster actual deployment of ITS services relevant for road safety. This is also reflected within the EasyWay Programme which, since 2007, had joined a multitude of key players (National Ministries and Road Authorities, Road Operators and partners from the private and public sectors of almost all EU Member States and neighbouring countries) for harmonised deployment of ITS across Europe.

Finaly, there is a substantial agreement that ITS are an asset for the whole infrastructure development and the whole traffic system. Therefore, they should be part of the assessment that is performed when implementing the road infrastructure safety management procedures stipulated by the Directive. Moreover, any ITS intervention requires an upgrade of the existing roads, which can be achieved in synergy with the procedures established by the Directive itself.[60]

Given this background, it is important to mention that Directive 2008/96/EC does not stipulate specific instructions on the way in which ITS systems should be deployed across EU Member States. The Directive only provides a reference to ITS in Article 5 as part of the procedure for Network Safety Rankings. In this context it is mentioned as a potential remedial measure. The general framework for ITS is, conversely, provided by Directive 2010/40/EU (known as the "ITS Directive"). This Directive establishes what kind of specifications the Commission will have to adopt within a 7-year timeframe to address the compatibility, interoperability and continuity of ITS solutions across the EU.

4.7.1 Scenario Definition

As discussed in above, within this two-way relationship, ITS can play different roles

- As applications that supports safer traffic, provide information to the driver, support enforcement, etc.
- As a tool that supports road infrastructure safety management
- As a tool for the collection of necessary data.

impact vehicle response. EN1317 sets out criteria for normal containment (N1 and N2), higher containment (H1 to H3) and very high containment (H4a and H4b).

[60] Comment made by the grouping of road safety research stakeholders (interview on 25 June 2014).

In all three cases this can be provided by infrastructure sensors, but can also be based on vehicle-to-vehicle communication (e.g. where do people brake suddenly).

Within this framework the Directive could emphasise

- That ITS which form part of the infrastructure should be assessed according to the guidelines.
- The possible role of ITS as a remedial measure, without prescribing specific solutions.
- The role that ITS plays in enabling the deployment of ITS by providing clear road markings, traffic signalisation, etc.

4.7.2 Estimating the size of the target groups

The target group would be the people travelling the TEN- T roads as well as the other roads which have been included – on a voluntary basis by the different Member States.

4.7.3 Identification of positive and negative effects, including unintended side-effects

Given the broad subject of ITS it is not possible to give an exhaustive list of all possible measures and their expected effects. Some relevant projects that provide more detailed information on specific systems are SafeSpot (a cooperative network to improve communication between vehicle and road infrastructure safety), Intro (which deals with intelligent roads, novel systems for surface safety monitoring, traffic and safety monitoring, etc.), InSafety (information on cost efficient combinations of new technologies and traditional infrastructure) and SAFETRIP (a satellite application for emergency handling, traffic alerts, road safety and incident prevention).

Benefits

The option of specifying that ITS which forms part of the infrastructure should also be subject to the procedures will mainly increase the efficiency of the ITS measures. Hence the effect on road safety would be indirect. This conclusion is in line with the findings of (Ripcord-Iserest D7.2, 2007). They included a scenario in which a checklist of variable message signing (VMS) and relevant telematics road equipment during RSA and RSI procedures was assessed, but this scenario received the lowest-but-one score for its expected effect on safety.

As a remedial proposal the possible safety gains are much higher. The OECD (2003)[61] claimed that ITS safety technologies can potentially reduce the total number of road crash injuries and fatalities by 40%. (Ripcord-Iserest D7.2, 2007) made an assessment of a selection of scenarios. The scenario with the highest rating with respect to safety (scoring between -3 and +3) was the VMS and a safe curve speed warning. (DACOTA, 2012) states that, for the moment, evidence of the effectiveness of cooperative systems remains limited. For most systems the estimates of the effectiveness are based on simulator studies, small field behavioural trials and analysis of crash causation factors and provide little evidence[62]. Having said this, it is of course of primary concern for designers, planners

[61] Referred to in (Ripcord-Iserest D7.2, 2007)

[62] www.esafety-effects-database.org.

and constructors that they have a good knowledge of the potential in order to use it accordingly. In this way, the level of provided infrastructure will be changed[63].

Infrastructure as an enabler for the use of ITS will mainly increase the uptake of certain ITS systems such as lane departure warning systems, speed guidance tools, etc. Vehicle manufacturers[64] view the installation of roadside equipment as a 'game changer' for the vehicle manufacturers. "Without the roadside equipment, the in-vehicle systems that will be available would be less attractive to car buyers." They also state that global collaboration is needed as "Each region is doing its own research and not surprisingly, when the engineers started talking they found they were all working on similar applications. So now we are looking at working towards common standards. It makes sense for cooperative systems to comply with common standards when possible, and this is acknowledged among many of the major road operators and the vehicle manufacturers." This is also recognised in a cooperation between ERF, the European Road Assessment Programme and the European Association of Vehicle Manufactors within the concept of "Roads that cars can read". Moreover, EuroRap and EuroNCap warned that unless core elements of the road (road marking and signs) were properly maintained, drivers would largely fail to reap the benefits of ITS systems such as Lane Departure Warnings[65].

This increased standardisation of, for example, road markings and traffic signals might also have the side effect of increasing road safety on itself as it would create a more coherent message to the road users, especially when driving abroad. Moreover, this could also be used to apply more efficient (visisble in all circumstances) road markings. Rainvision[66] suggest that the use of a different road marking material can effectively increase road safety, outweighing the risk of increased speeds associated with a better visibility.

Costs

In general ITS infrastructure is expensive, has a high maintenance cost and is quickly outdated. The safe curve speed warning system which scored well with respect to the expected safety effect had the highest-but-one costs of all the scenarios that were assessed. The most expensive scenario was the use of traffic simulation models to assess the needs of the road safety impact assessment.

However, including specific checks for ITS equipment during RSA and RSI procedures would be relatively cheap. It was ranked as the cheapest option in (Ripcord-Iserest D7.2, 2007).

The costs of changing infrastructure characteristics such as road markings to accommodate the use of ITS can be relatively cheap as normal paint markings should be renewed every year and other systems such as thermoplastic should be renewed every three years and hence any changes necessary could be integrated in the normal maintenance planning.

[63] (Ripcord-Iserest D7.1, 2007).

[64] http://www.itsinternational.com/categories/location-based-systems/features/roadside-infrastructure-key-to-in-vehicle-deployment/

[65] http://www.rainvision.eu/images/Top%20Marks.pdf

[66] Rainvision.eu

Possible Hurdles

As became clear during the workshop, ITS are innovative, and they are the future, but legislative steps should be cautious and run in parallel with ITS deployment and with the relevant Directives. This is especially the case because it appears that the industry is generally more orientated towards vehicle-to-vehicle (V2V) than towards the infrastructure-to-vehicle. ITS infrastructure is quite expensive both in terms of investment and maintenance[67]. Thus, there is a danger of it being outdated very quickly.

It is also important here not to duplicate the work done by others. Apart from the ITS Directive, there is also the DG ENV INSPIRE Directive (Infrastructure for Spatial Information in the European Community (INSPIRE) Directive (2007/2/EC))[68] which deal with the sharing of spatial data (the transport network and roads are only a small part of the total network). The idea is that there would be an obligation to share information that pertains to the road network. If you design a new road, there should be some obligation to share its digitalised data and to provide maintenance of this data. Also relevant is the OPEN DATA Directive on the re-use of public sector information (Directive 2003/98/EC, known as the 'PSI Directive')[69]. This Directive states that "any data held in digital form can be published by public authorities". This Directive could be expressed in a more open way, so that the ITS Directive can make reference to it. It also includes a sentence on the obligation that commercial information as well ought to be provided to the government. This might help for some of the road safety infrastructure management procedures (e.g. information on the speeds driven).

This leads to the question as to whether the road safety infrastructure management is the right Directive to focus on ITS applications. The ITS Directive, which currently provides a framework, might be better placed to take up this role. For example, V2V real-time information gathering is already covered by the ITS framework Directive.

4.7.4 Conclusion

ITS plays an important role in road infrastructure safety. They can be a part of the infrastructure, help in assessments or act as a countermeasure. ITS are also believed to have great benefits.

However, to have a well-functioning ITS systems, it is highly important to an infrastructure which enables the use of the ITS. Moreover it is of importance to have digital maps. The road design should also be digitalised and shared. When road characteristics change (such as changes in speed limits, if there are variable message signs), when it is put in operation, when there are maintenance works (e.g. moving working places), etc. the related information should go to the users (through map makers and/or real time information providers). For ITS, it is of the highest importance that information is shared, published and used.

In conclusion, it could be beneficial if the Directive would emphasise the role that infrastructure plays as an enabler of the deployment of ITS.

[67] Source: interview with ERTICO (20/06/2014)

[68] http://ec.europa.eu/environment/resource_efficiency/haveyoursay/past_consultations/inspire_en.htm

[69] http://ec.europa.eu/digital-agenda/en/european-legislation-reuse-public-sector-information

4.8 Area 8: Clearer definition of procedures

At the time the Directive was being written some countries were already putting into place some road safety management procedures. In order to enable those countries to use the same methodology as they did before the Directive does not include an exact description of what the procedures exactly should entail. For RSA and NSM, a reference is made to a number of criteria which are to be followed, but at the same time, the Directives's wording gives some flexibility (cf. "endeavour to meet the criteria"). For RSIA the elements which should be part and the elements which should be considered are listed but no methodology is prescribed. For RSI, it is indicated that, in order to measure high accident concentrations one should at least take the accidents of last year into account, but the Directive leaves the freedom to take into account more years, attribute different weights to fatalities and injuries, etc.

This led to a situation in which there have been differences between the actual implementations of the procedures in real life, although this freedom also allowed the Member States to adapt the procedures to their own specific needs.

4.8.1 Scenario Definition

In this scenario it is assumed that the Directive would give more guidelines on the way in which the different procedures should be implemented in the field. This could be based on the work done within Ripcord-Iserest and IASP [70]. This work should be updated to take into account the current practices in the different Member States.

4.8.2 Estimating the size of the target groups

This area of improvement would mainly affect the efficiency of the procedures itself. Hence the effect on safety would be indirect. As before the main target group are the road users travelling the TEN-T network and the roads to which the application of the Directive was extended voluntary.

4.8.3 Identification of positive and negative effects, including unintended side-effects

Benefits

- Uniform understanding of the definition and the application of the different procedures
- Possible gains in efficiency if ineffective procedures are replaced by best practices
- Facilitates information exchange
- Allows for a better comparison and benchmarking of the implementation of the Directive in the field

Costs

The main costs of this scenario would be

[70] (Ripcord-Iserest D4, 2005) (Ripcord-Iserest D6, 2007) (IASP, 2003)

- The research cost of investigating the actual use and implementation of the procedures in the field. This work should ideally be done by someone who has experience conducting the different procedures.

- The research cost of establishing a shared definition and best practices

- Cost of implementation: changes to the training curriculum will have to be made and road safety auditors will need to follow additional training. This training cost amount to about 400-500 euro per auditor[71], excluding their opportunity costs.

Possible Hurdles

The reason the procedures are not strictly defined today was to allow countries to use their own methodologies. Given that by now most countries have developed their own guidelines and methods the support for this scenario might be low.

Moreover this freedom also allowed the Member States to develop the procedures which fit their need the most.

4.8.4 Conclusion

The ex post evaluation showed that there are differences in the actual implementation of the procedures in real life and that this might hinder the efficiency of the procedures. On the other hand this freedom also allows the Member States to adapt the procedures to their specific needs. Moreover, the support for switching procedures may be relatively low, while the benefits would mainly be indirect. It would be a good point of departure first to investigate the differences in implementation in the field in order to find out if these differences are beneficial for road safety (since they are more likely to be adapted to the local situation) or negative (as the procedures used are very far removed from what could be considered best practice).

[71] Based on the costs for following 4 courses to work with the RAP methodology. http://capacity.irap.org/training/rap-courses . This is in line with the costs for the periodic training of professional drivers which ranged between 57-786 euro.

5 Conclusions and recommendations

This report makes a preliminary analysis of areas of further improvement of road safety and of safety of road infrastructure in particular. The goal of this report was to define possible ways forward with regards to the road infrastructure safety management Directive and to provide a first insight into the main costs and benefits these ways forward would entail. Separate reports discuss the ex post evaluation of this Directive and the stakeholder conference which was held in the context of the same study.

We first discussed the starting points for our analysis. We based ourselves on a data analysis of the locations in which accidents happen and the types of road users that are involved. We also took into account the data that was available on the TEN-T network. Another point of departure was the input which we received by consulting the stakeholders. We consulted them by way of a survey and a stakeholder conference. Finally, we added to this information the information which came out of the ex post evaluation of the Directive.On the basis of this first analysis of the starting points, the following conclusions were drawn:

- Most Member States believe that, at this point in time, there are no real issues with respect to the scope and the application of the Directive. This is because the implementation of the Directive is still relatively recent. Moreover, questions arise as to whether there would be enough resources (human and financial) should the scope of the Directive change. Most Member States, and especially those who have less experience with the different road safety management procedures, do recognise that a higher level of cooperation and information exchange is needed. The other stakeholders acknowledge this as well.This exchange of information could take place via an EU-supported platform. Today, most of the exchanges of information happen either via the CEDR working group on infrastructure safety or on a bilateral basis.

- The stakeholders do see a need for a revision. They focus on the extension to other roads; on having a clear definition of the procedures, on the need for more data (including cost-benefit analyses, before and after analyses) and on a larger focus on vulnerable road users.

- Given the data on the locations in which road accidents happen, the demand for the extension to other roads seems valid. However, 20 out of 26 Member States who replied to the survey indicated that they had already extended the use of (some of) the procedures to other roads.

Given this analysis, we used the third chapter to elaborate on the eight themes which proved most promising. This chapter also discussed the methodology that was used and the construction of a baseline.

The fourth chapter presents the analysis of the main costs and benefits of the areas of improvement of the Directive. The table below summarizes the result of this analysis by discussing the different areas of further improvement of road infrastructure safety, the different scenarios which are possible in these areas, the main benefits, costs as well as the possible hurdles.

Table 26: Summary of areas of further improvement

Area for further improvement	Possible scenarios	Main benefits	Main costs	Possible hurdles
Extending the scope beyond the TEN-T Network	A1) Towards all main roads (urban, regional and national network) – on a voluntary basis	Improved road safety (-4% fatalities; -5% seriously injured) Consistency over the road network	Costs of carrying out the procedures	Availability of road safety auditors Limited budgets Different responsibilities for different types of roads There is no uniform classification of roads The application of the Directive to urban roads
	A2) Towards all main roads (urban, regional and national network)- on a mandatory basis	Improved road safety (-8% fatalities; -9% seriously injured) Consistency over the road network	Costs of carrying out the procedures	As in A1)
	B) Towards roads which benefit from EU contributions	Limited effect on road safety (-0.04% fatalities; -0.03% seriously injured) Consistency over the road network	Costs of carrying out the procedures	As in A1) but to a more limited extend
	C) Tunnels in scope of Directive 2004/54/EC	Increase in coherence and an integrated approach towards road infrastructure safety Limited effect on road safety	Cost of having a certified road safety auditor Administrative cost of developing an integrated Directive	Limited support from stakeholders
More targeted actions towards VRU	A1) Informative, no extension	Limited effect on road safety	Cost of developing guidelines,	Does not take into account

Area for further improvement	Possible scenarios	Main benefits	Main costs	Possible hurdles
	towards other roads	Better knowledge of design criteria for different road users	setting up a web-based database (5.000 euro + 5.000 euro/year) and workshops (4.600-9.000 euro/workshop)	particularities of different countries
	A2) Informative, extension towards other roads	Improved road safety (-4% fatalities; -5% seriously injured) Better knowledge of design criteria for different road users	Cost of developing guidelines, setting up a web-based database (5.000 euro + 5.000 euro/year) and workshops (4.600-9.000 euro/workshop) Cost of carrying out procedures on other roads	As in A1)
	B1) Prescriptive, no extension towards other roads	Limited effect on road safety Better knowledge of design criteria for different road users		Does not take into account particularities of different countries
	B2) Prescriptive, extension towards other roads	Improved road safety (-3.3% to -6.7 % for fatalities and -7.1to – 14.3% for seriously injured) Better knowledge of design criteria for different road users	As in A1)	As in A1) Does not take into account particularities of different countries
Measurement of the safety performance of the roads	1) Obligation to measure the safety performance without methodology obligation	Better understanding of the risks of the roads Identification of dangerous infrastructure before an accident happens Provides information to the drive	Cost of developing a methodology Cost of data collection Training costs (400-500 euro/person) Administrative costs	Low support from stakeholders

Area for further improvement	Possible scenarios	Main benefits	Main costs	Possible hurdles
		Helps in setting objectives		
	2) Certification + obligation to measure safety performance following a certain methodology	Allows for benchmarking Incentives to improve Provides information to the driver Helps in setting objectives	Cost of developing a methodology Cost of data collection Training costs (400-500 euro/person) Administrative costs Cost of certification Costs linked to improvements that are made to obtain a better score.	Low support from stakeholders
Increasing information communicated towards road users	Include the obligation to inform citizens about the outcome of all procedures, the methodologies used and measures taken as a consequence.	Limited or no direct safety effects Increased public awareness and support Pressure to increase safety of road infrastructure	Cost depends on actual implementation. Messaging: 23.000-35.000 capital costs + O&M cost of 1.400 euro for a classic message board and 28.500-70.400 capital cost + 1.400-3.500 O&M cost for a dynamic board. Television add: 7.000-30.000 euro	Effective transposition of requirements
Monitoring and exchange of information	1) Increased exchange of information via workshops, guidelines, database	Access to a broader range of data and datasets Possible cost savings by avoiding duplication of work Increased effectiveness of the procedures (indirect safety effect)	Cost of developing guidelines, setting up a web-based database (5.000 euro + 5.000 euro/year) and workshops (4.600-9.000 euro/workshop)	Danger of duplicating work already being done Local circumstances have to be taken into account

Area for further improvement	Possible scenarios	Main benefits	Main costs	Possible hurdles
	2) Monitoring: obligation of periodic reporting	Self-enforcing effect Better evaluation of the Directive	Data collection cost Administrative cost of reporting	Possibly limited support by stakeholders Availability of data
More explicit mutual recognition/acceptance auditor training certificate	1) Obligation to accept auditor-training certificates issued by another MS	Enhances consistency of training standards, ensure common interpretation of RSA Potential for exchange of information Objective evaluations Small, but positive, influence on labour mobility Potential cost savings associated with optimization training centres.	Cost of certifying the training centres	Support by stakeholders, although the majority of the countries do accept foreign certificates. Education should be of the same standards Auditor should have a good understanding of the local practices and rules.
	2) Obligation to accept auditor training certificates issued by another MS and the provision of guidelines with respect to the auditor training	Enhances consistency of training standards, ensure common interpretation of RSA Potential cost savings associated with optimization training centres	As in 1) Development of guidelines (although there is already some research available)	Support by stakeholders
Better integrating ITS systems and services	Explicitly include that ITS which forms part of the infrastructure should be assessed according to the guidelines	Increases the efficiency of the functioning of the ITS systems (indirect safety effect)	Low cost of, for example, setting up specific checklists	Risk of rapidly being outdated
	Include more information on the role of ITS as a remedial measure	Depending on the measure, the safety effects of ITS are potentially large. However as this is an	Setting up a database of remedial measures	Risk of rapidly being outdated Risk of duplicating work done in

Area for further improvement	Possible scenarios	Main benefits	Main costs	Possible hurdles
		informative measure the direct safety effect is expected to be small	ITS infrastructure is expensive	other projects. Is this Directive the best option to target ITS solutions? Industry is focusing more and more on v2v applications
	Emphasise the role of infrastructure as an enabler of ITS	Increased efficiency of cooperative ITS systems which rely on I2V communication such as lane departure warning systems. Possible additional benefit from improved road markings and signaling.	Limited investment costs as focus is on road markings and signaling.	
Clearer definition of procedures	Providing more guidelines on best practices for carrying out the different procedures	Uniform understanding of the definition of the procedures and more consistencies over countries Possible gains in efficiency by adoption of best practices Facilitates information exchange Allows for better comparison and benchmarking of the actual implementation	Research cost of investigating implementation in the field Cost of developing shared definition and shared best practices Cost of additional training for auditors (400-500 euro/auditor) + opportunity cost	How to take into account local circumstances and practices Possibly limited support.

Given the results of the analysis made in chapter 4 the following recommendations can be made:

- Potentially, a large number of lives could be saved if the Directive would be **extended to other roads**. However, the costs and the administrative burden this would entail cannot be underestimated. Given that many countries have already extended the current provisions on a voluntary basis, this might be a better option than the decision go enforce the extension and make it mandatory. A possible compromise, in this respect, could be a mandatory extension to all motorways, since this would also create more consistency for the road users who do not know whether they are travelling on a TEN-T motorway section or not. Including all roads which receive an EU contribution will have a relatively low effect on road safety, but it also comes at a low cost. The benefits of, and support for, the extension of the Directive to the tunnels that fall under the Tunnel Directive appear to be small. It would however create a more coherent and integrated approach towards road infrastructure safety.

- **Focussing more on VRU**, without extending the Directive to other roads, comes down to focussing more on PTW, and the effect on road safety in general remains limited. In a scenario in which the Directive is extended, the target group becomes much wider as it now also includes cyclist and pedestrians and the expected safety effect is much larger. However, as discussed above, extending the Directive mandatory to other roads would come at a substantial cost.

- The **measurement of safety performance of roads and the possibility of linking a certification** to this process would make it easier to benchmark countries and might give an incentive to policy makers to improve their performance. This process of certification would require a shared methodology. This would not be in line with the current spirit of the Directive, since the Directive leaves the countries a lot of freedom with respect to the actual implementation.

- In general, literature agrees that the direct safety effect of providing **more information to citizens and road users** is very limited. However, the costs in doing so are relatively low and it will increase general awareness. Specific message signing that draw attention to points that are especially dangerous can have a direct safety effect.

- **Information exchange** between professionals may be an effective way to improve road safety at a limited cost and there is a demand from the stakeholders for this type of exchange. However, a lot of information is available today and information exchange does take place. It would be of upmost importance not to duplicate existing work. Therefore a first step should be a thorough analysis of what is already available in the field, its effectiveness and the ways in which effectiveness could be improved. A closer **monitoring** of the resources that are spent and the effectiveness of the Directive would make it easier to evaluate the Directive and would provide relevant information which can also be used in other projects. Still, this would require a lot of efforts from the administrations as data will not be readily available.

- The **obligation to accept road safety auditor certificates from other Member States** may potentially increase the efficiency of the RSA, since it would lead to an exchange in

information and a possible saving in training costs. However, even without this obligation the majority of the Member States accept certificates from other Member States. To oblige Member States to accept road safety auditor certificates from other Member States would require the certification of their training centres and this might need a shared training structure.

- The matter **of better integrating ITS systems** and services is a very broad topic. If we focus on a scenario such as explicitly including the requirement to assess ITS infrastructure within the different procedures, it is clear that this is a low cost measure which would improve the efficiency of the ITS itself. Including information about specific ITS systems as a form of remedial actions risks being rapidly outdated. In general, there is little interest in this area among the stakeholders and it is unsure if this Directive is the right place to be targeting ITS measures. There could however be a role for the Directive focussing on the support road infrastructure can give to the deployment of ITS applications. Linked to this is the topic of establishing standards for certain road infrastructure elements or making their use mandatory. This could help improve road safety and deserves more research.

- The demand for **cleared definitions** was raised within the stakeholder consultation and the ex post evaluation, which showed that there are differences in the actual implementation of procedures in real life that might hinder the efficiency of the procedures. On the other hand, this freedom also allowed the Member States to adapt procedures to their needs. It would be a good starting point to first investigate the differences in implementation in the field to find out if these differences are beneficial for road safety (as they are more likely to be adapted to the local situation) or negative (as the procedures used are very far away from what could be considered as best practice).

Please note that the above analysis focusses on the different, seperate areas individually, even though there are in fact some interlinkeages between them. For example, extending the provisions to other roads will automatically better bring VRU into the picture. An explicit mutual recognition of the certificates for auditors will also lead to an exchange of information and might decrease the need for a separate series of workshops, guidelines, etc. This explicit recognition will also lead to a more streamlined definition of the RSA, making the last area less relevant for this procedure. Better integrating ITS systems in an informative way can also be taken as a specific topic that relates to information exchange, as can the topic VRU.

6 Bibliography

Bijleveld & Commandeur. (2006). *The basic evaluation model.* SWOV.

CARE and CADAS database. (sd).

DACOTA. (2011). *Pedestrians and cyclists.*

DACOTA. (2012). *Roads.*

Easyway. (2010). *General Brocure 2010.*

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

ERF (2012) Road Safety and Road Restraint Systems. A flexible and cost-effective solution.

ERSO. (2013). *Traffic Safety Basic Facts 2012 - Cyclists.*

ERSO. (2013). *Traffic Safety Basic Facts 2012 - Motorcycles and Mopeds.*

ERSO. (2013). *Traffic Safety Facts 2012- Pedestrians.*

European Investment Bank. (2011). *EIB Transport Lending Policy.*

Gerlach, J. (2012). *Road infrastructure safety management as part of the Decade of Action for Road Safety - preconditions, instruments and examples from Europe.*

Heatco - D5. (2006). *Proposal for Harmonised Guidelines.*

Hill, J. &. (2011). *Saving Lives, Saving Money. The costs and benefits of achieving safer roads.*

IASP. (2003). *Identification of Hazard Locations and Ranking of Measures to Improve Safety on Local Roads - final report.*

INTRO. (2008). *Final Summary Report.*

Pilot4Safety. (2012). *Deliverable 7A, Evaluation Report.*

PROMISING. (2001). *Final Report.*

Ricoardo-AEA. (2014). *Update of the Handbook on External Costs of Transport.*

Ripcord-Iserest. (2007). *RSA requirements for a training curriculum for the education of auditors and validated measures to improve traffic safety.*

Ripcord-Iserest D4. (2005). *Road Safety Audits- Best Practice Guidelines, Qualification for Auditors and Programming.*

Ripcord-Iserest D6. (2007). *Black Spot Management and Safety Analysis of Road Networks - Best Practice Guidelines and Implementation Steps.*

Ripcord-Iserest D7.1. (2007). *Road infrastructure related issues of telematic applications and other new technologies.*

Ripcord-Iserest D7.2. (2007). *Possible impact and interrelation of new technologies on road infrastructure safety.*

Ripcord-Iserest D9. (2005). *SEROES: best practices in road safety measures.*

Royal Society for the Prevention of Accidents. (2007). *Road Safety Information, Rural roads*. Opgehaald van rospa: www.rospa.com/roadsafety/advice/highway/RuralRoads.htm

SUPREME. (2007). *Summary and Publication of Best Practices in Road Safety in the Member States - Best Practices in Road Safety. Handbook for Measures at the European level.*

SWOV. (2013). *Fact Sheet: Mass-media information campaigns about road safety.*

T&E and ETSC. (2003). *Position paper on tunnel safety requirements.*

Tziotis, M. e. (2000). *Effectiveness evaluation results of road safety measures world-wide.* ICTCT workshop, Proceedings.

United Nations, Economic and Social Council, Economic Commission for Europe. (2001). *Recommendations of the group of experts on safety in road tunnels, final report.*

Wikipedia. (sd). *List of countries by road network size*. Opgehaald van http://en.wikipedia.org/wiki/List_of_countries_by _road_network_size

Wikipedia. (sd). *List of OECD countries by road network size*. Opgehaald van http://en.wikipedia.org/wiki/List_of_OECD_countries_by_road_network_size

Websites

http://capacity.irap.org/training/rap-courses

http://capacity.irap.org/training/rap-courses

http://www.easyway-its.eu/highlights/easyway-programme-2007-2020-and-its-projects

http://ec.europa.eu/digital-agenda/en/european-legislation-reuse-public-sector-information

http://ec.europa.eu/environment/resource_efficiency/haveyoursay/past_consultations/inspire_en.htm

http://ec.europa.eu/regional_policy/what/future/index_en.cfm#_ftn1

http://ec.europa.eu/transport/road_safety/pdf/news/nl8_en.pdf

http://ec.europa.eu/transport/road_safety/topics/infrastructure/tunnels/index_nl.htm

http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32006R1084&from=EN

http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32006R1080&from=EN

http://pilot4safety.fehrl.org/

www.carrsq.qut.edu.au

http://cordis.europa.eu/cost-transport/src/cost-331.htm

www.esafety-effects-database.org

www.itscosts.its.dot.gov

http://www.itsinternational.com/categories/location-based-systems/features/roadside-infrastructure-key-to-in-vehicle-deployment/

www.oanda.com

Annex 1: Average social accident costs, at market prices in €2010

Country	fatality	severe injury	slight injury
Austria	2395000	327000	25800
Belgium	2178000	330400	21300
Bulgaria	984000	127900	9800
Croatia	1333000	173300	13300
Cyprus	1234000	163100	11900
Czech Republic	1446000	194300	14100
Denmark	2364000	292600	22900
Estonia	1163000	155800	11200
Finland	2213000	294300	22000
France	2070000	289200	21600
Germany	2220000	307100	24800
Greece	1518000	198400	15100
Hungary	1225000	164400	11900
Ireland	2412000	305600	23300
Italy	1916000	246200	18800
Latvia	1034000	140000	10000
Lithuania	1061000	144900	10500
Luxembourg	3323000	517700	31200
Malta	2122000	269500	20100
Netherlands	2388000	316400	25500
Poland	1168000	156700	11300
Portugal	1505000	201100	13800
Romania	1048000	136200	10400
Slovakia	1593000	219700	15700
Slovenia	1989000	258300	18900
Spain	1913000	237800	17900
Sweden	2240000	328700	23500
Great Brittain	2170000	280300	22200
EU Average	*1870000*	*243100*	*18700*

Source: RICARDO-AEA (2014), Update of the Handbook on External Costs of Transport

Annex 2: Building a baseline scenario

Methodology

We will use a common relationship between the (time dependent) number of fatalities N_f (t), the number of serious injuries N_i(t), the mobility M(t) and their ratio, the accident rate r_f(t) and the injury rate r_i(t). t denotes the year.

$$N_f(t) = r_f(t) * M(t) \quad (1)$$

$$N_i(t) = r_i(t) * M(t) \quad (2)$$

It is assumed that r_f(t) and r_i(t) show a smoother trend than N_f (t) and N_i(t). Therefore we use time series for M(t) and N_f(t) and N_i(t) to calculate a time series for r_f(t) and r_i(t). Values for N_f and N_i in the future, eg. for 2020 and 2030 are achieved by assessing values of M, r_f and r_i for 2020 and 2030, and multiply them using the formula's (1) and (2). More precisely, five steps were taken:

1) For each EU country separately we gathered data for M(t), N_f(t) and N_i(t) for the years 1995-2012[72].

   The data on N_f(t) and N_i(t) is based on the CARE/CADaS database and distinguish between road type (motorways, rural roads, urban roads), received from the Commission. For some countries these data sources were not complete or the data was assessed not to be reliable. The table below summarizes the data used for the different EU Member States.

[72] For some countries the time series only goes to 2011

Table 27: data on accidents included in estimation

	fatalities			seriously injured		
	motorways	**rural roads**	**urban roads**	**motorways**	**rural roads**	**urban roads**
BE	1995-2011, except 2004 because of police reform	1995-2011, except 2004 because of police reform	1995-2011, except 2004 because of police reform	1995-2011, except 2004 because of police reform	1995-2011, except 2004 because of police reform	1995-2011, except 2004 because of police reform
BG	excluded, not sufficient data	excluded, not sufficient data	excluded, not sufficient data	excluded, not sufficient data	excluded, not sufficient data	excluded, not sufficient data
CZ	1995-2012	1995-2012	1995-2012	1995-2012	1995-2012	1995-2012
DK	1995-2012	1995-2012	1995-2012	1995-2012	1995-2012	1995-2012
DE	2000-2012	2000-2012	2000-2012	2000-2012	2000-2012	2000-2012
EE	excluded, not sufficient data	2005-2009	2005-2009	excluded, not sufficient data	excluded, not sufficient data	excluded, not sufficient data
IE	1995-2012	1995-2012	1995-2012	1995-2012	1995-2012	1995-2012
GR	1997-2011	1995-2011	1995-2011	1996-2011	1995-2011	1995-2011
ES	2001-2012	1995-2012	1995-2012	2001-2012	1995-2012	1995-2012
FR	1995-2012	1995-2012	1995-2012	excluded, unreliable data	2005-2012	2005-2012
HR	excluded, not sufficient data	2007-2012	2007-2012	2007-2012	2007-2012	2007-2012
IT	1995-2012	1995-2012	1995-2012	excluded, not sufficient data	excluded, not sufficient data	excluded, not sufficient data
CY	excluded, not sufficient data	2004,2007-2012	2004,2007-2012	2007-2012	2007-2012	2007-2012
LT	excluded, not sufficient data	excluded, not sufficient data	excluded, not sufficient data	excluded, not sufficient data	excluded, not sufficient data	excluded, not sufficient data
LV	excluded, no motorways	2004-2012	2004-2012	excluded, no motorways	2004-2012	2004-2012
LU	1995-2012	1995-2012 (except 2009-2010)	1995-2012	1995-2012 (except 2009-2010)	1995-2012 (except 2009-2010)	1995-2012
MT	excluded, no motorways	excluded, no rural roads	2005-2010	excluded, no motorways	excluded, no rural roads	2005-2010
HU	2003-2012	2003-2012	2003-2012	2003-2012	2003-2012	2003-2012
NL	1995-2003	1995-2012	1995-2012	1995-2003	1995-2008	1995-2009
AT	1995-2012	1995-2012	1995-2012	1995-2012	1995-2012	1995-2012
PL	2000-2012	2000-2012	2000-2012	2000-2012	2000-2012	2000-2012
PT	1995-2012	1995-2012	1995-2012	1995-2012	1995-2012	1995-2012
RO	1999-2005;2008-2012	2000-2011	1999-2012	1999-2012	1999-2012	1999-2012
SL	2000-2011	2005-2010	2000-2011	2000-2011 (except 2005)	2000-2011	2000-2011
SK	excluded, not sufficient data	2005-2010	2005-2010	2005-2010	2005-2010	2005-2010
FI	1995-2012	1995-2012	1995-2012	excluded, not sufficient data	excluded, not sufficient data	excluded, not sufficient data
SE	1995-2010	1995-2011	1995-2010	1995-2010	1995-2010	1995-2010
UK	1995-2012	1995-2012	1995-2009	1995-2012	1995-2012	1995-2009

For M(t) we used the database of the TREMOVE-PRIMES model version 3.5c as a source as

- This database includes information on vkm for all EU countries and allows for a distinction according to the network type (urban roads, interurban, motorways). Eurostat and UNECE do also have some data on vkm, but not a complete time series and not for all Member States. Most importantly, they do not make a distinction towards the network type.

- This database also includes values on M(t) for the future period, which can be used for the estimation. This version captures the start of the economic crisis (real data is used up to 2009) and the projections for the years coming are adjusted and assume a slow recovery.

2) Calculate $r_f(t)$ and $r_i(t)$ from M(t), $N_f(t)$ and $N_i(t)$.

3) Extrapolate $r_f(t)$ and $r_i(t)$ to $r_f(2020)$, $r_f(2030)$, $r_i(2020)$ and $r_i(2030)$. We assumed a loglinear relationship.

$$r_f(t) = e^{a_f + b_f t + \varepsilon_f}$$
$$r_i(t) = e^{a_i + b_i t + \varepsilon_i}$$

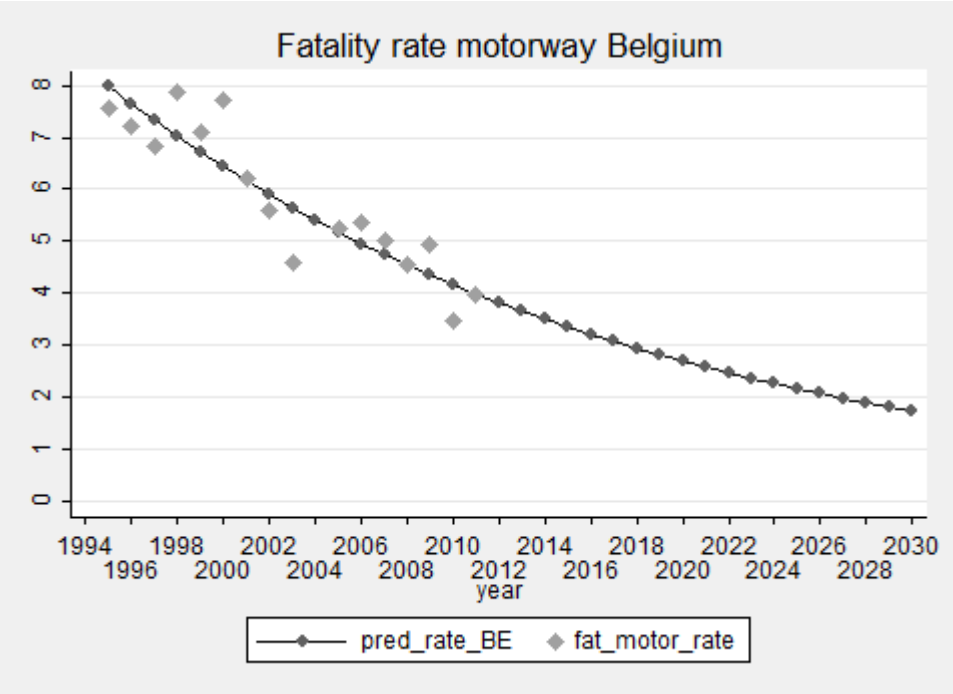
where a and b are the unknown and ε the residual. Taking the log of this generates

$$\log r_f(t) = a_f + b_f t + \varepsilon_f$$
$$\log r_i(t) = a_i + b_i t + \varepsilon_i$$

which is simply a linear regression of the logarithm of the fatality rate on time. We then estimated this relationship– using STATA and corrected for the time dependencies. Given the estimates for a and b, we can then calculate the expected fatality rate as

$$\hat{r}_f(t) = e^{a_f + b_f t + \varepsilon_f} \mu$$
$$\hat{r}_i(t) = e^{a_i + b_i t + \varepsilon_i}$$

This gave us the fatality and seriously injury rate for the different countries and the different road types. Below we show the example of Belgium – further in the text the results for all countries are given:



4) The expected mobility growth is taken from the TREMOVE-PRIMES baseline scenario. More information on this baseline can be found in the report for JRC-IRTS Sevilla (2010), Tremove model version 3.4: set up of a new baseline.

5) The number of accidents is calculated from the results of the previous steps, using equations (1) and (2).

Results

In this section we show the detailed results. For each country we show the statistical results (estimate of the coefficients, significance level of the estimates, R^2) and figures for fatalities and seriously injured on motorways, rural roads and urban roads.

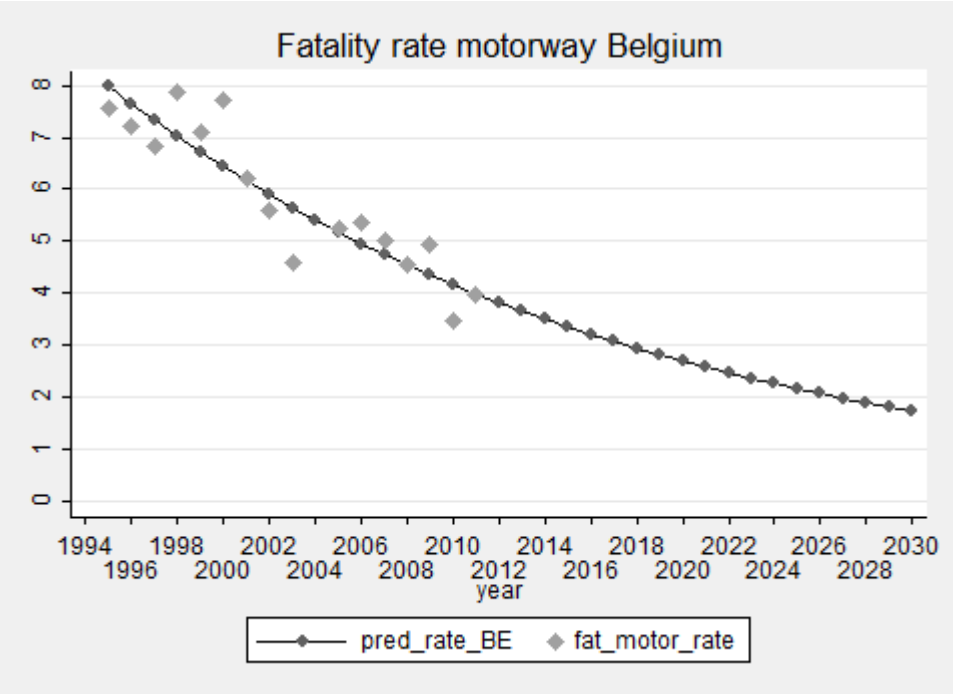
Fatalities, motorways

Belgium

```
. reg ln_fat_motor_rate time if country == "BE"

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  1,    14) =   66.19
       Model |  .770600247     1  .770600247           Prob > F      =  0.0000
    Residual |   .16299052    14   .01164218           R-squared     =  0.8254
-------------+------------------------------           Adj R-squared =  0.8129
       Total |  .933590767    15  .062239384           Root MSE      =   .1079

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0435162   .0053488    -8.14   0.000    -.0549881   -.0320442
       _cons |     2.1225     .05489    38.67   0.000     2.004773    2.240227
```

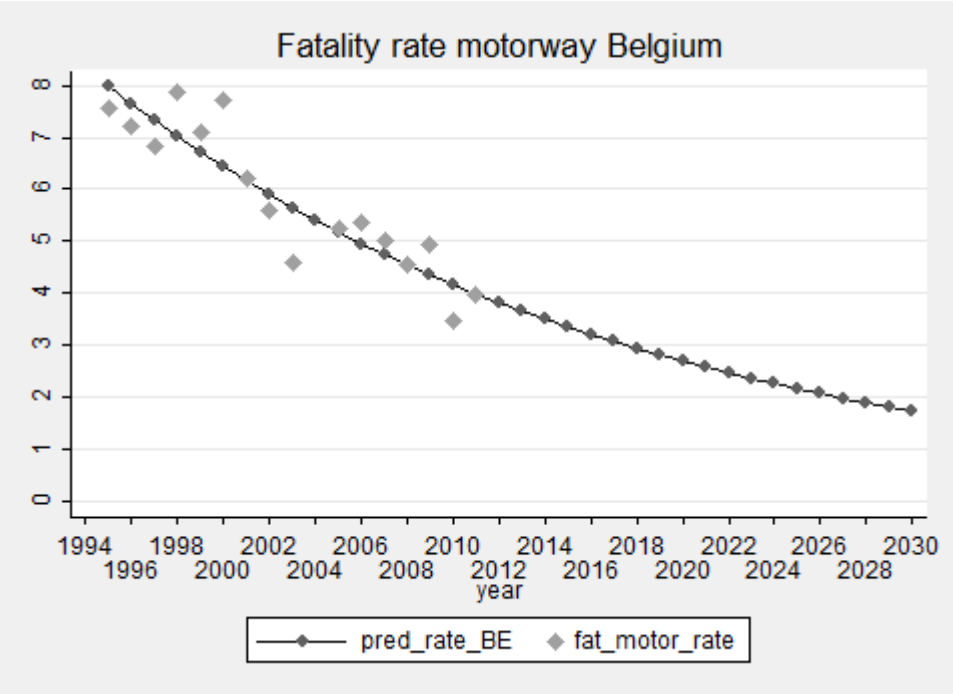


Czech Republic

```
. reg ln_fat_motor_rate time if country == "CZ"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   24.37
       Model |  1.41613276     1  1.41613276           Prob > F      =  0.0001
    Residual |  .929822695    16  .058113918           R-squared     =  0.6036
-------------+------------------------------           Adj R-squared =  0.5789
       Total |  2.34595545    17   .13799738           Root MSE      =  .24107

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0540636    .010952    -4.94   0.000    -.0772808   -.0308464
       _cons |   2.218509   .1185483    18.71   0.000     1.967198    2.46982
------------------------------------------------------------------------------
```

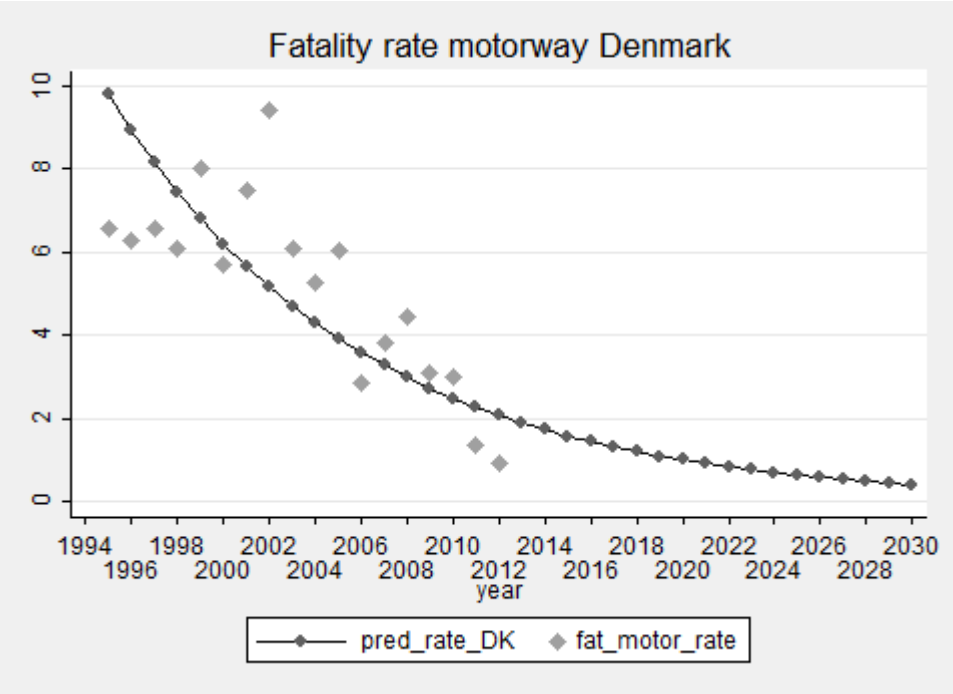


Denmark

```
. reg ln_fat_motor_rate time if country == "DK"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   27.34
       Model |  4.07206148     1  4.07206148            Prob > F      =  0.0001
    Residual |  2.38313101    16  .148945688           R-squared     =  0.6308
-------------+------------------------------           Adj R-squared =  0.6077
       Total |  6.45519249    17  .379717205           Root MSE      =  .38593

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   -.091677   .0175334    -5.23   0.000    -.1288462   -.0545077
       _cons |   2.372427   .1897882    12.50   0.000     1.970094    2.77476
------------------------------------------------------------------------------
```

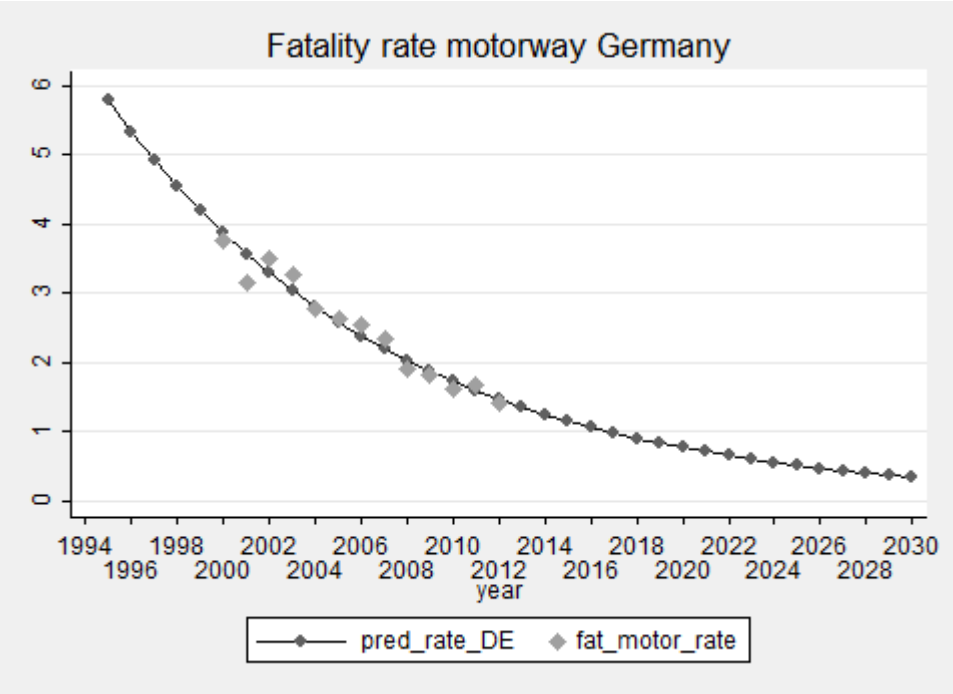


Germany

```
. reg ln_fat_motor_rate time if country == "DE"

      Source |       SS       df       MS              Number of obs =      13
-------------+------------------------------           F(  1,    11) =  286.79
       Model |  1.17820036     1  1.17820036           Prob > F      =  0.0000
    Residual |  .045190112    11  .004108192           R-squared     =  0.9631
-------------+------------------------------           Adj R-squared =  0.9597
       Total |  1.22339047    12  .101949206           Root MSE      =   .0641

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0804589   .0047511   -16.93   0.000    -.0909159   -.0700019
       _cons |   1.835014   .0597198    30.73   0.000     1.703572    1.966456
------------------------------------------------------------------------------
```

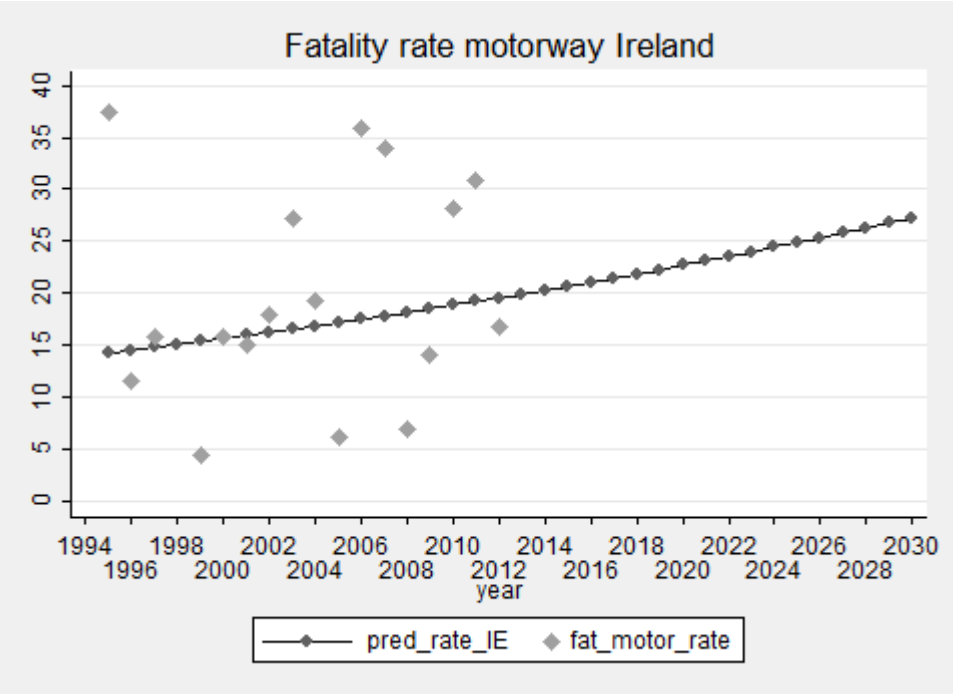


Ireland

```
. reg ln_fat_motor_rate time if country == "IE"

      Source |       SS       df       MS              Number of obs =      17
-------------+------------------------------           F(  1,    15) =    0.37
       Model |  .154899231     1  .154899231            Prob > F      =  0.5519
    Residual |  6.27166764    15  .418111176            R-squared     =  0.0241
-------------+------------------------------           Adj R-squared = -0.0410
       Total |  6.42656687    16  .401660429            Root MSE      =  .64662

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   .0185025   .0303984     0.61   0.552    -.0462902    .0832951
       _cons |   2.640188   .3372957     7.83   0.000     1.921259    3.359117
------------------------------------------------------------------------------
```

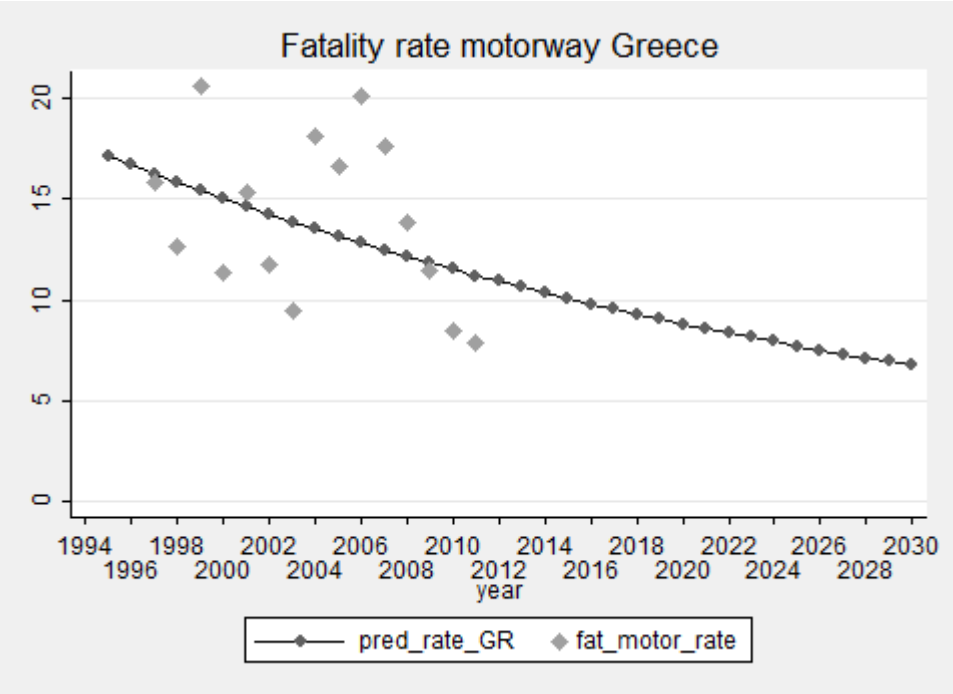


Greece

```
. reg ln_fat_motor_rate time if country == "GR"

      Source |       SS       df       MS              Number of obs =      15
-------------+------------------------------           F(  1,    13) =    2.35
       Model |  .199434209     1  .199434209           Prob > F      =  0.1492
    Residual |  1.10276638    13  .084828183           R-squared     =  0.1532
-------------+------------------------------           Adj R-squared =  0.0880
       Total |  1.30220059    14  .093014328           Root MSE      =  .29125

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0266883   .0174057    -1.53   0.149     -.064291    .0109144
       _cons |   2.869252   .1896075    15.13   0.000      2.45963    3.278874
------------------------------------------------------------------------------
```

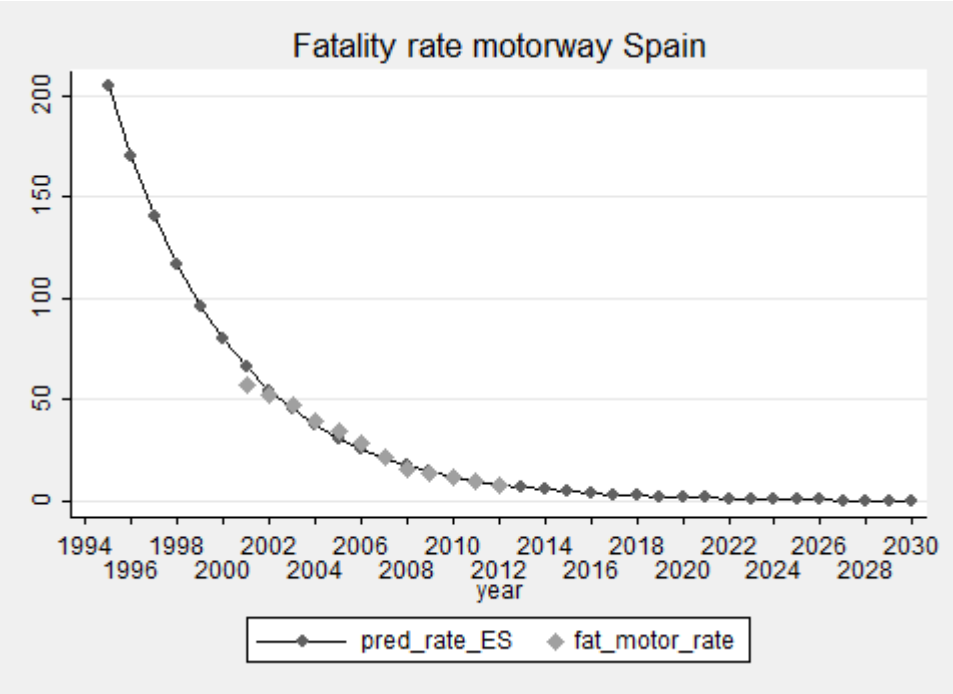


Spain

```
. reg ln_fat_motor_rate time if country == "ES"

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  1,    10) =  837.29
       Model |  5.10232395     1  5.10232395            Prob > F      =  0.0000
    Residual |  .060938505    10   .00609385            R-squared     =  0.9882
-------------+------------------------------           Adj R-squared =  0.9870
       Total |  5.16326246    11  .469387496            Root MSE      =  .07806

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1888931    .006528   -28.94   0.000    -.2034383   -.1743478
       _cons |   5.513115   .0846541    65.13   0.000     5.324493    5.701736
------------------------------------------------------------------------------
```

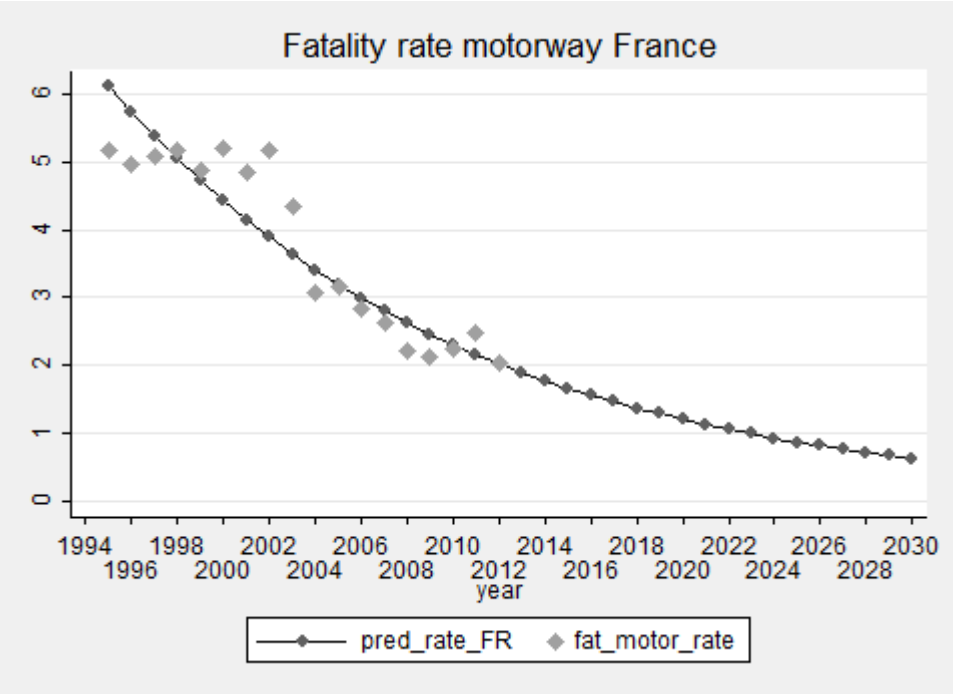


France

```
.
. reg ln_fat_motor_rate time if country == "FR"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  106.75
       Model |  2.05023352     1  2.05023352           Prob > F      =  0.0000
    Residual |  .307306243    16   .01920664           R-squared     =  0.8696
-------------+------------------------------           Adj R-squared =  0.8615
       Total |  2.35753976    17   .13867881           Root MSE      =  .13859

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0650511   .0062962   -10.33   0.000    -.0783985   -.0517038
       _cons |   1.878036   .0681524    27.56   0.000     1.733559    2.022513
------------------------------------------------------------------------------
```

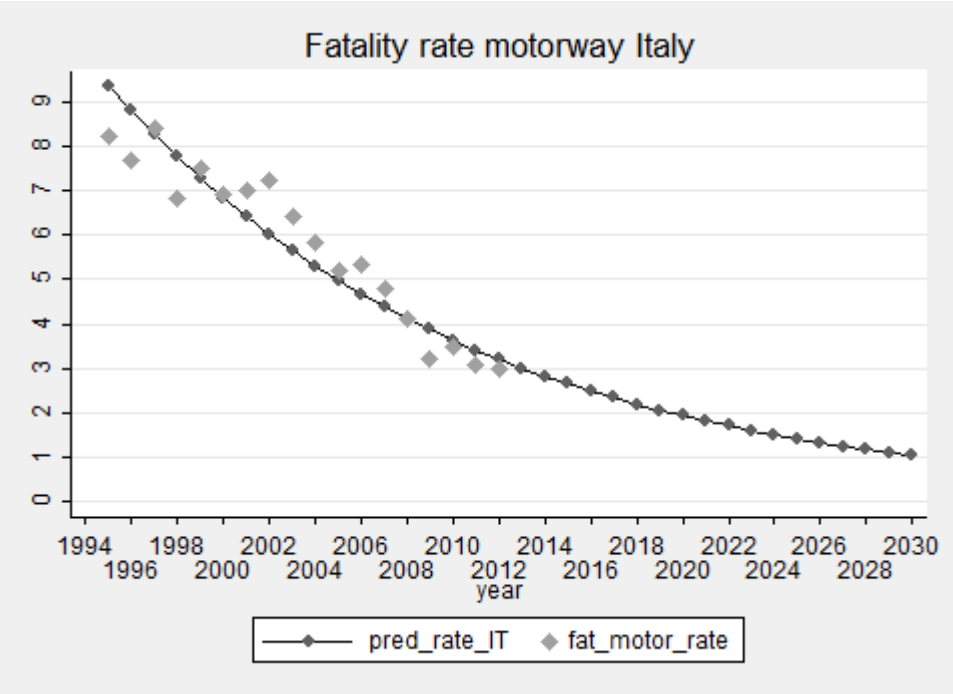


Italy

```
. reg ln_fat_motor_rate time if country == "IT"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  157.58
       Model |  1.93573895     1  1.93573895            Prob > F      =  0.0000
    Residual |  .196542653    16  .012283916           R-squared     =  0.9078
-------------+------------------------------           Adj R-squared =  0.9021
       Total |  2.13228161    17   .12542833           Root MSE      =  .11083

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0632086   .0050353   -12.55   0.000    -.0738829   -.0525344
       _cons |   2.301937   .0545034    42.23   0.000     2.186395    2.417479
------------------------------------------------------------------------------
```

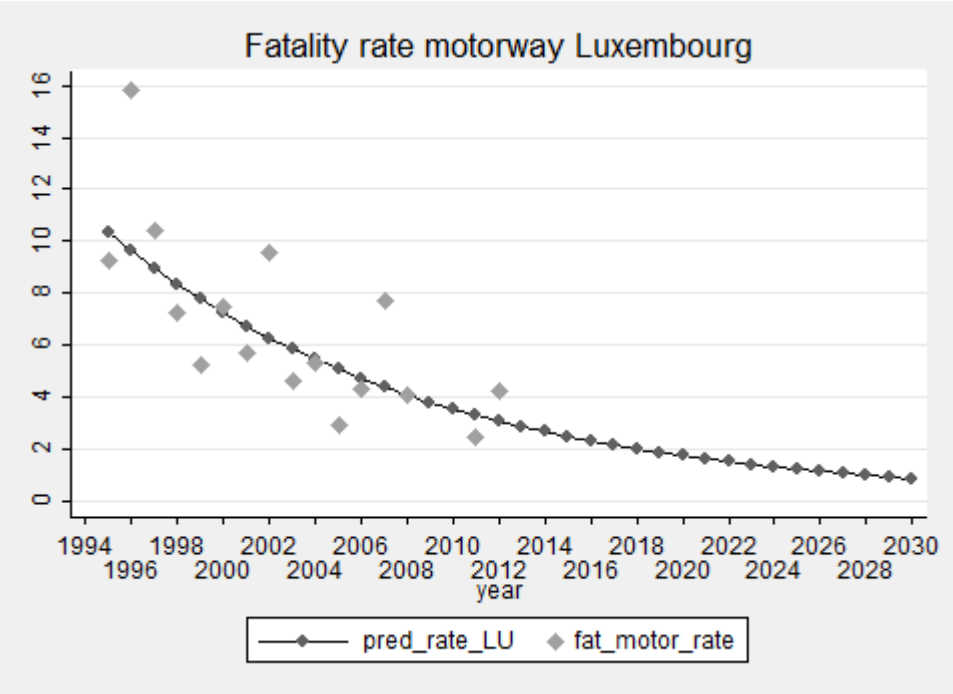


Luxemburg

```
. reg ln_fat_motor_rate time if country == "LU"

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  1,    14) =   18.77
       Model |  2.03466629     1  2.03466629            Prob > F      =  0.0007
    Residual |  1.51748565    14  .108391832           R-squared     =  0.5728
-------------+------------------------------           Adj R-squared =  0.5423
       Total |  3.55215194    15   .23681013           Root MSE      =  .32923

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0710549   .0164001    -4.33   0.001    -.1062296   -.0358803
       _cons |   2.404861   .1654295    14.54   0.000      2.05005    2.759672
------------------------------------------------------------------------------
```

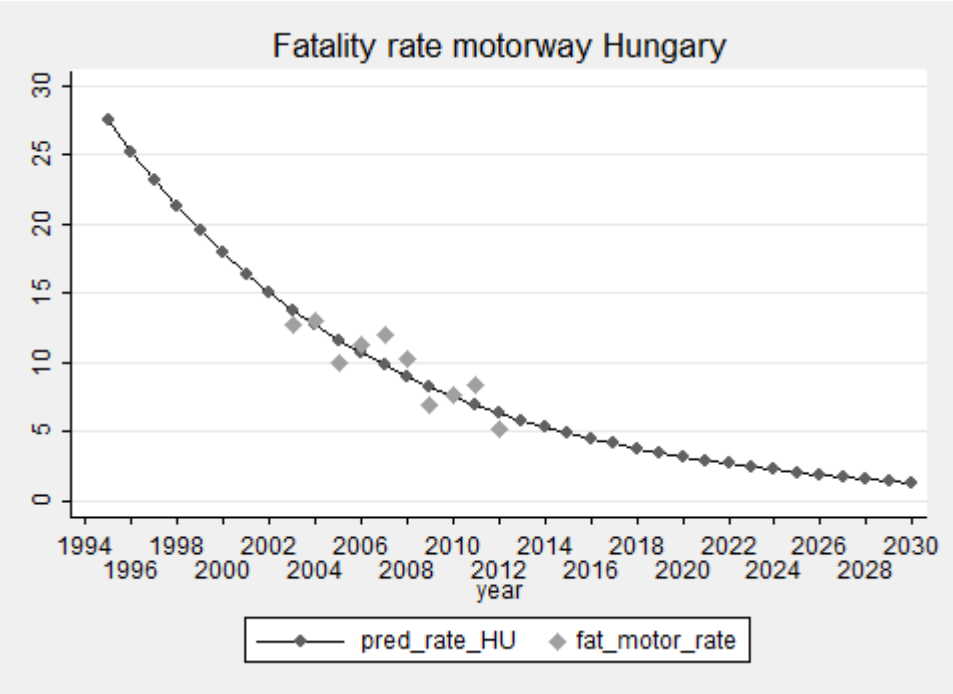


Hungary

```
. reg ln_fat_motor_rate time if country == "HU"

      Source |       SS       df       MS              Number of obs =      10
-------------+------------------------------           F(  1,     8) =   23.88
       Model |  .607938845     1  .607938845           Prob > F      =  0.0012
    Residual |  .203646846     8  .025455856           R-squared     =  0.7491
-------------+------------------------------           Adj R-squared =  0.7177
       Total |  .811585691     9  .090176188           Root MSE      =  .15955

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0858426   .0175658    -4.89   0.001    -.1263493   -.0453359
       _cons |   3.398149   .2424456    14.02   0.000     2.839069    3.95723
------------------------------------------------------------------------------
```

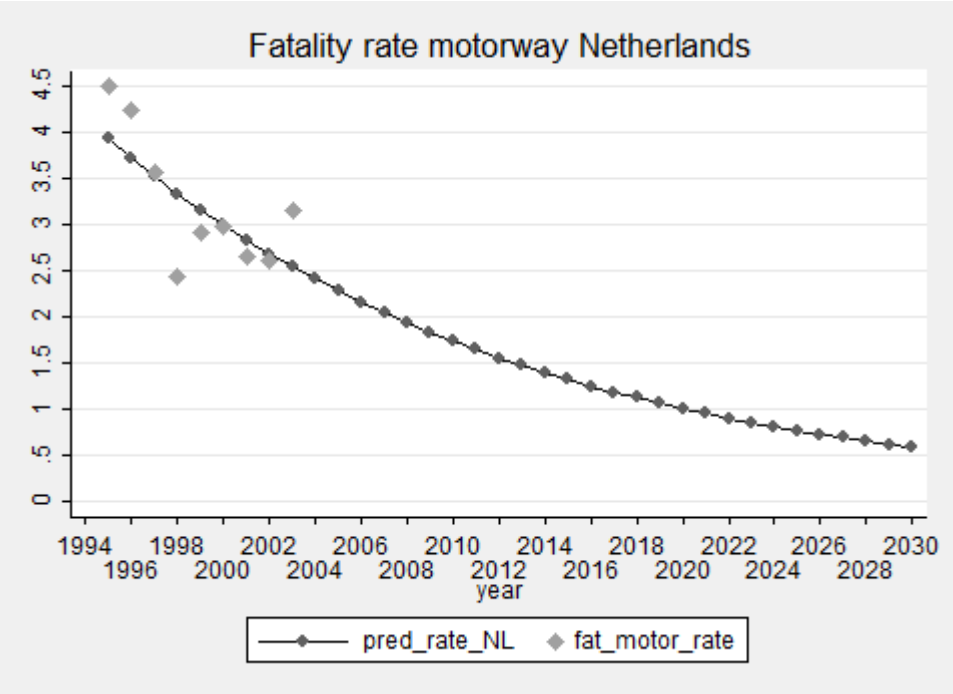


The Netherlands

```
. reg ln_fat_motor_rate time if country == "NL"

      Source |       SS       df       MS              Number of obs =       9
-------------+------------------------------           F(  1,     7) =    6.33
       Model |  .178625149     1  .178625149           Prob > F      =  0.0400
    Residual |   .19742871     7  .028204101           R-squared     =  0.4750
-------------+------------------------------           Adj R-squared =  0.4000
       Total |  .376053859     8  .047006732           Root MSE      =  .16794

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0545627   .0216811    -2.52   0.040    -.1058302   -.0032951
       _cons |   1.421423   .1220061    11.65   0.000     1.132924    1.709921
------------------------------------------------------------------------------
```

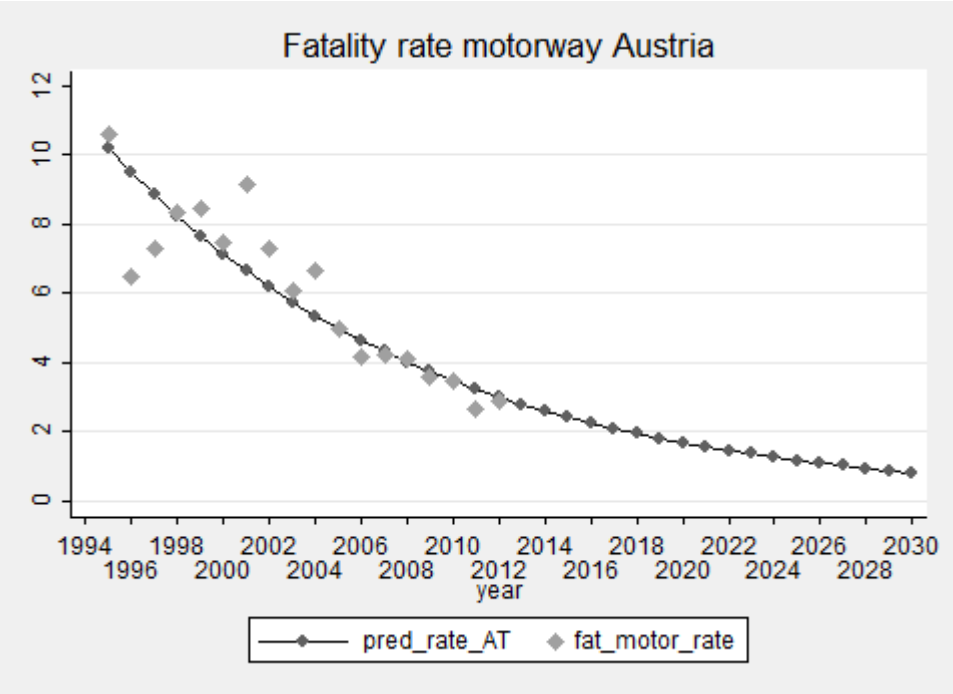


Austria

```
. reg ln_fat_motor_rate time if country == "AT"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   94.71
       Model |   2.4997093     1   2.4997093           Prob > F      =  0.0000
    Residual |  .422300044    16  .026393753           R-squared     =  0.8555
-------------+------------------------------           Adj R-squared =  0.8464
       Total |  2.92200935    17  .171882903           Root MSE      =  .16246

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0718287   .0073808    -9.73   0.000    -.0874753   -.0561821
       _cons |   2.394916   .0798924    29.98   0.000     2.225552    2.56428
------------------------------------------------------------------------------
```

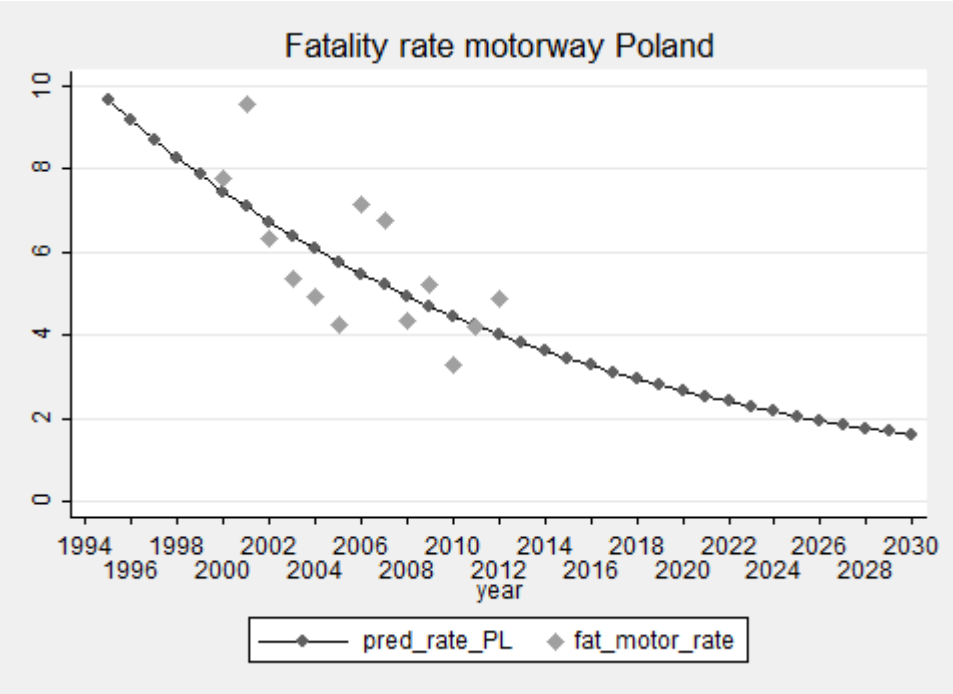


Poland

```
. reg ln_fat_motor_rate time if country == "PL"

      Source |       SS       df       MS              Number of obs =      13
-------------+------------------------------           F(  1,    11) =    9.59
       Model |  .485692913     1  .485692913            Prob > F      =  0.0102
    Residual |  .557195422    11  .050654129            R-squared     =  0.4657
-------------+------------------------------           Adj R-squared =  0.4171
       Total |  1.04288833    12  .086907361            Root MSE      =  .22506

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0516589   .0166829    -3.10   0.010    -.0883777   -.0149401
       _cons |    2.31781   .2097009    11.05   0.000     1.856262    2.779359
------------------------------------------------------------------------------
```

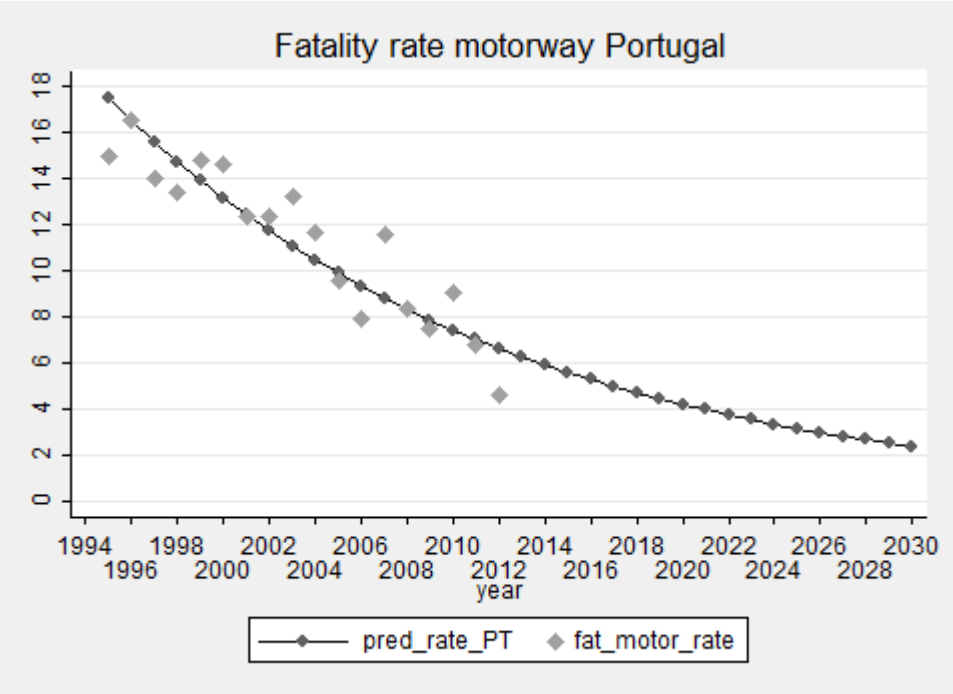


Portugal

```
. reg ln_fat_motor_rate time if country == "PT"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   66.20
       Model |  1.57126683     1  1.57126683            Prob > F      =  0.0000
    Residual |  .379752054    16  .023734503           R-squared     =  0.8054
-------------+------------------------------           Adj R-squared =  0.7932
       Total |  1.95101888    17  .114765816           Root MSE      =  .15406

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0569479   .0069991    -8.14   0.000    -.0717854   -.0421105
       _cons |   2.913971   .0757609    38.46   0.000     2.753365    3.074577
------------------------------------------------------------------------------
```

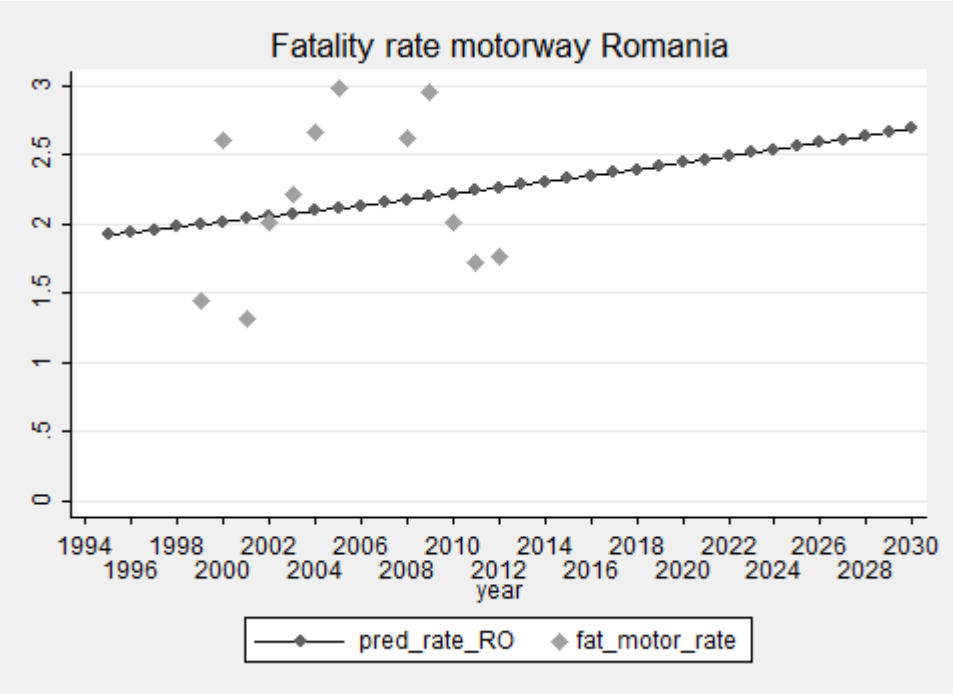


Romania

```
.
. reg ln_fat_motor_rate time if country == "RO"

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  1,    10) =    0.26
       Model |  .020592818     1  .020592818           Prob > F      =  0.6234
    Residual |  .802249226    10  .080224923           R-squared     =  0.0250
-------------+------------------------------           Adj R-squared = -0.0725
       Total |  .822842044    11  .074803822           Root MSE      =  .28324

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   .0095739   .0188967     0.51   0.623    -.0325305    .0516783
       _cons |   .6425955   .2292398     2.80   0.019     .1318173    1.153374
------------------------------------------------------------------------------
```

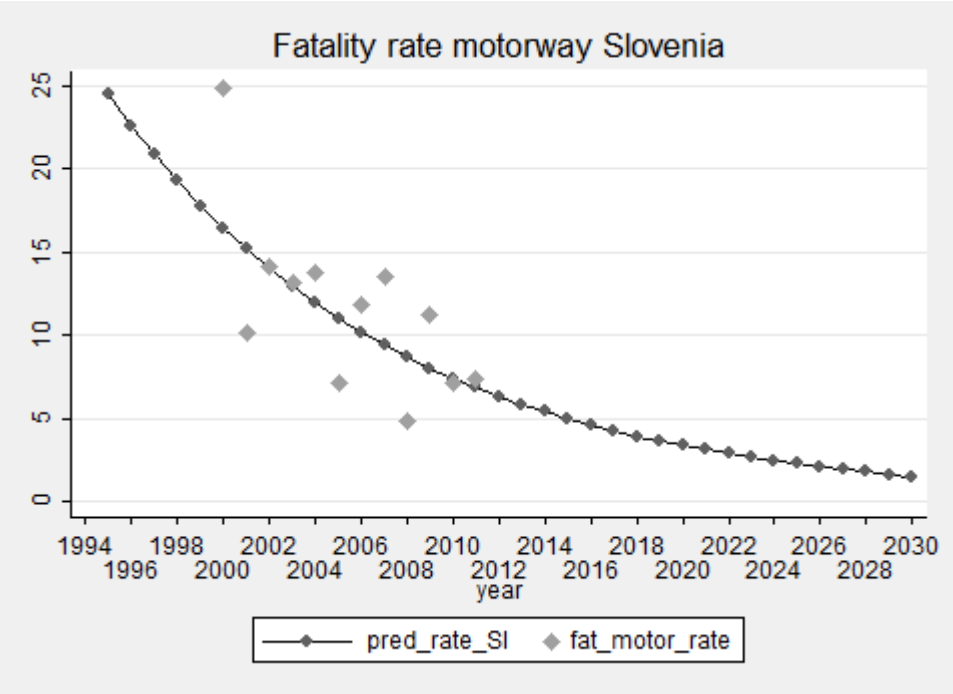


Slovenia

```
.
. reg ln_fat_motor_rate time if country == "SI"

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  1,    10) =    7.72
       Model |  .908970165     1  .908970165           Prob > F      =  0.0195
    Residual |  1.17799124    10  .117799124           R-squared     =  0.4355
-------------+------------------------------           Adj R-squared =  0.3791
       Total |  2.08696141    11  .189723764           Root MSE      =  .34322

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0797273   .0287014    -2.78   0.020    -.1436779   -.0157766
       _cons |   3.276507    .344616     9.51   0.000     2.508654    4.044359
------------------------------------------------------------------------------
```

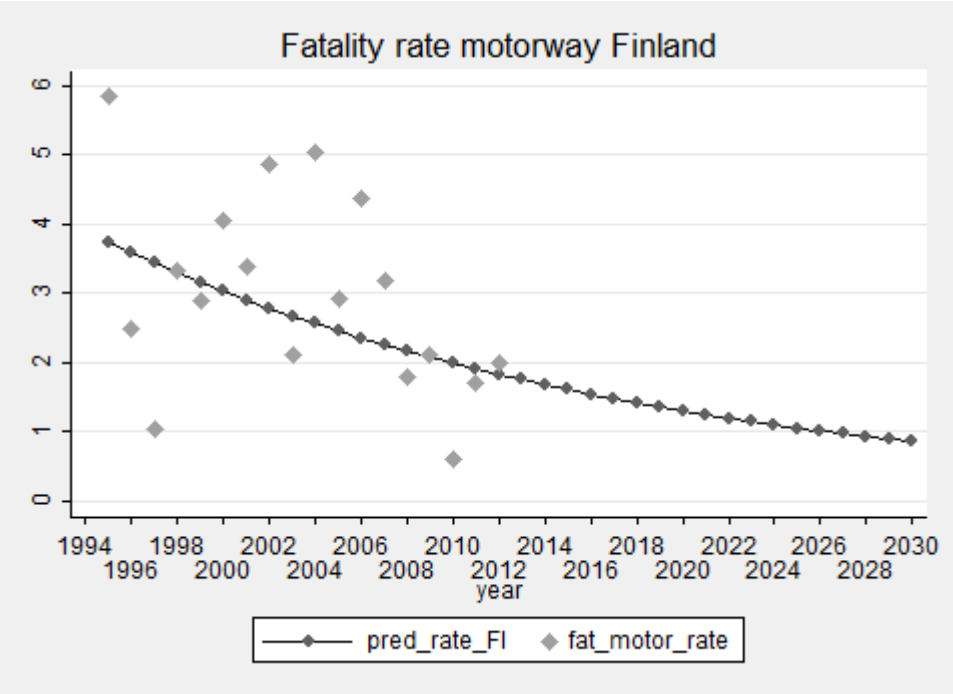


Finland

```
. reg ln_fat_motor_rate time if country == "FI"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =    2.96
       Model |  .863944769     1  .863944769            Prob > F      =  0.1044
    Residual |  4.66467955    16  .291542472            R-squared     =  0.1563
-------------+------------------------------           Adj R-squared =  0.1035
       Total |  5.52862432    17  .325213195            Root MSE      =  .53995

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0422276   .0245304    -1.72   0.104    -.0942296    .0097745
       _cons |   1.362639   .2655254     5.13   0.000     .7997506    1.925528
------------------------------------------------------------------------------
```

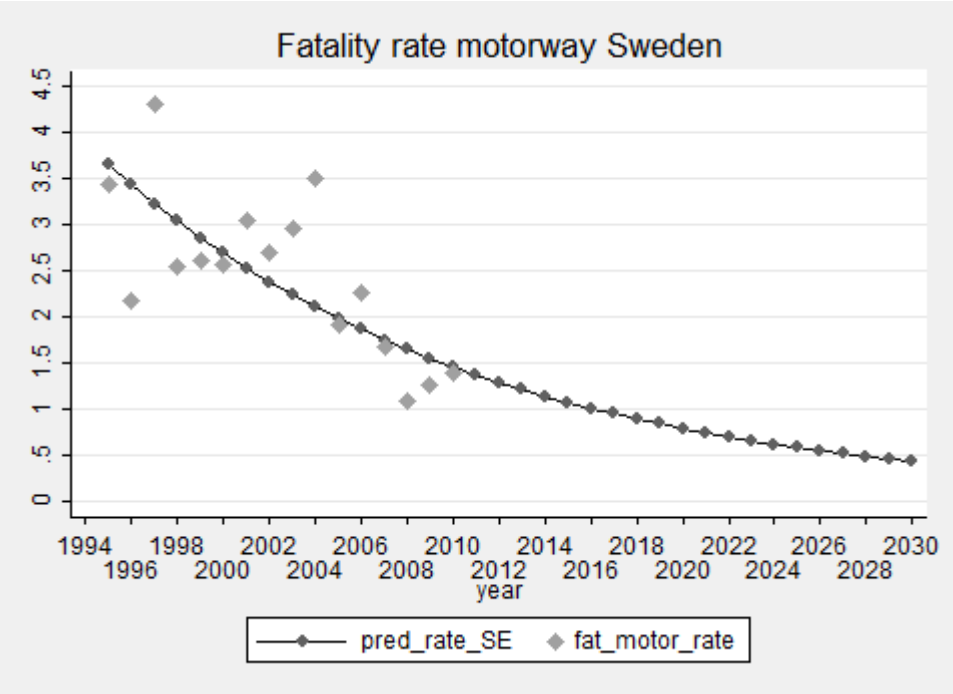


Sweden

```
. reg ln_fat_motor_rate time if country == "SE"

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  1,    14) =   18.20
       Model |  1.27618241     1  1.27618241            Prob > F      =  0.0008
    Residual |  .981887069    14  .070134791           R-squared     =  0.5652
-------------+------------------------------           Adj R-squared =  0.5341
       Total |  2.25806948    15  .150537965           Root MSE      =  .26483

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0612656   .0143624    -4.27   0.001    -.0920699   -.0304613
       _cons |   1.353327   .1388779     9.74   0.000     1.055463    1.65119
------------------------------------------------------------------------------
```

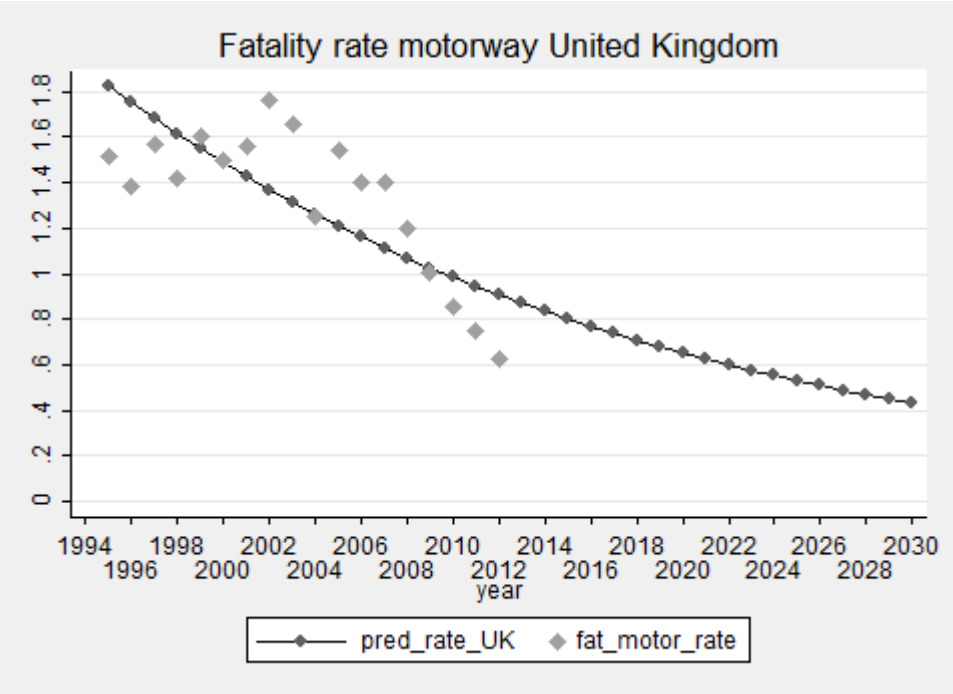


UK

```
.
. reg ln_fat_motor_rate time if country == "UK"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   21.79
       Model |   .82568847     1   .82568847           Prob > F      =  0.0003
    Residual |  .606319845    16   .03789499           R-squared     =  0.5766
-------------+------------------------------           Adj R-squared =  0.5501
       Total |  1.43200832    17  .084235783           Root MSE      =  .19467

------------------------------------------------------------------------------
ln_fat_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   -.041282   .0088439    -4.67   0.000    -.0600303   -.0225338
       _cons |   .6446158   .0957296     6.73   0.000     .4416782    .8475534
------------------------------------------------------------------------------
```



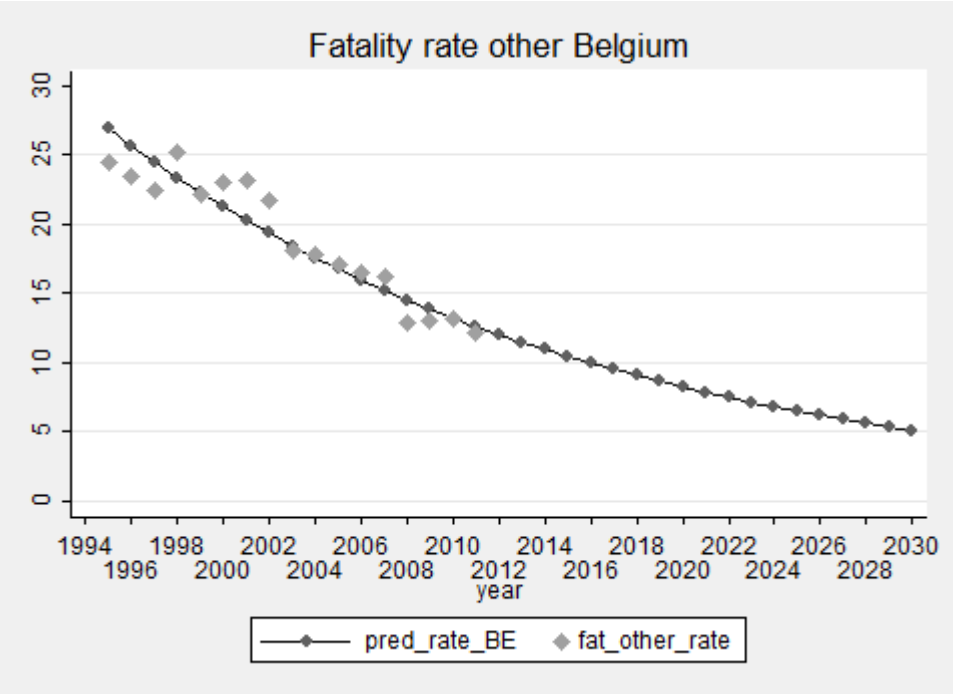
Fatalities, rural roads;

Belgium

```
. reg ln_fat_other_rate time if country == "BE"

      Source |       SS       df       MS              Number of obs =      17
-------------+------------------------------           F(  1,    15) =  148.43
       Model |  .917423695     1  .917423695           Prob > F      =  0.0000
    Residual |  .092713106    15  .006180874           R-squared     =  0.9082
-------------+------------------------------           Adj R-squared =  0.9021
       Total |   1.0101368    16   .06313355           Root MSE      =  .07862

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0474193   .0038922   -12.18   0.000    -.0557153   -.0391233
       _cons |   3.340128   .0398832    83.75   0.000     3.255119    3.425137
------------------------------------------------------------------------------
```

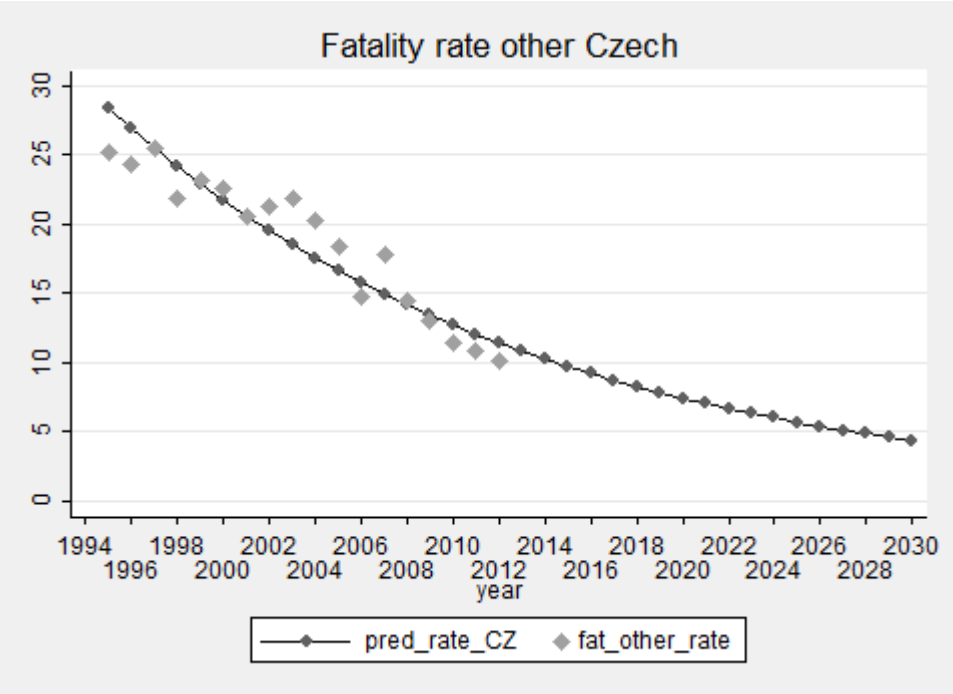


Czech Republic

```
. reg ln_fat_other_rate time if country == "CZ"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  124.82
       Model |  1.38578531     1  1.38578531            Prob > F      =  0.0000
    Residual |  .177641642    16  .011102603           R-squared     =  0.8864
-------------+------------------------------           Adj R-squared =  0.8793
       Total |  1.56342696    17  .091966292           Root MSE      =  .10537

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0534812    .004787   -11.17   0.000    -.0636292   -.0433332
       _cons |   3.397385   .0518164    65.57   0.000     3.287539    3.507231
------------------------------------------------------------------------------
```

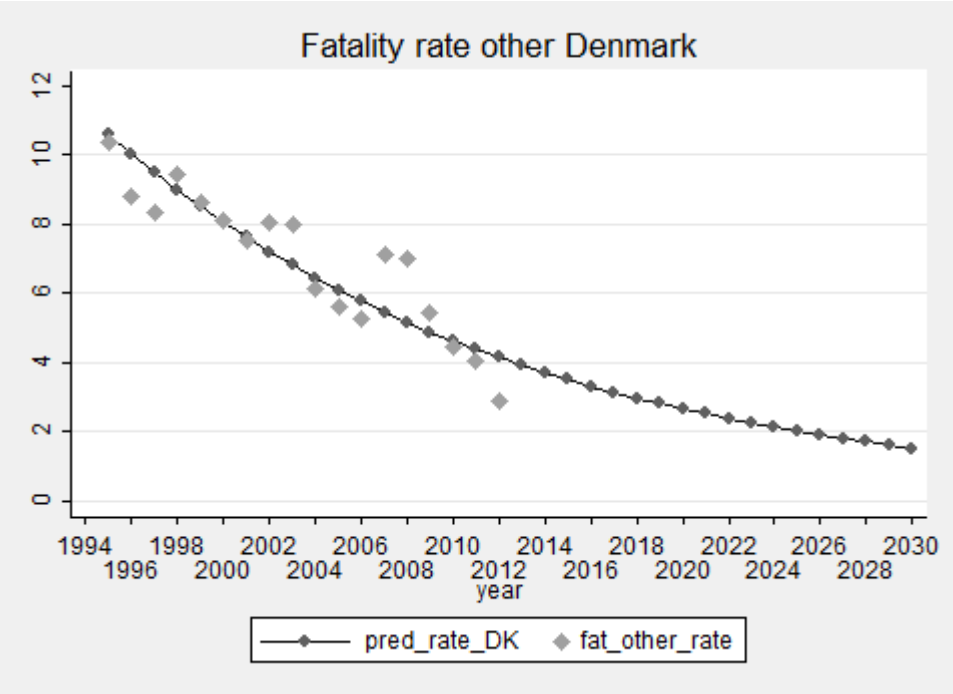


Denmark

```
.
. reg ln_fat_other_rate time if country == "DK"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   58.08
       Model |  1.48185638     1  1.48185638           Prob > F      =  0.0000
    Residual |  .408255584    16  .025515974           R-squared     =  0.7840
-------------+------------------------------           Adj R-squared =  0.7705
       Total |  1.89011196    17  .111183057           Root MSE      =  .15974

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   -.055304    .007257    -7.62   0.000    -.0706882   -.0399197
       _cons |   2.416622   .0785527    30.76   0.000     2.250097    2.583146
------------------------------------------------------------------------------
```

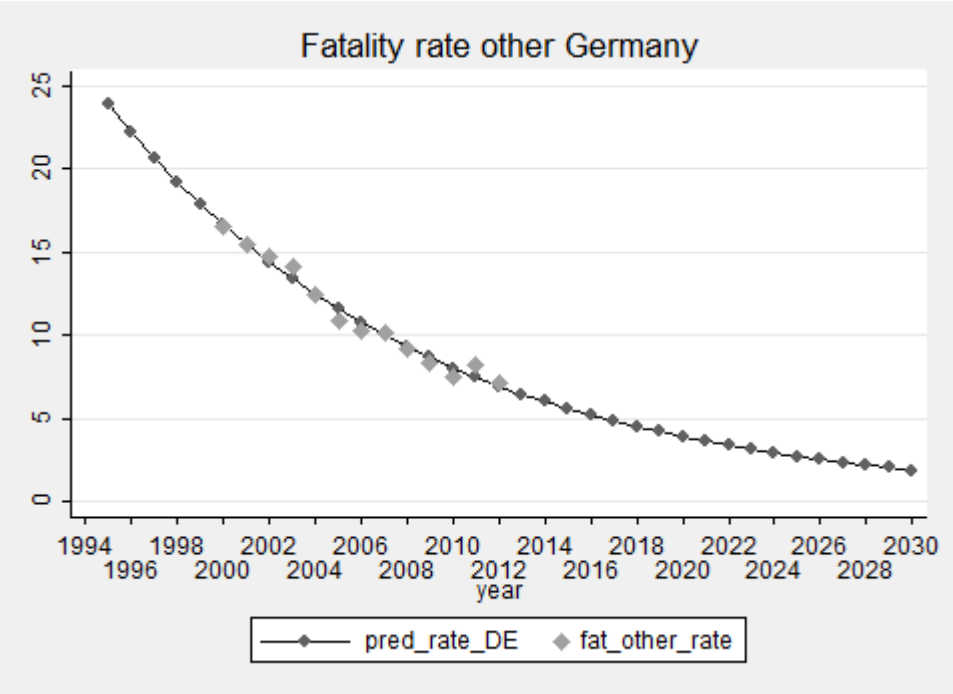


Germany

```
. reg ln_fat_other_rate time if country == "DE"

      Source |       SS       df       MS              Number of obs =      13
-------------+------------------------------           F(  1,    11) =  424.87
       Model |  .964217794     1  .964217794            Prob > F      =  0.0000
    Residual |   .02496404    11  .002269458            R-squared     =  0.9748
-------------+------------------------------           Adj R-squared =  0.9725
       Total |  .989181834    12   .08243182            Root MSE      =  .04764

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0727867   .0035312   -20.61   0.000    -.0805588   -.0650145
       _cons |   3.245972   .0443868    73.13   0.000     3.148278    3.343667
------------------------------------------------------------------------------
```

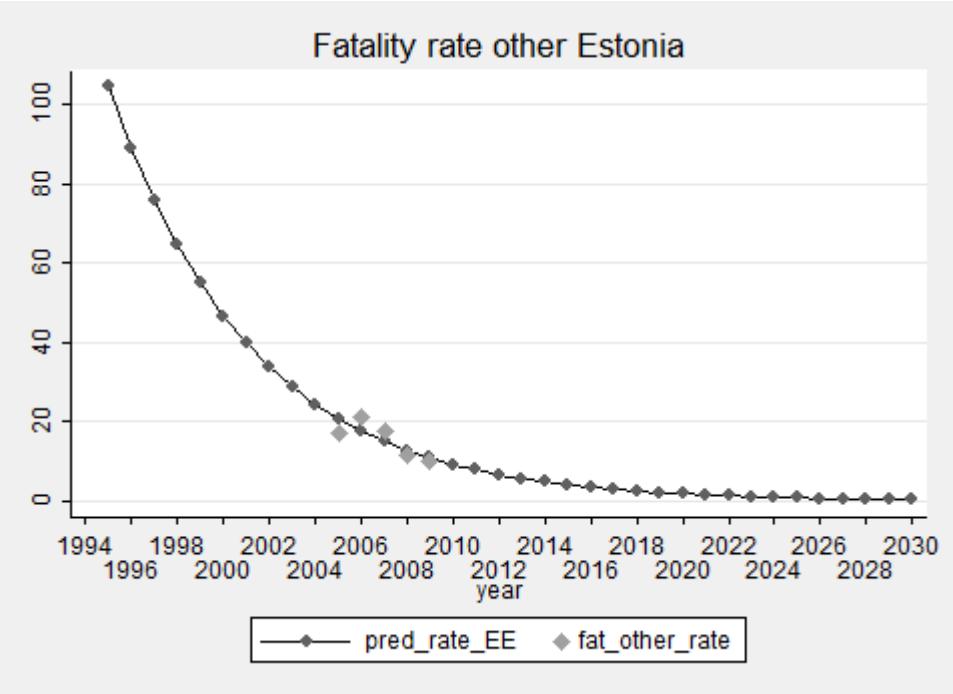


Estonia

```
. reg ln_fat_other_rate time if country == "EE"

      Source |       SS       df       MS              Number of obs =       5
-------------+------------------------------           F(  1,     3) =    7.10
       Model |   .26150101     1   .26150101           Prob > F      =  0.0760
    Residual |  .110475269     3   .03682509           R-squared     =  0.7030
-------------+------------------------------           Adj R-squared =  0.6040
       Total |  .371976279     4   .09299407           Root MSE      =   .1919

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1617099   .0606837    -2.66   0.076    -.3548325    .0314126
       _cons |   4.815771   .7935421     6.07   0.009     2.290365    7.341176
------------------------------------------------------------------------------
```

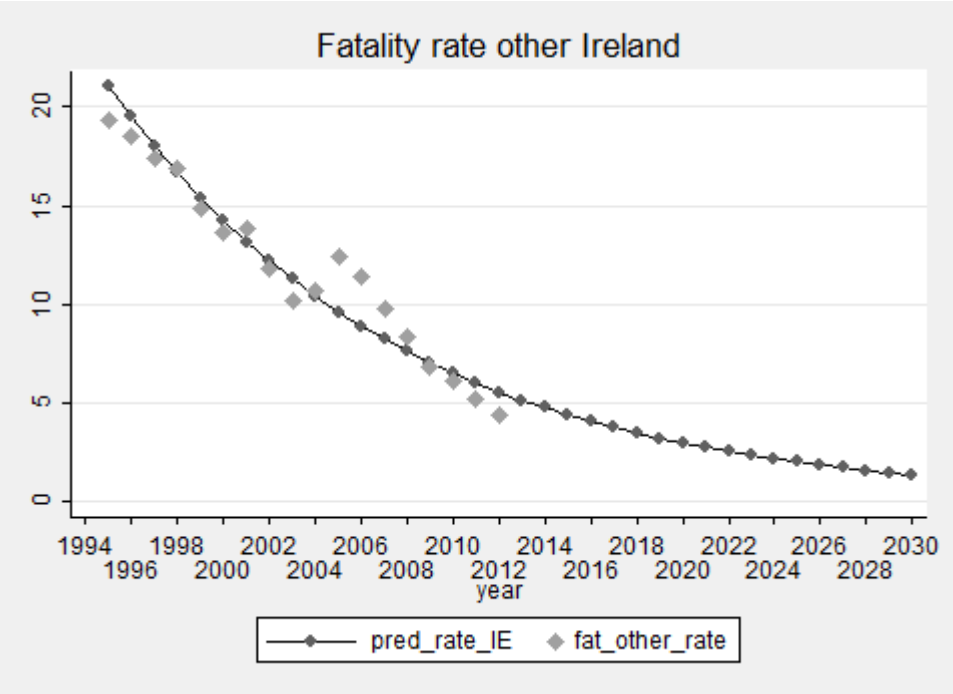


Ireland

```
.
. reg ln_fat_other_rate time if country == "IE"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  175.36
       Model |  2.99423546     1  2.99423546           Prob > F      =  0.0000
    Residual |  .273196896    16  .017074806           R-squared     =  0.9164
-------------+------------------------------           Adj R-squared =  0.9112
       Total |  3.26743236    17  .192201903           Root MSE      =  .13067

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0786133   .0059365   -13.24   0.000    -.0911981   -.0660285
       _cons |   3.128413   .0642589    48.68   0.000     2.992191    3.264636
------------------------------------------------------------------------------
```

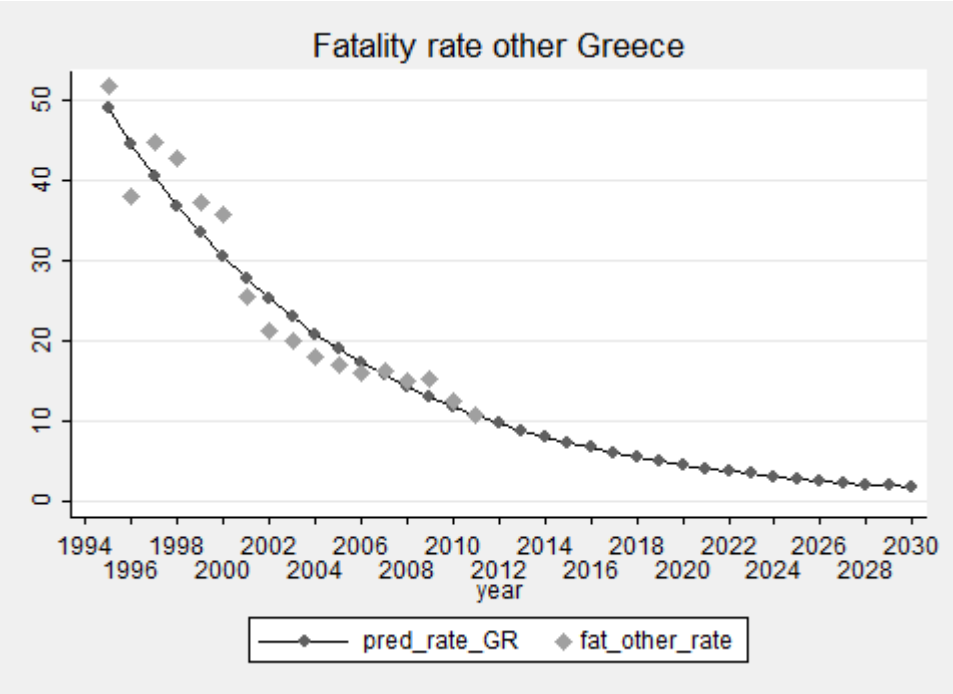


Greece

```
. reg ln_fat_other_rate time if country == "GR"

      Source |       SS       df       MS              Number of obs =      17
-------------+------------------------------           F(  1,    15) =  248.47
       Model |  3.69812179     1  3.69812179            Prob > F      =  0.0000
    Residual |  .223252136    15  .014883476           R-squared     =  0.9431
-------------+------------------------------           Adj R-squared =  0.9393
       Total |  3.92137393    16  .245085871           Root MSE      =    .122

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0952052   .0060398   -15.76   0.000    -.1080787   -.0823317
       _cons |   3.985669   .0618895    64.40   0.000     3.853755    4.117583
------------------------------------------------------------------------------
```

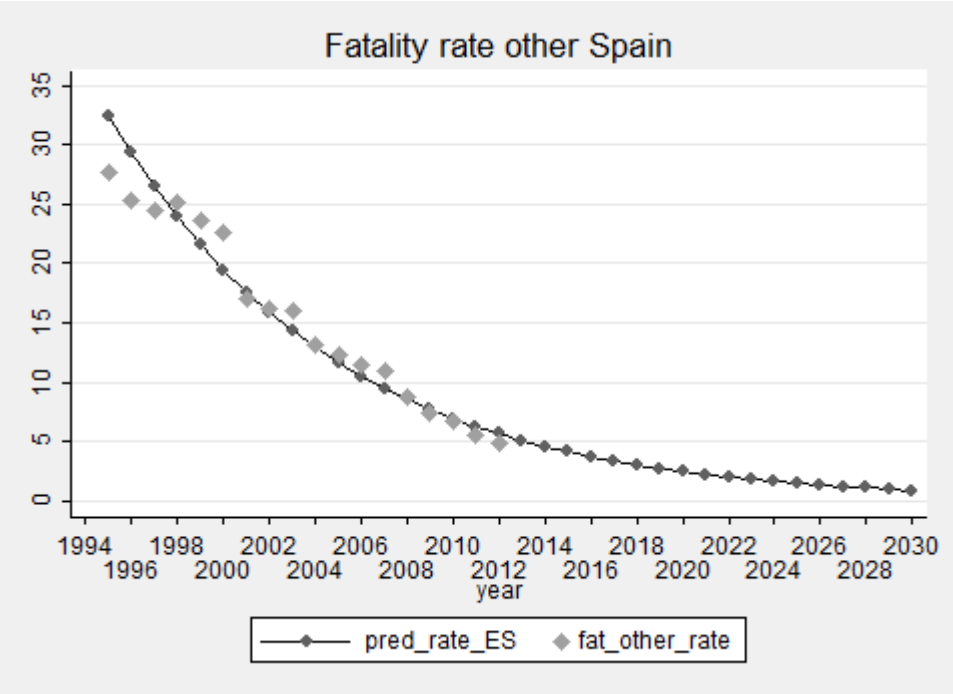


Spain

```
. reg ln_fat_other_rate time if country == "ES"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  473.33
       Model |  5.08692637     1  5.08692637           Prob > F      =  0.0000
    Residual |   .17195472    16   .01074717           R-squared     =  0.9673
-------------+------------------------------           Adj R-squared =  0.9653
       Total |  5.25888109    17  .309345946           Root MSE      =  .10367

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1024662   .0047098   -21.76   0.000    -.1124505    -.092482
       _cons |   3.582867   .0509803    70.28   0.000     3.474794    3.690941
------------------------------------------------------------------------------
```

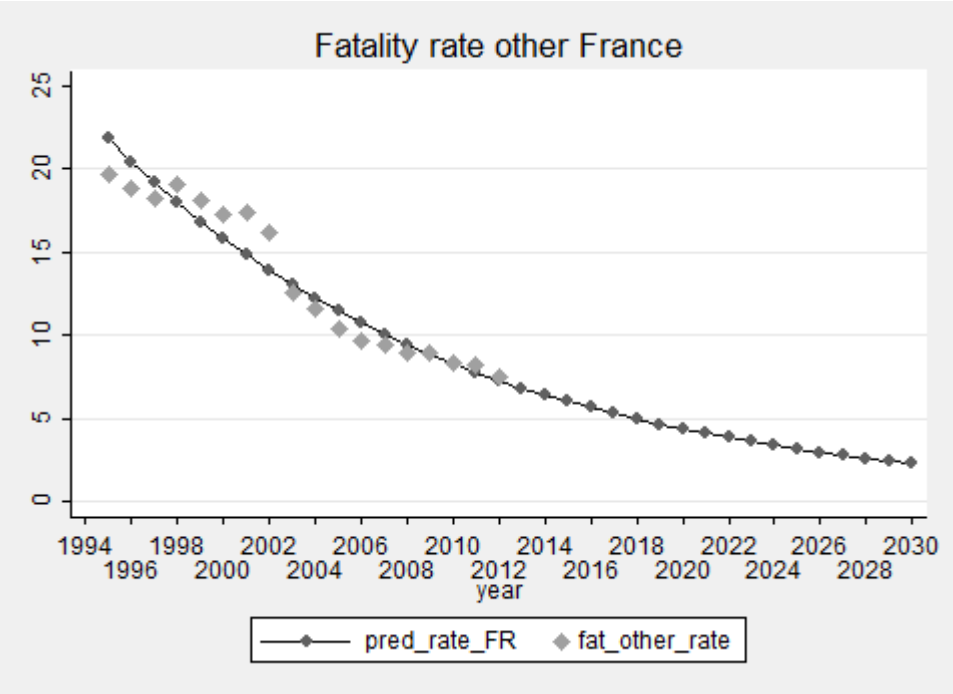


France

```
. reg ln_fat_other_rate time if country == "FR"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  264.41
       Model |   2.0190887     1   2.0190887           Prob > F      =  0.0000
    Residual |  .122178968    16  .007636185           R-squared     =  0.9429
-------------+------------------------------           Adj R-squared =  0.9394
       Total |  2.14126766    17  .125956921           Root MSE      =  .08739

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0645551     .00397   -16.26   0.000    -.0729712   -.0561391
       _cons |   3.144826   .0429728    73.18   0.000     3.053728    3.235924
------------------------------------------------------------------------------
```

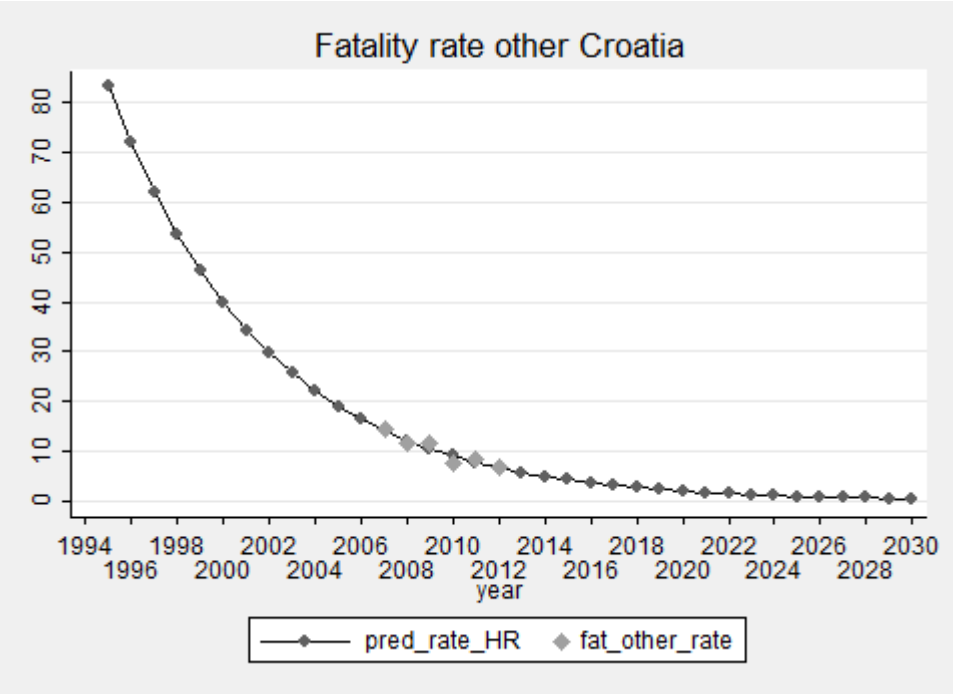


Croatia

```
.
. reg ln_fat_other_rate time if country == "HR"

      Source |       SS       df       MS              Number of obs =       6
-------------+------------------------------           F(  1,     4) =   32.70
       Model |  .382602982     1  .382602982           Prob > F      =  0.0046
    Residual |  .046804213     4  .011701053           R-squared     =  0.8910
-------------+------------------------------           Adj R-squared =  0.8638
       Total |  .429407195     5  .085881439           Root MSE      =  .10817

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1478615   .0258579    -5.72   0.005    -.2196546   -.0760684
       _cons |   4.571406   .4032232    11.34   0.000     3.451879    5.690933
------------------------------------------------------------------------------
```

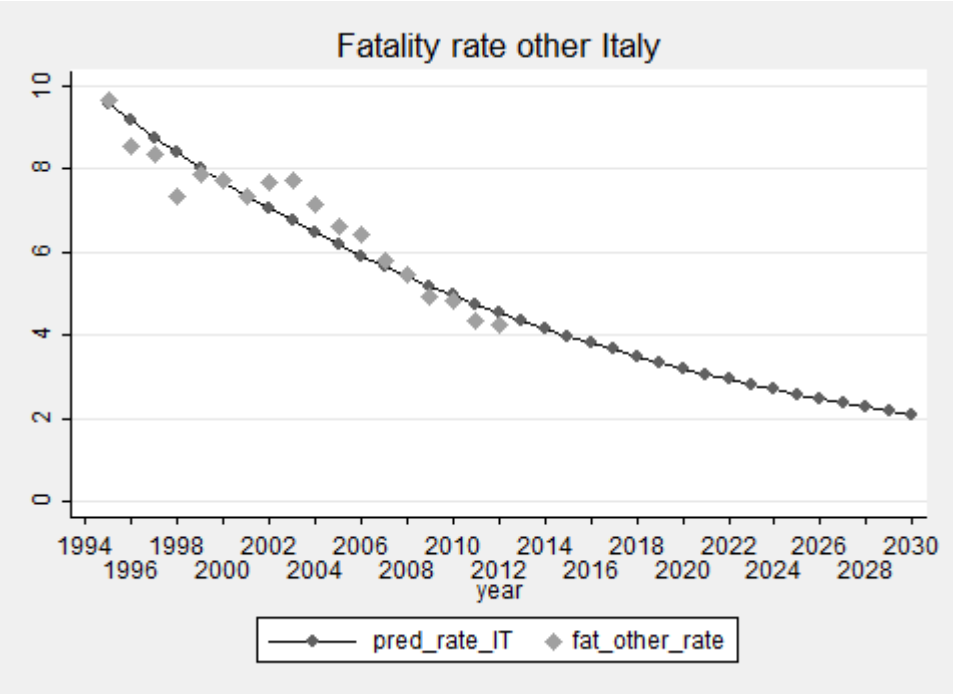


Italy

```
.
. reg ln_fat_other_rate time if country == "IT"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  166.39
       Model |  .928951095     1  .928951095           Prob > F      =  0.0000
    Residual |  .089327097    16  .005582944           R-squared     =  0.9123
-------------+------------------------------           Adj R-squared =  0.9068
       Total |  1.01827819    17  .059898717           Root MSE      =  .07472

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0437874   .0033946   -12.90   0.000    -.0509836   -.0365913
       _cons |   2.300174    .036744    62.60   0.000      2.22228    2.378068
------------------------------------------------------------------------------
```

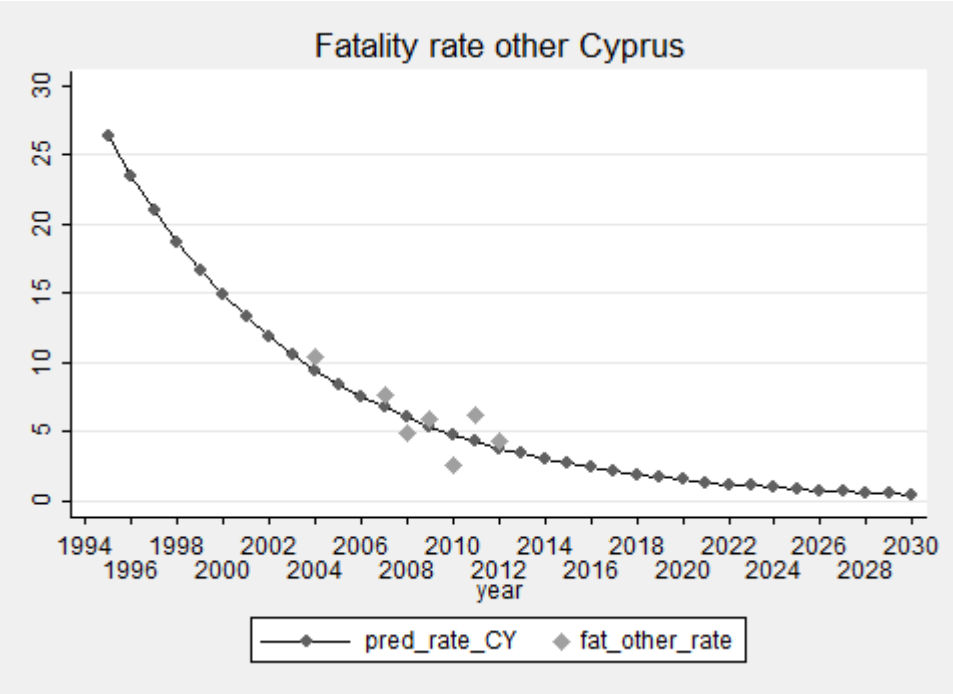


Cyprus.

```
. reg ln_fat_other_rate time if country == "CY"

      Source |       SS       df       MS              Number of obs =       7
-------------+------------------------------           F(  1,     5) =    4.77
       Model |  .560409363     1  .560409363           Prob > F      =  0.0806
    Residual |  .586966446     5  .117393289           R-squared     =  0.4884
-------------+------------------------------           Adj R-squared =  0.3861
       Total |  1.14737581     6  .191229302           Root MSE      =  .34263

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1135965   .0519917    -2.18   0.081    -.2472454    .0200524
       _cons |   3.383736   .7759038     4.36   0.007     1.389211     5.37826
------------------------------------------------------------------------------
```

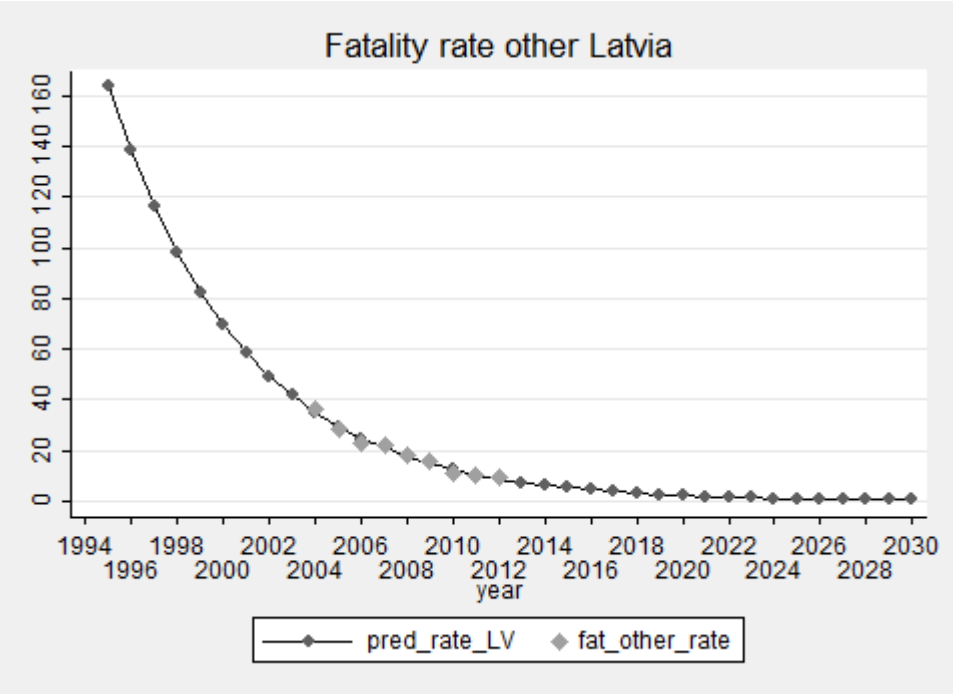


Latvia

```
. reg ln_fat_other_rate time if country == "LV"

      Source |       SS       df       MS              Number of obs =       9
-------------+------------------------------           F(  1,     7) =  405.19
       Model |  1.76319733     1  1.76319733           Prob > F      =  0.0000
    Residual |  .030460499     7    .0043515           R-squared     =  0.9830
-------------+------------------------------           Adj R-squared =  0.9806
       Total |  1.79365783     8  .224207229           Root MSE      =  .06597

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1714253   .0085162   -20.13   0.000    -.1915628   -.1512877
       _cons |   5.272731    .121237    43.49   0.000     4.986052    5.559411
------------------------------------------------------------------------------
```

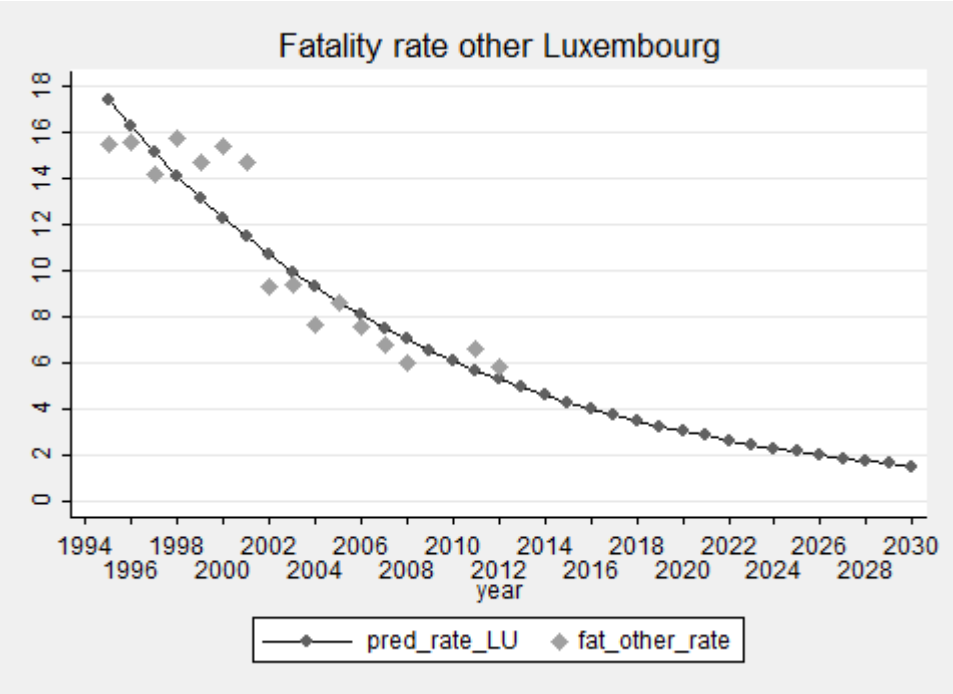


Luxembourg

```
.
. reg ln_fat_other_rate time if country == "LU"

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  1,    14) =   95.71
       Model |  1.96681381     1  1.96681381           Prob > F      =  0.0000
    Residual |  .287701727    14  .020550123           R-squared     =  0.8724
-------------+------------------------------           Adj R-squared =  0.8633
       Total |  2.25451554    15  .150301036           Root MSE      =  .14335

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0698601   .0071409    -9.78   0.000    -.0851759   -.0545443
       _cons |   2.923823   .0720314    40.59   0.000     2.769331    3.078315
------------------------------------------------------------------------------
```

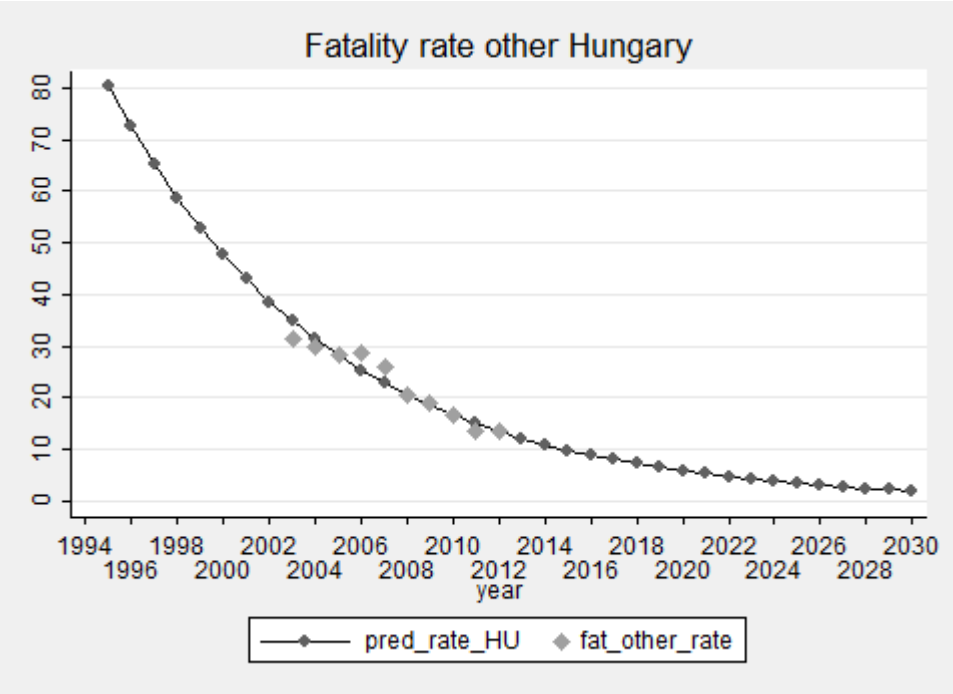


Hungary

```
. reg ln_fat_other_rate time if country == "HU"

      Source |       SS       df       MS              Number of obs =      10
-------------+------------------------------           F(  1,     8) =  130.60
       Model |  .908464922     1  .908464922           Prob > F      =  0.0000
    Residual |  .055650227     8  .006956278           R-squared     =  0.9423
-------------+------------------------------           Adj R-squared =  0.9351
       Total |  .964115149     9  .107123905           Root MSE      =   .0834

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1049366   .0091825   -11.43   0.000    -.1261115   -.0837617
       _cons |   4.493381   .1267386    35.45   0.000     4.201121    4.785641
------------------------------------------------------------------------------
```

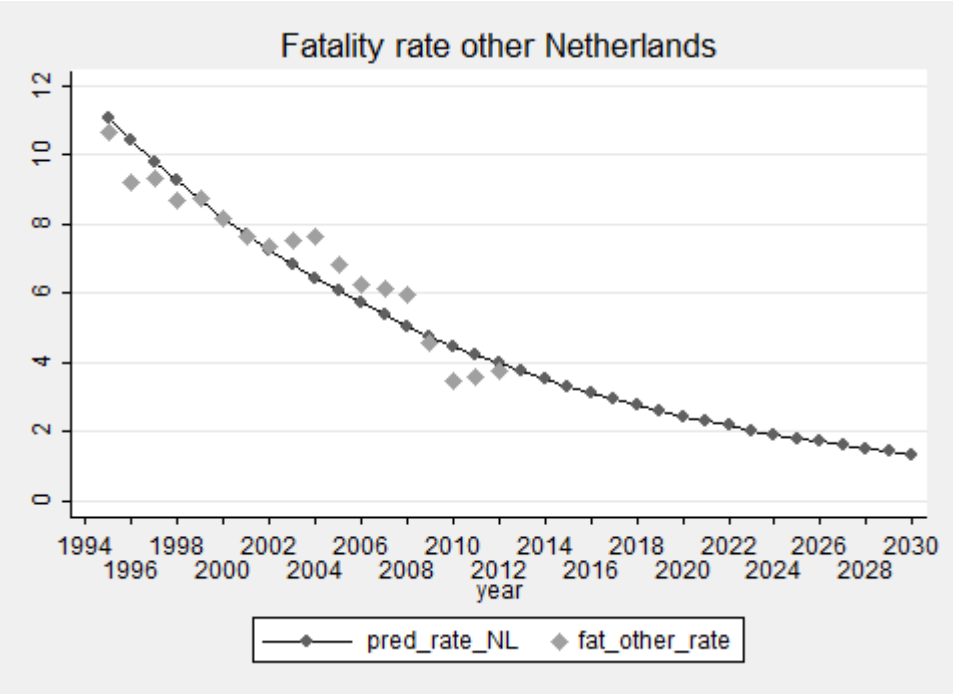


The Netherlands

```
. reg ln_fat_other_rate time if country == "NL"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  124.72
       Model |  1.75966248     1  1.75966248           Prob > F      =  0.0000
    Residual |   .22573381    16  .014108363           R-squared     =  0.8863
-------------+------------------------------           Adj R-squared =  0.8792
       Total |  1.98539629    17  .116788017           Root MSE      =  .11878

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0602654   .0053962   -11.17   0.000    -.0717049   -.0488258
       _cons |   2.463749   .0584108    42.18   0.000     2.339924    2.587575
------------------------------------------------------------------------------
```

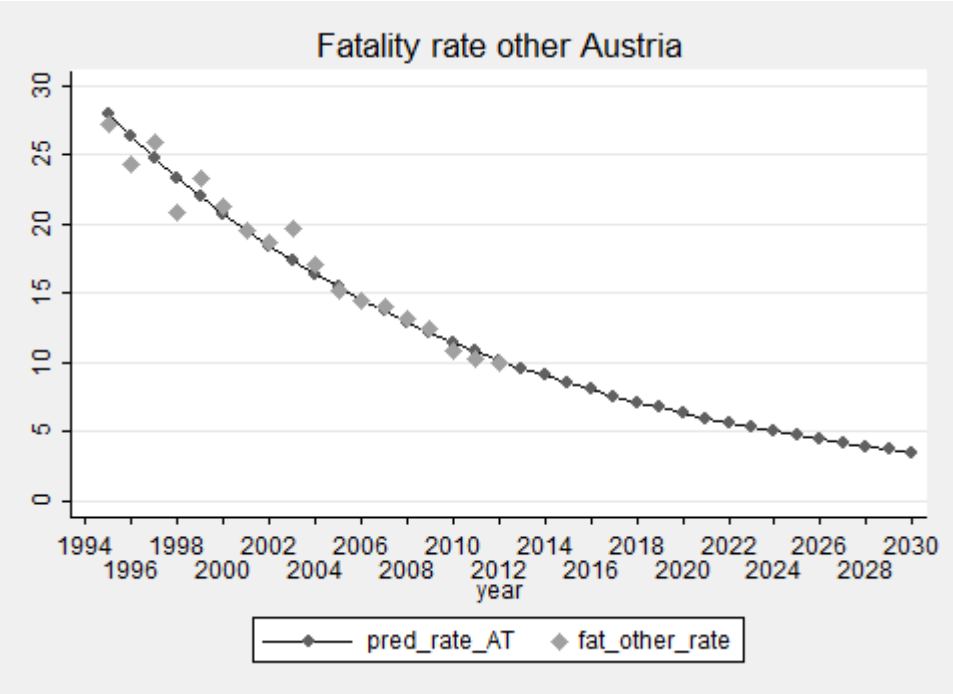


Austria

```
.
. reg ln_fat_other_rate time if country == "AT"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  561.03
       Model |  1.69658063     1  1.69658063           Prob > F      =  0.0000
    Residual |  .048385044    16  .003024065           R-squared     =  0.9723
-------------+------------------------------           Adj R-squared =  0.9705
       Total |  1.74496567    17   .10264504           Root MSE      =  .05499

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0591753   .0024983   -23.69   0.000    -.0644715   -.0538791
       _cons |   3.386505   .0270427   125.23   0.000     3.329177    3.443833
------------------------------------------------------------------------------
```

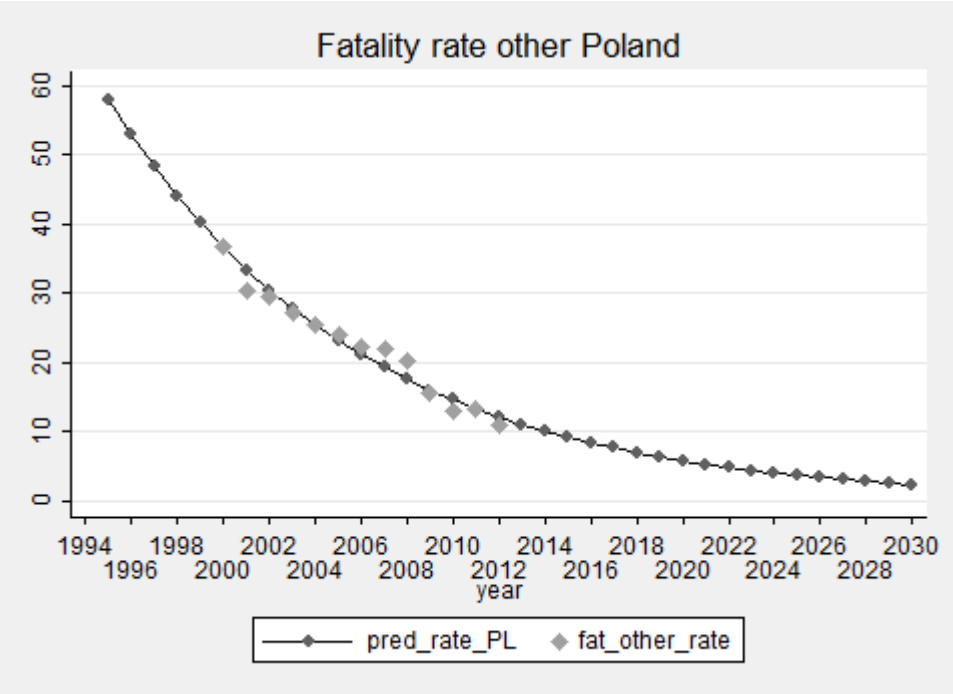


Poland

```
.
. reg ln_fat_other_rate time if country == "PL"

      Source |       SS       df       MS              Number of obs =      13
-------------+------------------------------           F(  1,    11) =  217.91
       Model |  1.53325478     1  1.53325478           Prob > F      =  0.0000
    Residual |  .077399556    11  .007036323           R-squared     =  0.9519
-------------+------------------------------           Adj R-squared =  0.9476
       Total |  1.61065434    12  .134221195           Root MSE      =  .08388

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0917849   .0062178   -14.76   0.000    -.1054702   -.0780996
       _cons |   4.151077   .0781566    53.11   0.000     3.979055    4.323098
------------------------------------------------------------------------------
```

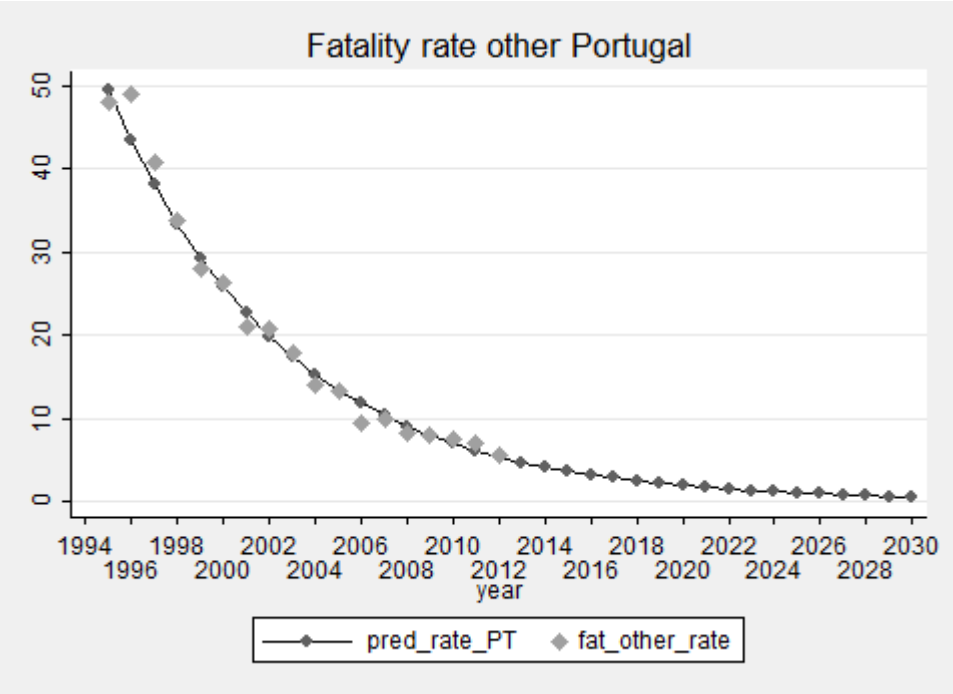


Portugal

```
.
. reg ln_fat_other_rate time if country == "PT"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) = 1089.89
       Model |  8.29160507     1  8.29160507           Prob > F      =  0.0000
    Residual |  .121723751    16  .007607734           R-squared     =  0.9855
-------------+------------------------------           Adj R-squared =  0.9846
       Total |  8.41332882    17  .494901696           Root MSE      =  .08722

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1308195   .0039626   -33.01   0.000    -.1392198   -.1224191
       _cons |   4.031266   .0428926    93.99   0.000     3.940338    4.122195
------------------------------------------------------------------------------
```

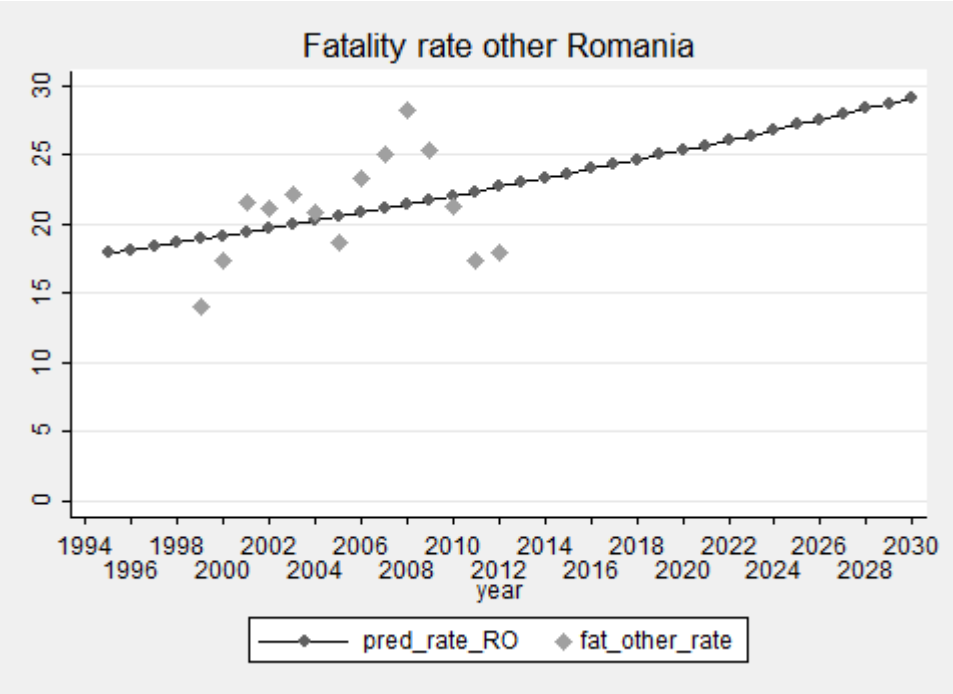


Romania

```
.
. reg ln_fat_other_rate time if country == "RO"

      Source |       SS       df       MS              Number of obs =      14
-------------+------------------------------           F(  1,    12) =    1.33
       Model |  .044235634     1  .044235634           Prob > F      =  0.2706
    Residual |  .397974761    12  .033164563           R-squared     =  0.1000
-------------+------------------------------           Adj R-squared =  0.0250
       Total |  .442210395    13  .034016184           Root MSE      =  .18211

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   .0139443   .0120739     1.15   0.271    -.0123624     .040251
       _cons |   2.868817   .1471329    19.50   0.000     2.548242    3.189392
------------------------------------------------------------------------------
```

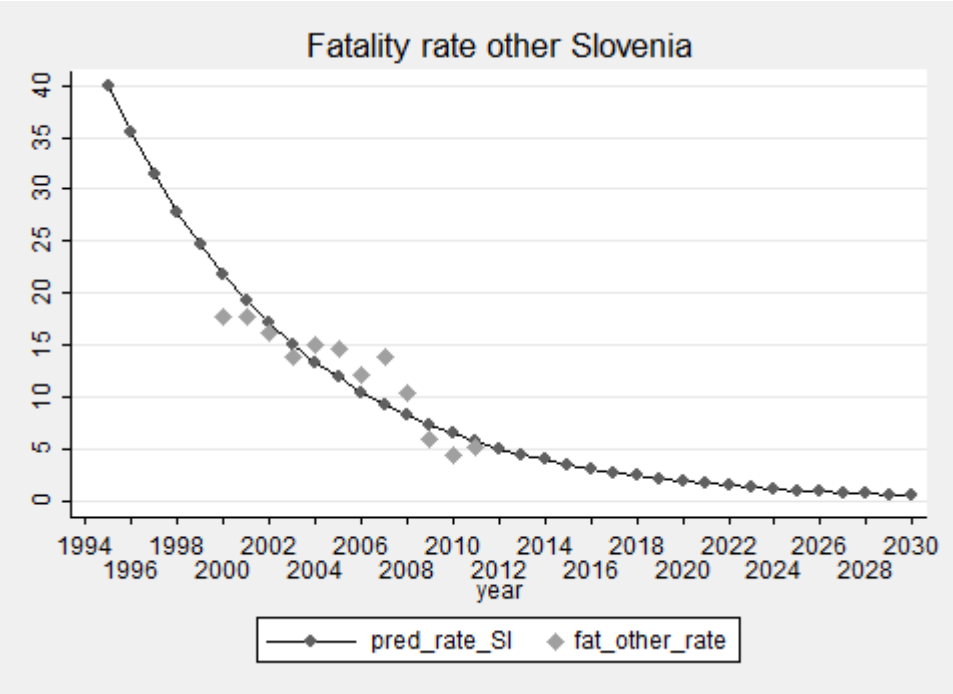


Slovenia

```
.
. reg ln_fat_other_rate time if country == "SI"

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  1,    10) =   38.05
       Model |   2.1113627     1   2.1113627           Prob > F      =  0.0001
    Residual |  .554955544    10  .055495554           R-squared     =  0.7919
-------------+------------------------------           Adj R-squared =  0.7711
       Total |  2.66631824    11  .242392568           Root MSE      =  .23557

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1215104   .0196998    -6.17   0.000    -.1654042   -.0776166
       _cons |   3.810129    .236534    16.11   0.000     3.283099    4.33716
------------------------------------------------------------------------------
```

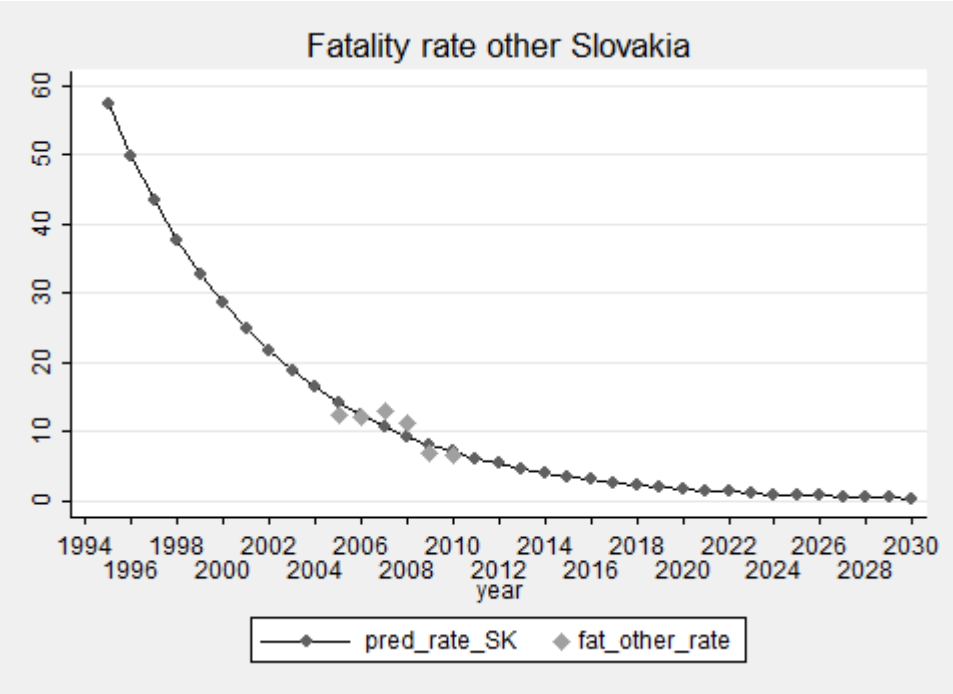


Slovakia

```
.
. reg ln_fat_other_rate time if country == "SK"

      Source |       SS       df       MS              Number of obs =       6
-------------+------------------------------           F(  1,     4) =   11.70
       Model |   .33916063     1   .33916063           Prob > F      =  0.0268
    Residual |  .115962675     4  .028990669           R-squared     =  0.7452
-------------+------------------------------           Adj R-squared =  0.6815
       Total |  .455123305     5  .091024661           Root MSE      =  .17027

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1392143   .0407015    -3.42   0.027    -.2522196   -.0262089
       _cons |   4.187307   .5538492     7.56   0.002     2.649575    5.725039
------------------------------------------------------------------------------
```

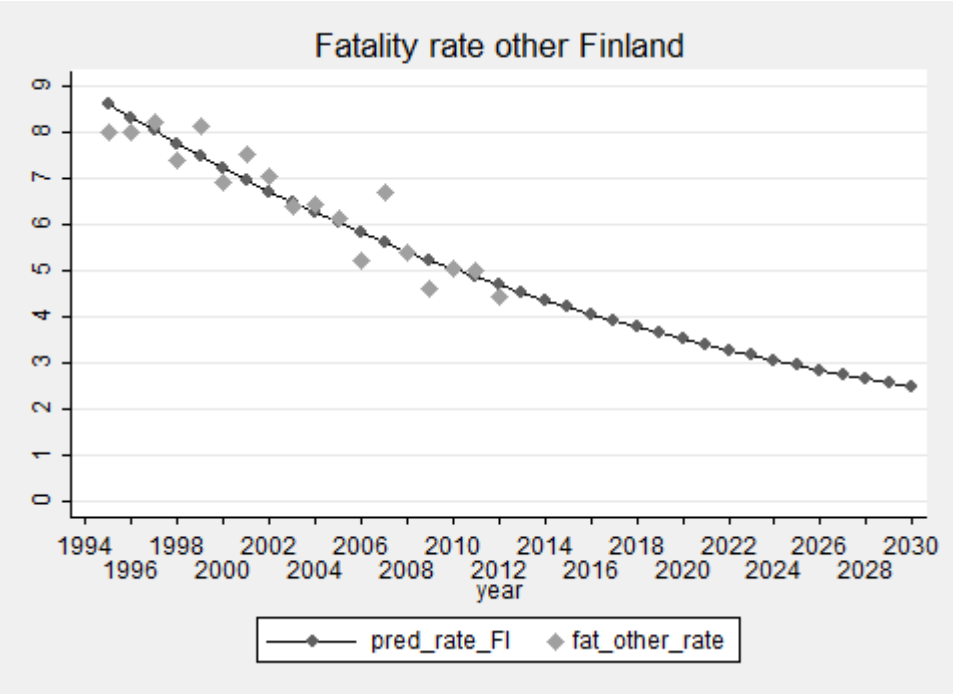


Finland

```
.
. reg ln_fat_other_rate time if country == "FI"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  111.68
       Model |  .622829022     1  .622829022           Prob > F      =  0.0000
    Residual |  .089228861    16  .005576804           R-squared     =  0.8747
-------------+------------------------------           Adj R-squared =  0.8669
       Total |  .712057883    17  .041885758           Root MSE      =  .07468

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   -.035854   .0033927   -10.57   0.000    -.0430462   -.0286618
       _cons |   2.187895   .0367238    59.58   0.000     2.110044    2.265746
------------------------------------------------------------------------------
```

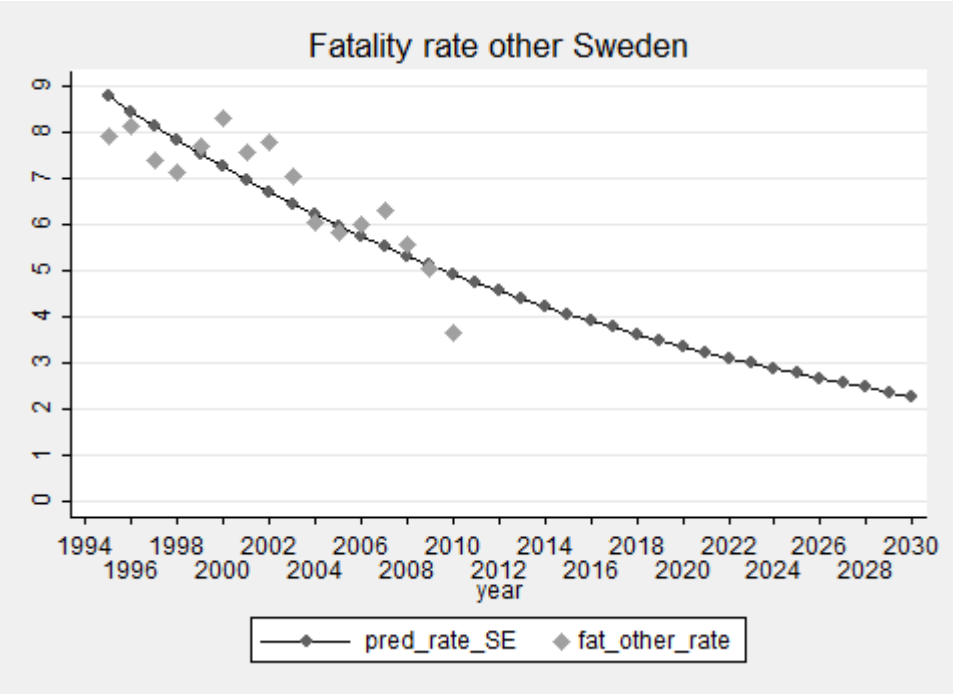


Sweden

```
. reg ln_fat_other_rate time if country == "SE"

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  1,    14) =   36.40
       Model |   .50496096     1   .50496096           Prob > F      =  0.0000
    Residual |  .194200503    14  .013871465           R-squared     =  0.7222
-------------+------------------------------           Adj R-squared =  0.7024
       Total |  .699161463    15  .046610764           Root MSE      =  .11778

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   -.038538   .0063874    -6.03   0.000    -.0522376   -.0248385
       _cons |   2.209735   .0617629    35.78   0.000     2.077267    2.342203
------------------------------------------------------------------------------
```

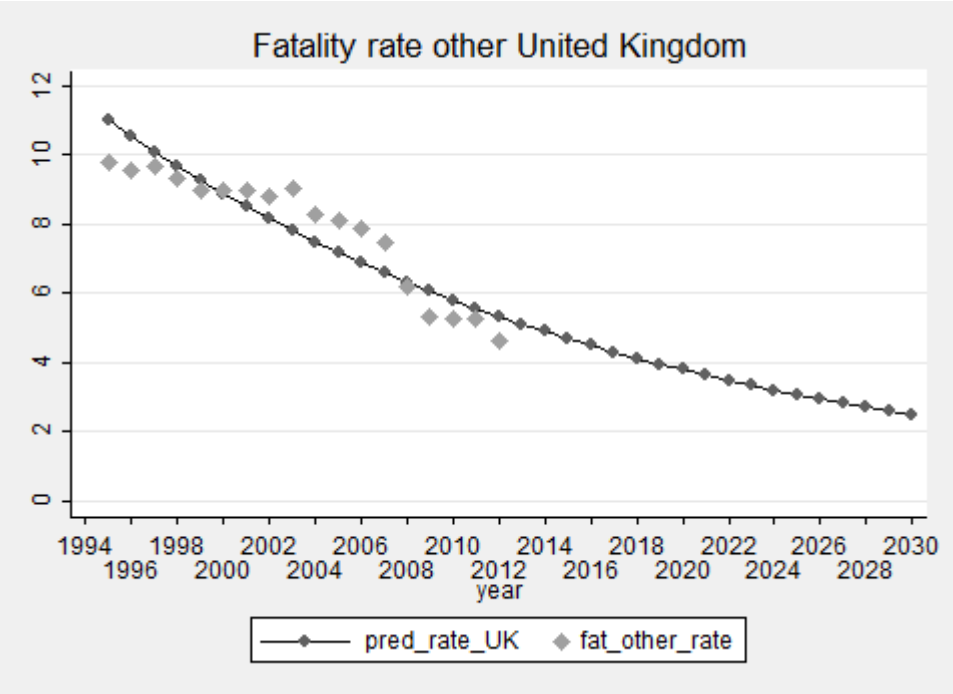


UK

```
.
. reg ln_fat_other_rate time if country == "UK"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   86.10
       Model |  .876027986     1  .876027986           Prob > F      =  0.0000
    Residual |  .162799554    16  .010174972           R-squared     =  0.8433
-------------+------------------------------           Adj R-squared =  0.8335
       Total |  1.03882754    17  .061107502           Root MSE      =  .10087

------------------------------------------------------------------------------
ln_fat_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0425218   .0045827    -9.28   0.000    -.0522367    -.032807
       _cons |   2.438393   .0496046    49.16   0.000     2.333236     2.54355
------------------------------------------------------------------------------
```



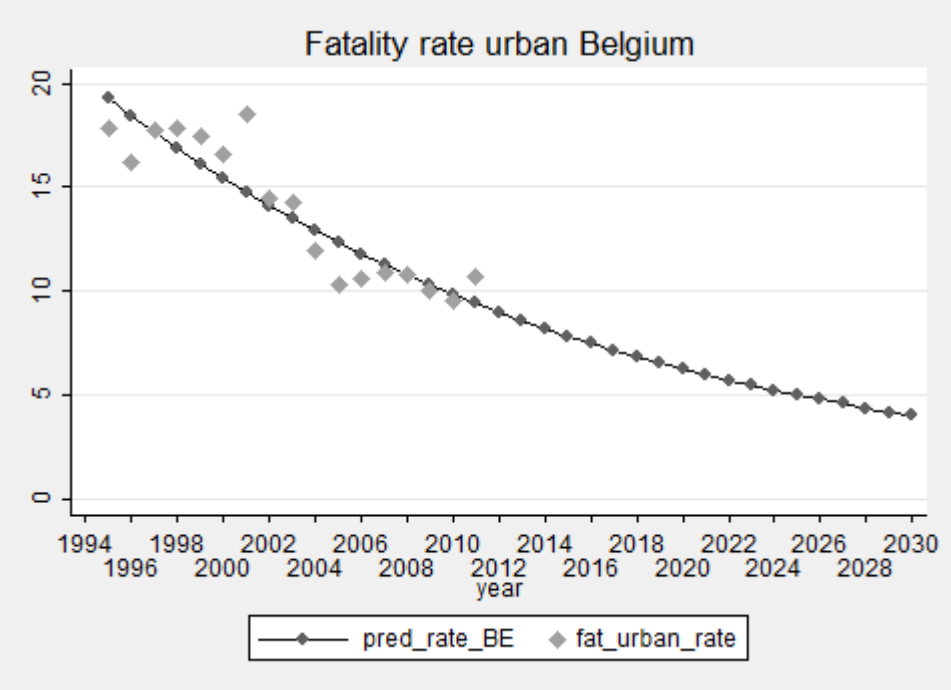
Fatalities, urban roads

Belgium

```
. reg ln_fat_urban_rate time if country == "BE"

      Source |       SS       df       MS              Number of obs =      17
-------------+------------------------------           F(  1,    15) =   76.57
       Model |  .824085447     1  .824085447           Prob > F      =  0.0000
    Residual |  .161436478    15  .010762432           R-squared     =  0.8362
-------------+------------------------------           Adj R-squared =  0.8253
       Total |  .985521926    16   .06159512           Root MSE      =  .10374

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0449424    .005136    -8.75   0.000    -.0558895   -.0339952
       _cons |   3.005295   .0526284    57.10   0.000      2.89312     3.11747
------------------------------------------------------------------------------
```

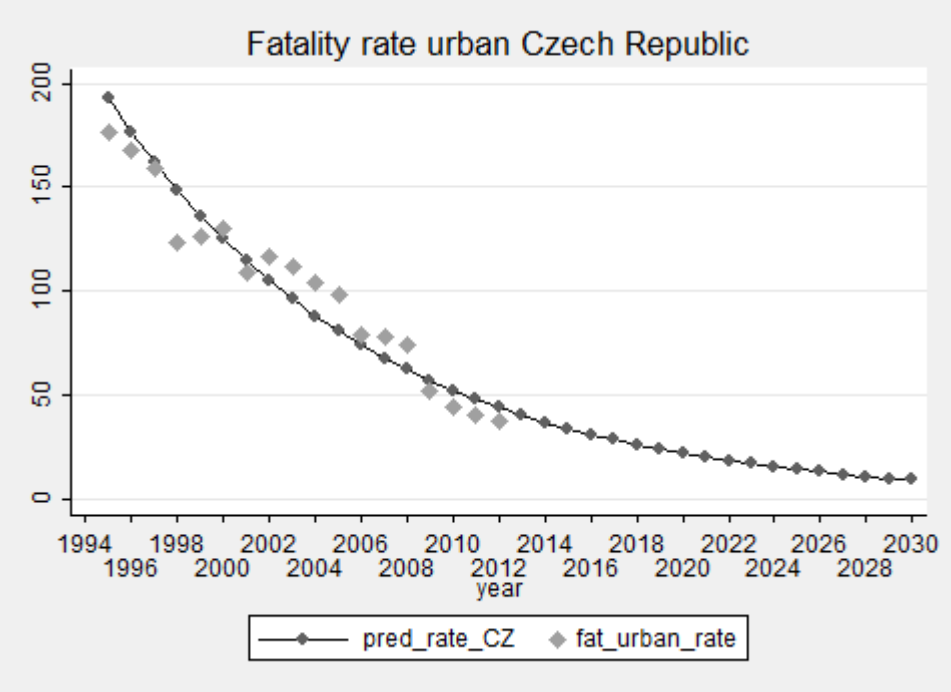


Czech Republic

```
. reg ln_fat_urban_rate time if country == "CZ"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  196.11
       Model |  3.65762974     1  3.65762974           Prob > F      =  0.0000
    Residual |  .298421677    16  .018651355           R-squared     =  0.9246
-------------+------------------------------           Adj R-squared =  0.9199
       Total |  3.95605142    17  .232708907           Root MSE      =  .13657

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0868866   .0062045   -14.00   0.000    -.1000396   -.0737336
       _cons |   5.348678   .0671599    79.64   0.000     5.206305    5.491051
------------------------------------------------------------------------------
```

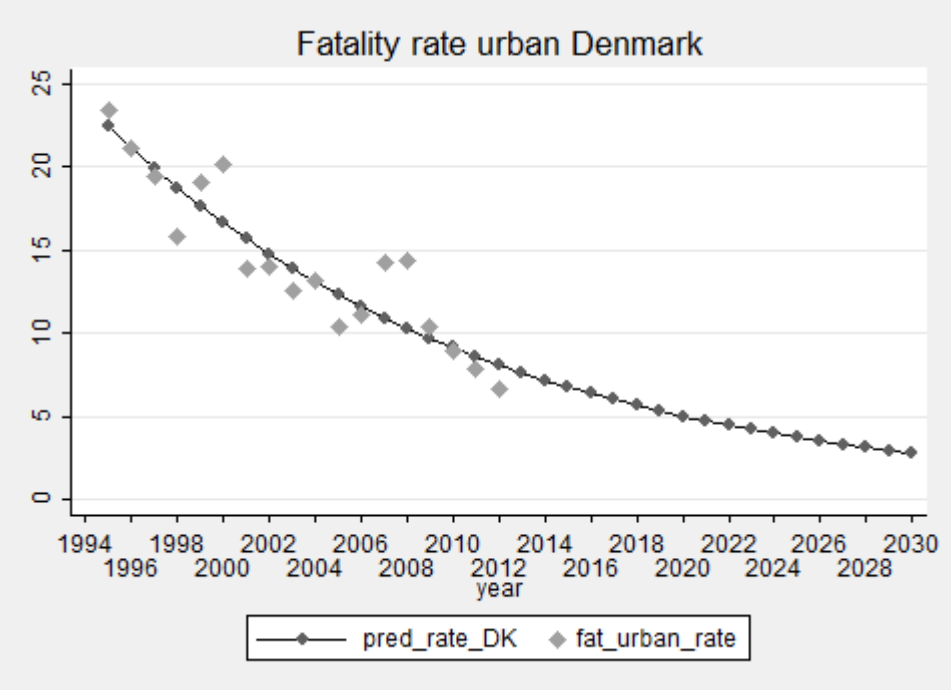


Denmark

```
.
. reg ln_fat_urban_rate time if country == "DK"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   74.78
       Model |  1.74954442     1  1.74954442           Prob > F      =  0.0000
    Residual |  .374325328    16  .023395333           R-squared     =  0.8238
-------------+------------------------------           Adj R-squared =  0.8127
       Total |  2.12386974    17  .124933514           Root MSE      =  .15296

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0600919   .0069489    -8.65   0.000    -.0748229   -.0453608
       _cons |    3.16994   .0752177    42.14   0.000     3.010485    3.329394
------------------------------------------------------------------------------
```

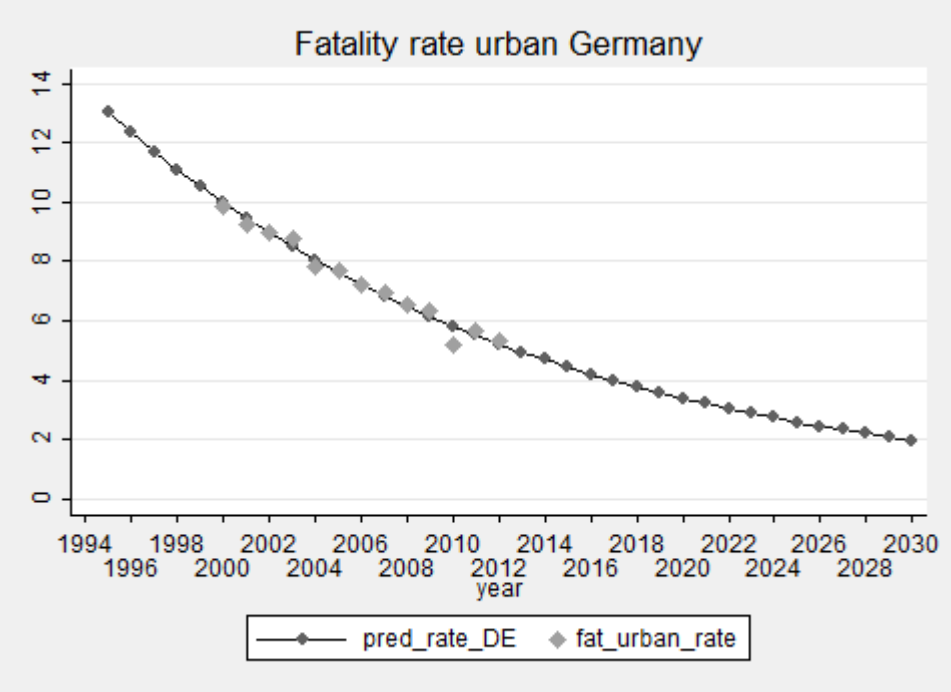


Germany

```
.
. reg ln_fat_urban_rate time if country == "DE"

      Source |       SS       df       MS              Number of obs =      13
-------------+------------------------------           F(  1,    11) =  339.42
       Model |  .525456013     1  .525456013           Prob > F      =  0.0000
    Residual |  .017028919    11  .001548084           R-squared     =  0.9686
-------------+------------------------------           Adj R-squared =  0.9658
       Total |  .542484932    12  .045207078           Root MSE      =  .03935

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0537319   .0029165   -18.42   0.000    -.0601511   -.0473128
       _cons |   2.620994   .0366598    71.50   0.000     2.540306    2.701682
------------------------------------------------------------------------------
```

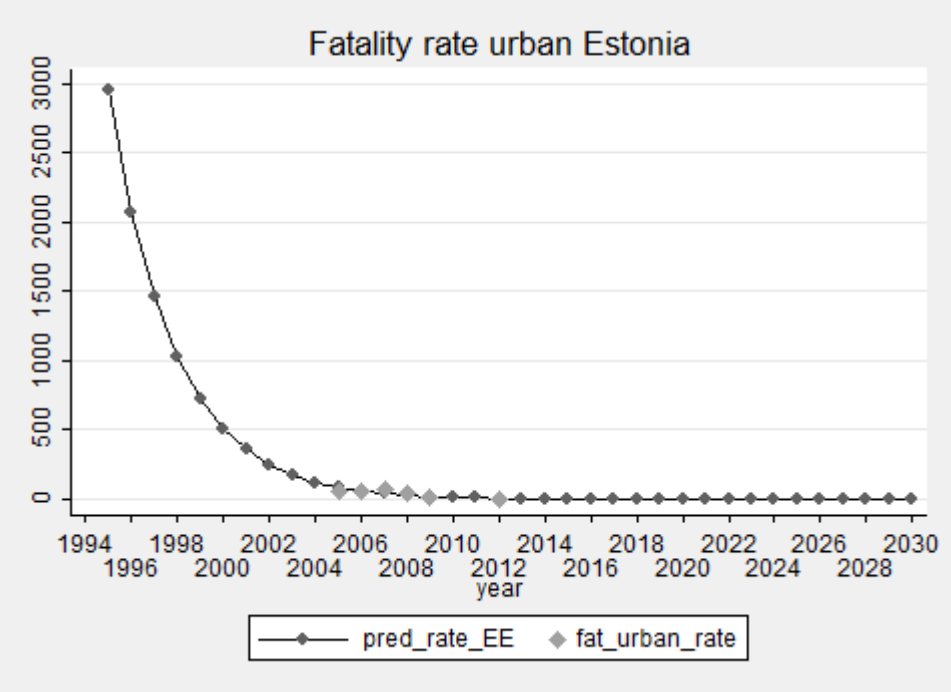


Estonia

```
. reg ln_fat_urban_rate time if country == "EE"

      Source |       SS       df       MS              Number of obs =       6
-------------+------------------------------           F(  1,     4) =   28.40
       Model |   3.8406733     1   3.8406733           Prob > F      =  0.0060
    Residual |  .540991708     4  .135247927           R-squared     =  0.8765
-------------+------------------------------           Adj R-squared =  0.8457
       Total |    4.381665     5  .876333001           Root MSE      =  .36776

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   -.352934     .06623    -5.33   0.006     -.536818   -.1690499
       _cons |   8.341665   .9284026     8.98   0.001     5.764006    10.91932
------------------------------------------------------------------------------
```

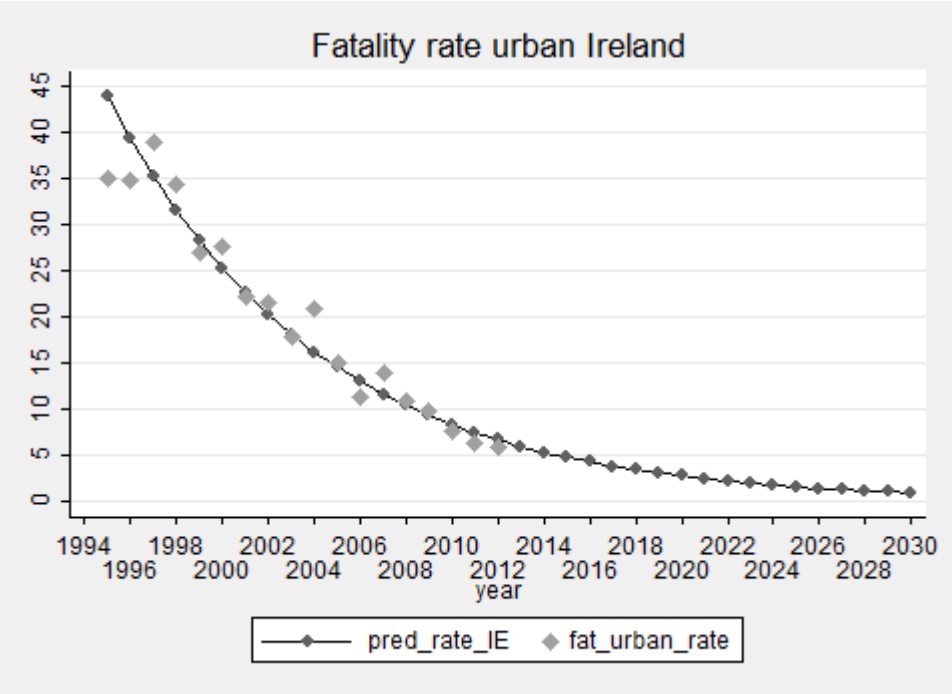


Ireland

```
.
. reg ln_fat_urban_rate time if country == "IE"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  362.29
       Model |  5.99646288     1  5.99646288           Prob > F      =  0.0000
    Residual |    .2648276    16  .016551725           R-squared     =  0.9577
-------------+------------------------------           Adj R-squared =  0.9551
       Total |  6.26129048    17  .368311205           Root MSE      =  .12865

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1112502   .0058449   -19.03   0.000    -.1236407   -.0988596
       _cons |   3.893425   .0632669    61.54   0.000     3.759305    4.027545
------------------------------------------------------------------------------
```

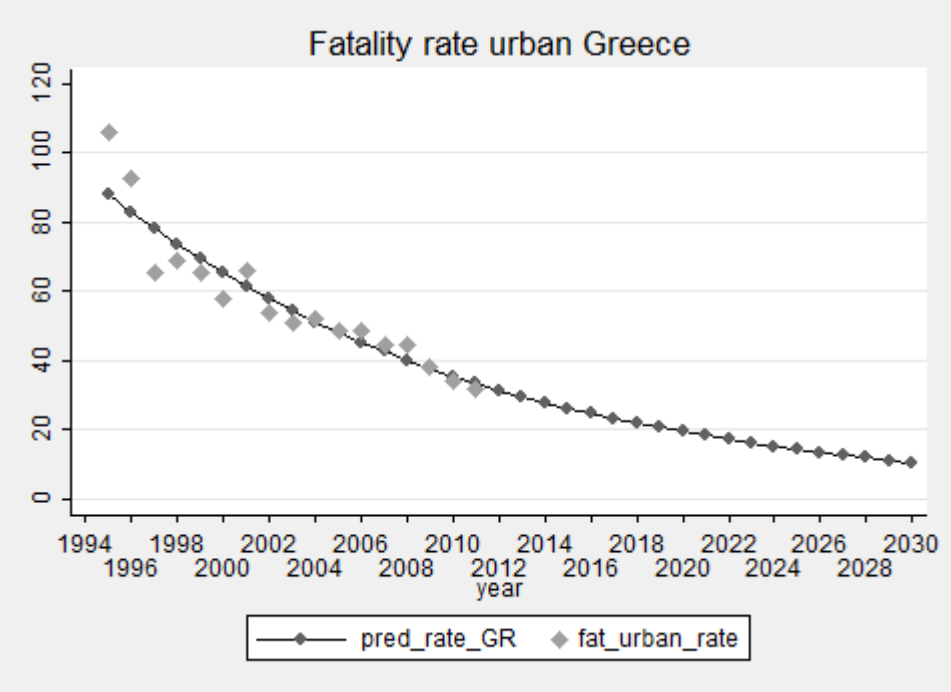


Greece

```
.
. reg ln_fat_urban_rate time if country == "GR"

      Source |       SS       df       MS              Number of obs =      17
-------------+------------------------------           F(  1,    15) =  164.50
       Model |  1.49243837     1  1.49243837           Prob > F      =  0.0000
    Residual |  .136084718    15  .009072315           R-squared     =  0.9164
-------------+------------------------------           Adj R-squared =  0.9109
       Total |  1.62852309    16  .101782693           Root MSE      =  .09525

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0604809   .0047155   -12.83   0.000    -.0705318     -.05043
       _cons |   4.538919   .0483196    93.94   0.000     4.435928     4.64191
------------------------------------------------------------------------------
```

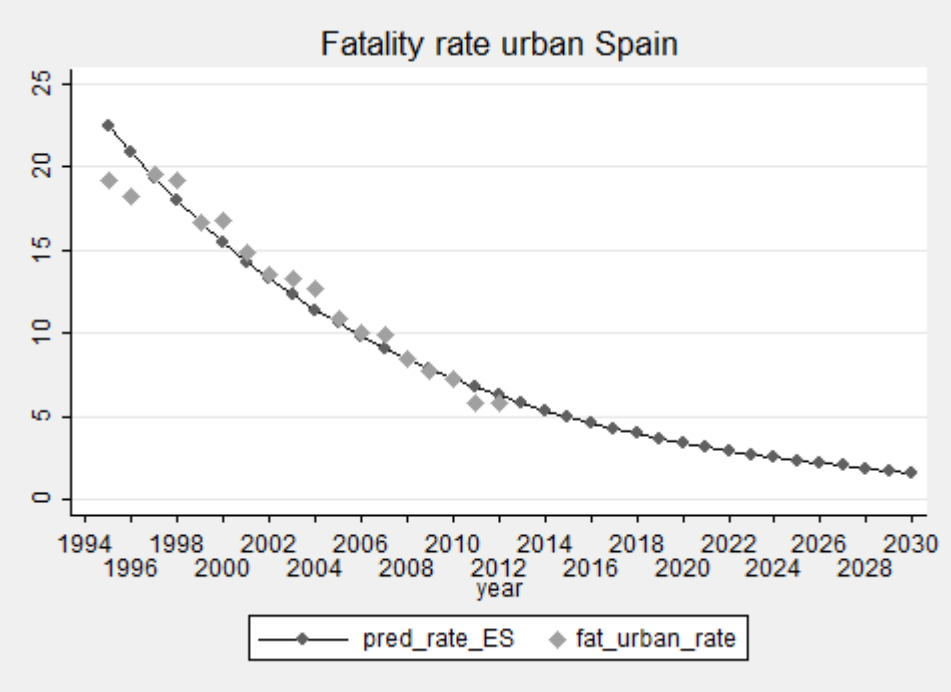


Spain

```
. reg ln_fat_urban_rate time if country == "ES"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  412.02
       Model |  2.76220471     1  2.76220471            Prob > F      =  0.0000
    Residual |  .107264531    16  .006704033           R-squared     =  0.9626
-------------+------------------------------           Adj R-squared =  0.9603
       Total |  2.86946924    17  .168792309           Root MSE      =  .08188

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0755059   .0037198   -20.30   0.000    -.0833916   -.0676203
       _cons |   3.187101   .0402646    79.15   0.000     3.101744    3.272458
------------------------------------------------------------------------------
```

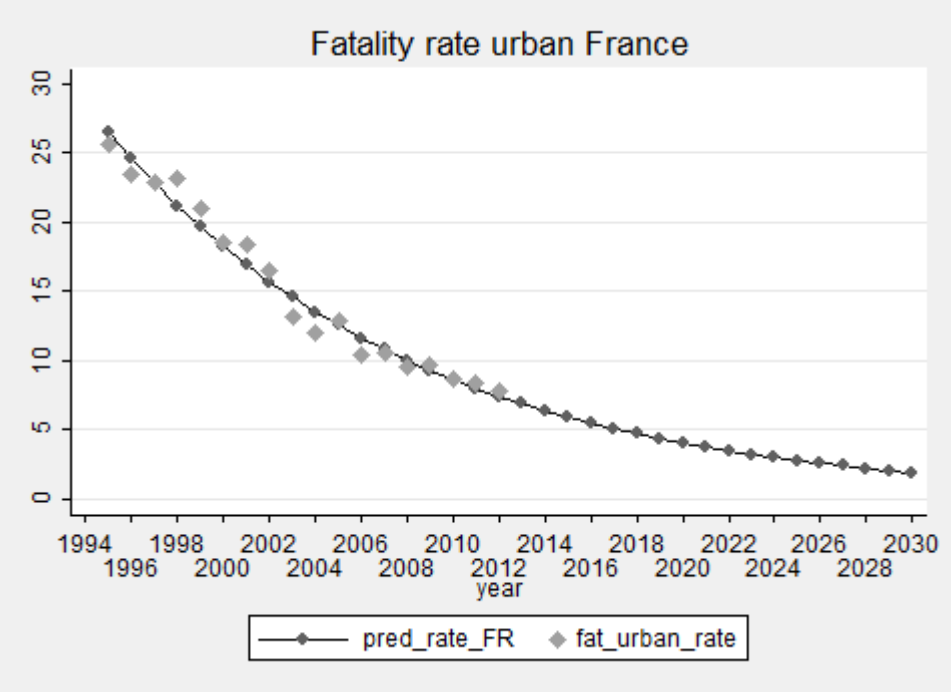


France

```
. reg ln_fat_urban_rate time if country == "FR"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  624.66
       Model |  2.72179854     1  2.72179854            Prob > F      =  0.0000
    Residual |  .069716415    16  .004357276           R-squared     =  0.9750
-------------+------------------------------           Adj R-squared =  0.9735
       Total |  2.79151496    17  .164206762           Root MSE      =  .06601

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0749516   .0029989   -24.99   0.000     -.081309   -.0685943
       _cons |   3.352428   .0324611   103.28   0.000     3.283614    3.421243
------------------------------------------------------------------------------
```

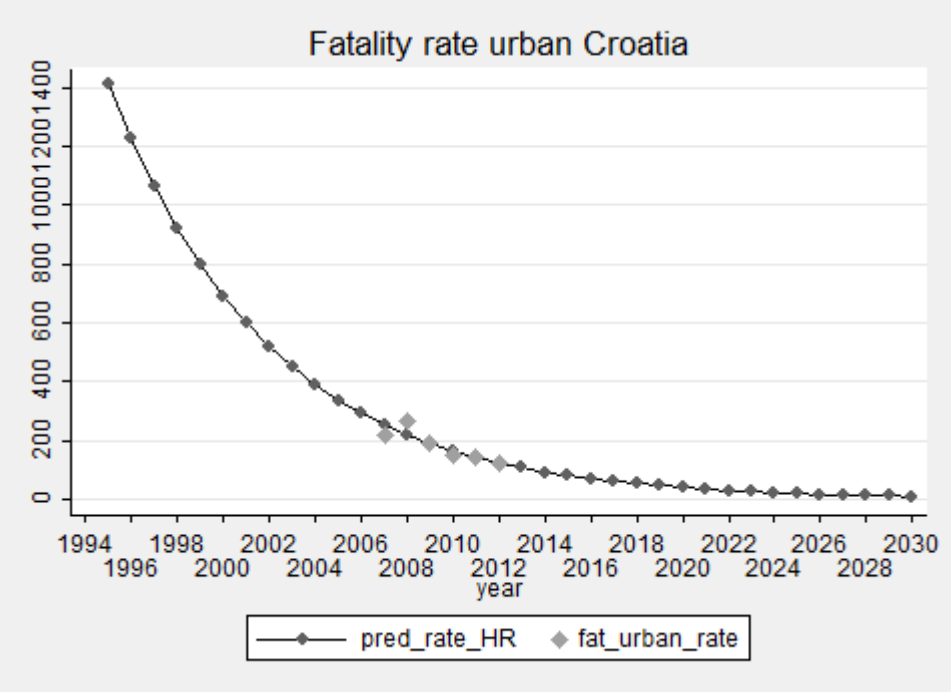


Croatia

```
.
. reg ln_fat_urban_rate time if country == "HR"

      Source |       SS       df       MS              Number of obs =       6
-------------+------------------------------           F(  1,     4) =   24.24
       Model |  .361726593     1  .361726593           Prob > F      =  0.0079
    Residual |  .059686457     4  .014921614           R-squared     =  0.8584
-------------+------------------------------           Adj R-squared =  0.8230
       Total |  .421413049     5   .08428261           Root MSE      =  .12215

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   -.143771   .0292004    -4.92   0.008    -.2248443   -.0626976
       _cons |    7.39897   .4553453    16.25   0.000     6.134728    8.663211
------------------------------------------------------------------------------
```

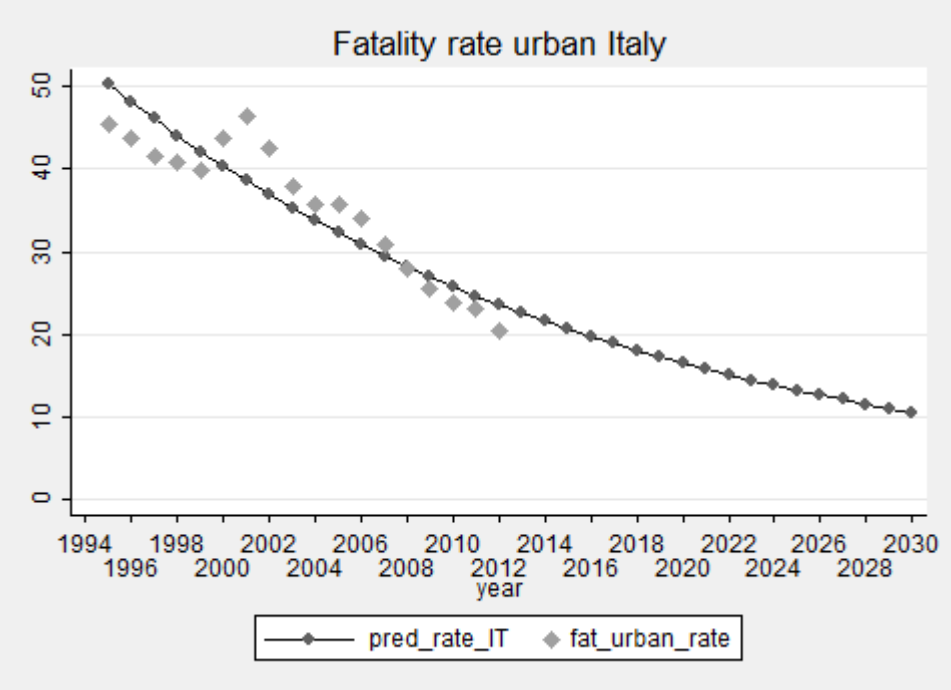


Italy

```
. reg ln_fat_urban_rate time if country == "IT"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   92.46
       Model |  .968131828     1  .968131828           Prob > F      =  0.0000
    Residual |  .167535101    16  .010470944           R-squared     =  0.8525
-------------+------------------------------           Adj R-squared =  0.8433
       Total |  1.13566693    17  .066803937           Root MSE      =  .10233

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0447013   .0046489    -9.62   0.000    -.0545565   -.0348462
       _cons |   3.965157   .0503209    78.80   0.000     3.858481    4.071832
------------------------------------------------------------------------------
```

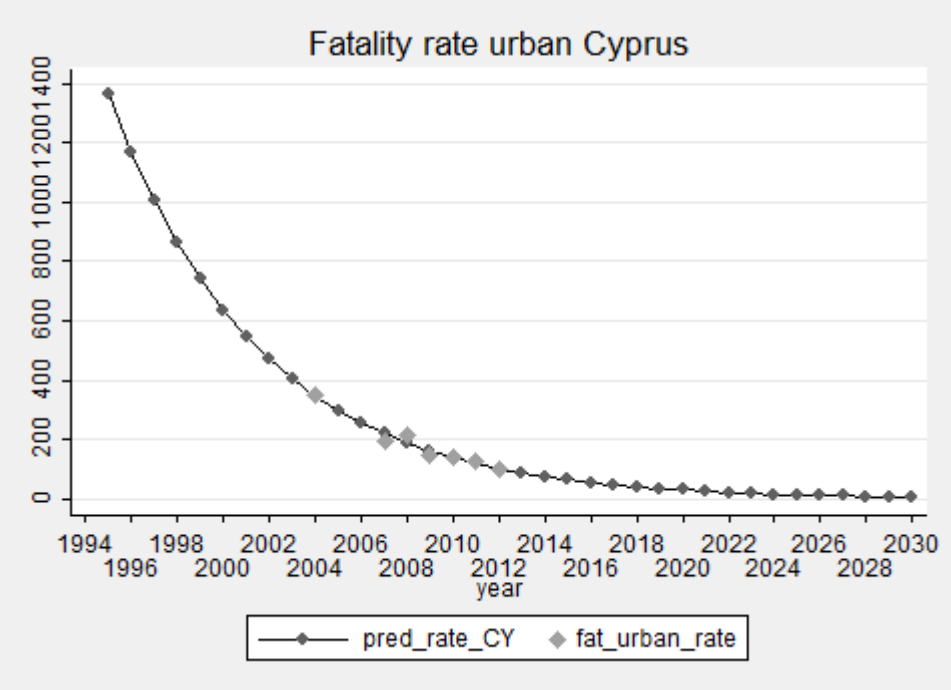


Cyprus

```
. reg ln_fat_urban_rate time if country == "CY"

      Source |       SS       df       MS              Number of obs =       7
-------------+------------------------------           F(  1,     5) =  111.73
       Model |  1.00095603     1  1.00095603           Prob > F      =  0.0001
    Residual |  .044794255     5  .008958851           R-squared     =  0.9572
-------------+------------------------------           Adj R-squared =  0.9486
       Total |  1.04575028     6  .174291714           Root MSE      =  .09465

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1518168   .0143628   -10.57   0.000    -.1887375   -.1148961
       _cons |   7.367503   .2143445    34.37   0.000     6.816513    7.918493
------------------------------------------------------------------------------
```

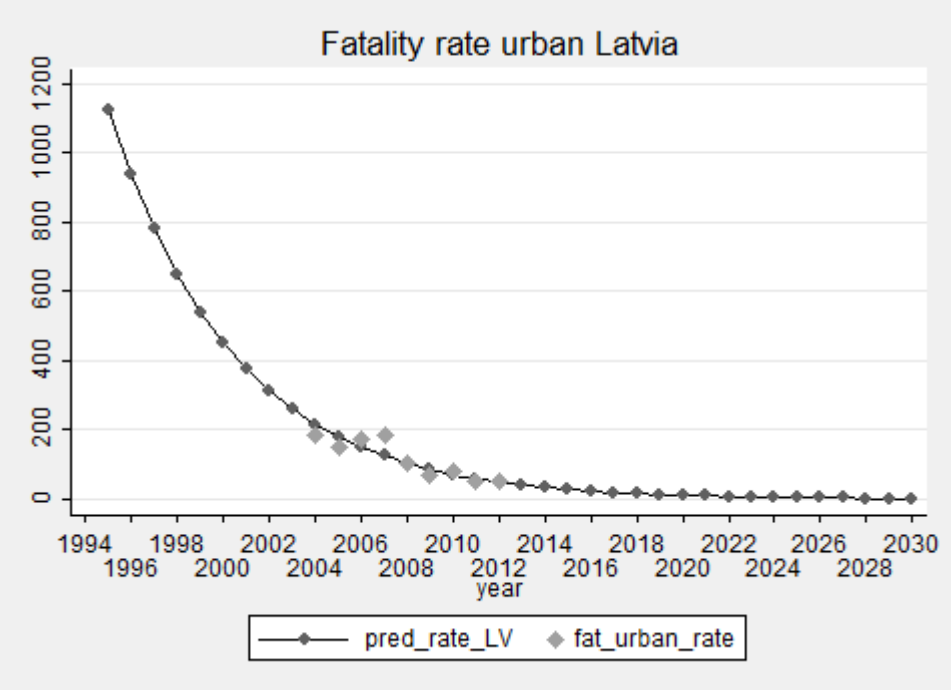


Latvia

```
. reg ln_fat_urban_rate time if country == "LV"

      Source |       SS       df       MS              Number of obs =       9
-------------+------------------------------           F(  1,     7) =   45.66
       Model |  2.01300674     1  2.01300674           Prob > F      =  0.0003
    Residual |  .308596961     7   .04408528           R-squared     =  0.8671
-------------+------------------------------           Adj R-squared =  0.8481
       Total |   2.3216037     8  .290200462           Root MSE      =  .20996

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1831669   .0271064    -6.76   0.000    -.2472632   -.1190705
       _cons |   7.206435   .3858889    18.67   0.000     6.293953    8.118918
------------------------------------------------------------------------------
```

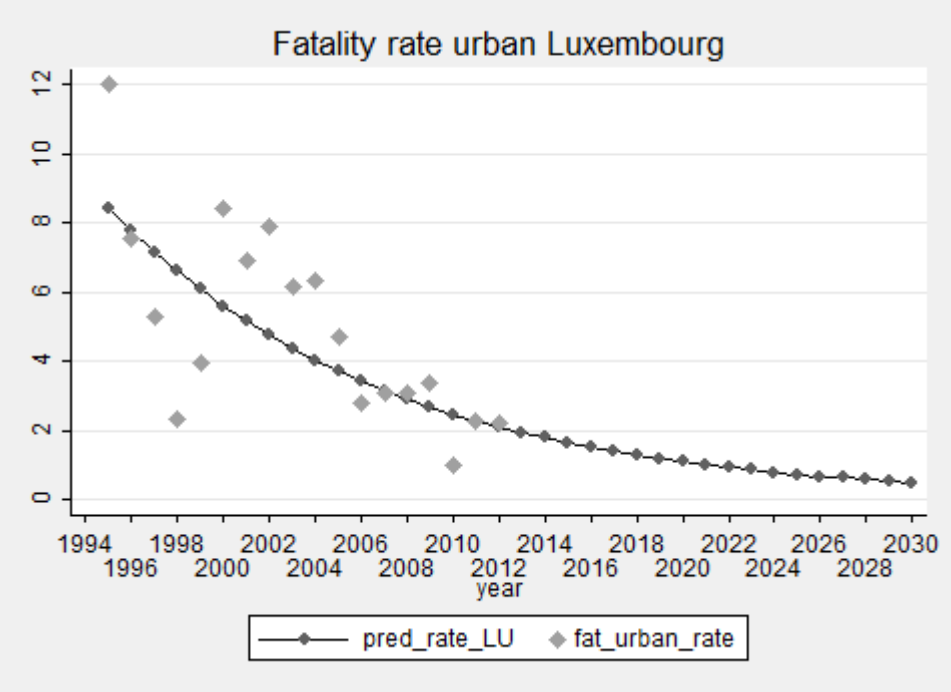


Luxembourg

```
.
. reg ln_fat_urban_rate time if country == "LU"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   15.74
       Model |  3.25326001     1  3.25326001           Prob > F      =  0.0011
    Residual |  3.30784336    16   .20674021           R-squared     =  0.4958
-------------+------------------------------           Adj R-squared =  0.4643
       Total |  6.56110337    17  .385947257           Root MSE      =  .45469

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0819431   .0206569    -3.97   0.001    -.1257338   -.0381524
       _cons |   2.212945   .2235978     9.90   0.000     1.738939    2.686951
------------------------------------------------------------------------------
```

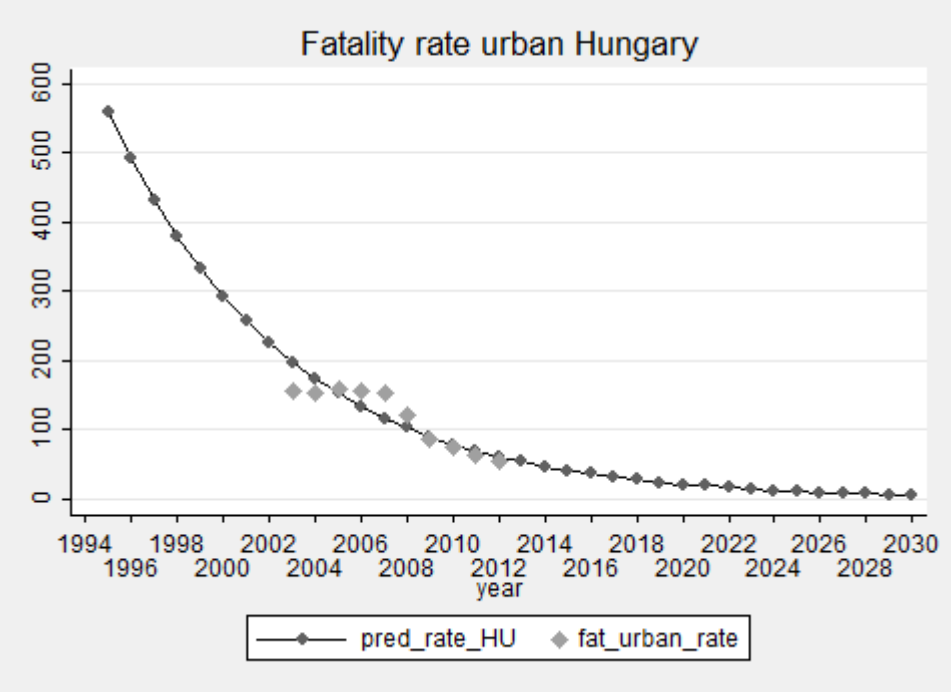


Hungary

```
. reg ln_fat_urban_rate time if country == "HU"

      Source |       SS       df       MS              Number of obs =      10
-------------+------------------------------           F(  1,     8) =   49.84
       Model |  1.40122045     1  1.40122045           Prob > F      =  0.0001
    Residual |   .22492512     8   .02811564           R-squared     =  0.8617
-------------+------------------------------           Adj R-squared =  0.8444
       Total |  1.62614556     9  .180682841           Root MSE      =  .16768

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1303246   .0184607    -7.06   0.000    -.1728949   -.0877542
       _cons |   6.457627   .2547971    25.34   0.000     5.870064     7.04519
------------------------------------------------------------------------------
```

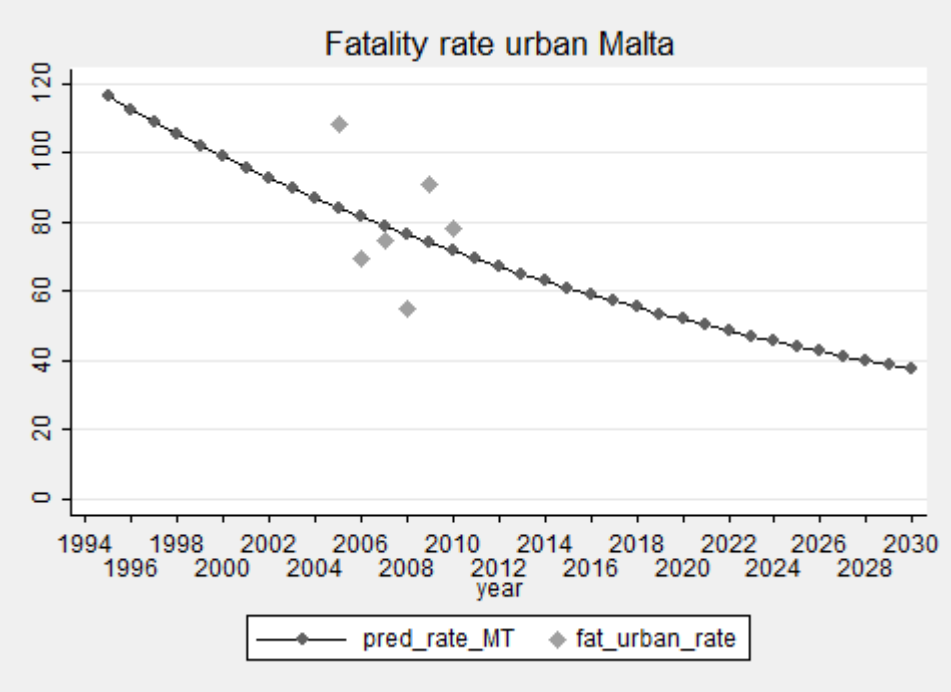


Malta

```
.
. reg ln_fat_urban_rate time if country == "MT"

      Source |       SS       df       MS              Number of obs =       6
-------------+------------------------------           F(  1,     4) =    0.29
       Model |  .018265533     1  .018265533           Prob > F      =  0.6164
    Residual |  .248431987     4  .062107997           R-squared     =  0.0685
-------------+------------------------------           Adj R-squared = -0.1644
       Total |   .26669752     5  .053339504           Root MSE      =  .24921

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   -.032307   .0595737    -0.54   0.616    -.1977102    .1330961
       _cons |   4.787566   .8106551     5.91   0.004     2.536827    7.038306
------------------------------------------------------------------------------
```

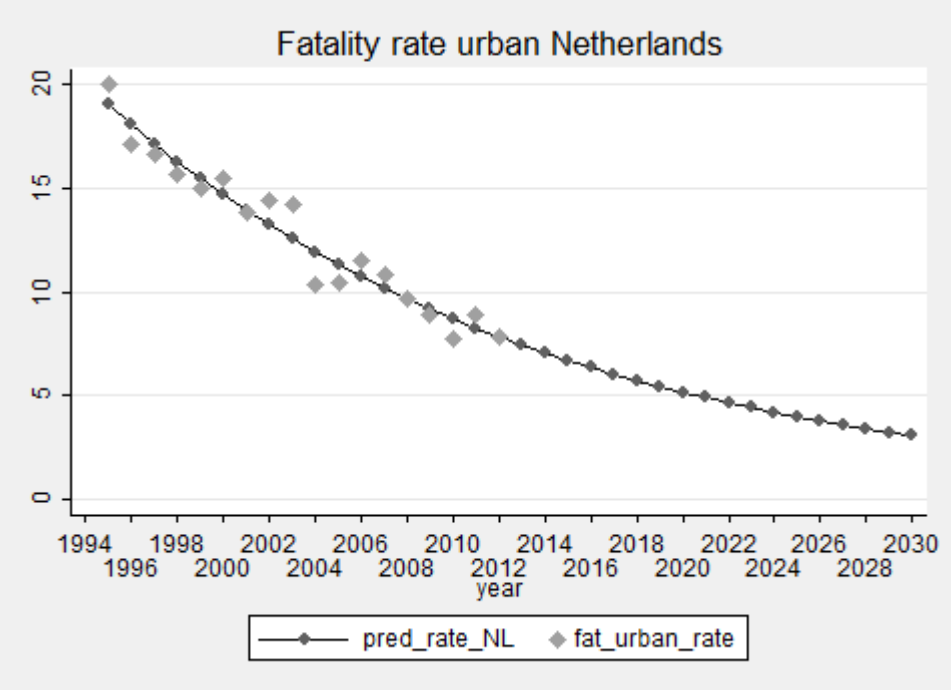


The Netherlands

```
.
. reg ln_fat_urban_rate time if country == "NL"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  233.50
       Model |  1.32636466     1  1.32636466           Prob > F      =  0.0000
    Residual |  .090886667    16  .005680417           R-squared     =  0.9359
-------------+------------------------------           Adj R-squared =  0.9319
       Total |  1.41725133    17  .083367725           Root MSE      =  .07537

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   -.052322   .0034241   -15.28   0.000    -.0595807   -.0450633
       _cons |   2.999082   .0370634    80.92   0.000     2.920511    3.077653
------------------------------------------------------------------------------
```

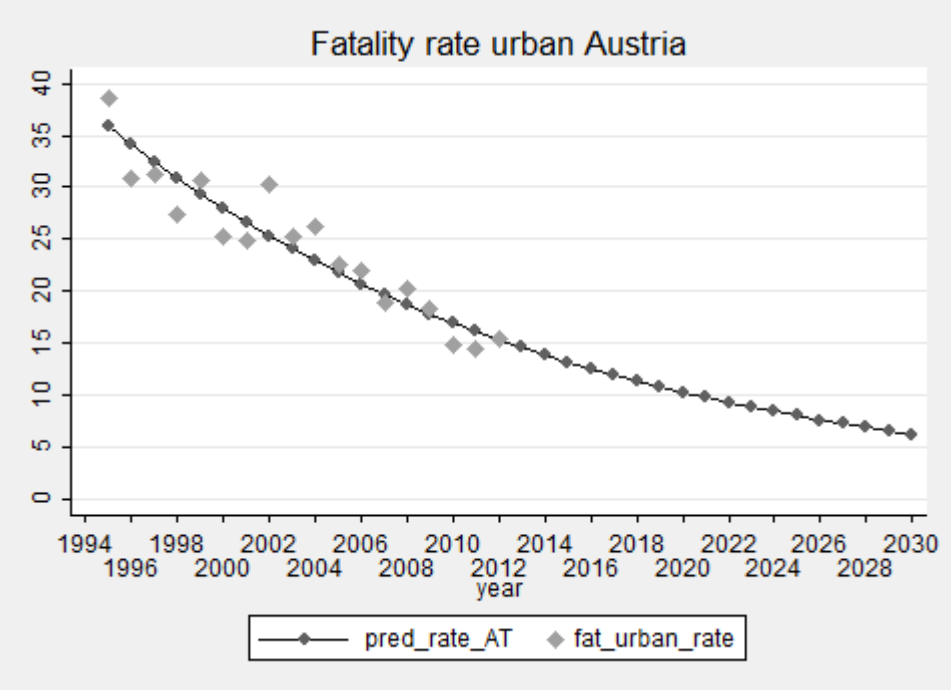


Austria

```
.
. reg ln_fat_urban_rate time if country == "AT"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  130.92
       Model |  1.20797623     1  1.20797623            Prob > F      =  0.0000
    Residual |  .147633112    16   .00922707           R-squared     =  0.8911
-------------+------------------------------           Adj R-squared =  0.8843
       Total |  1.35560934    17  .079741726           Root MSE      =  .09606

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0499324    .004364   -11.44   0.000    -.0591837   -.0406811
       _cons |   3.628492   .0472375    76.81   0.000     3.528353    3.728631
------------------------------------------------------------------------------
```

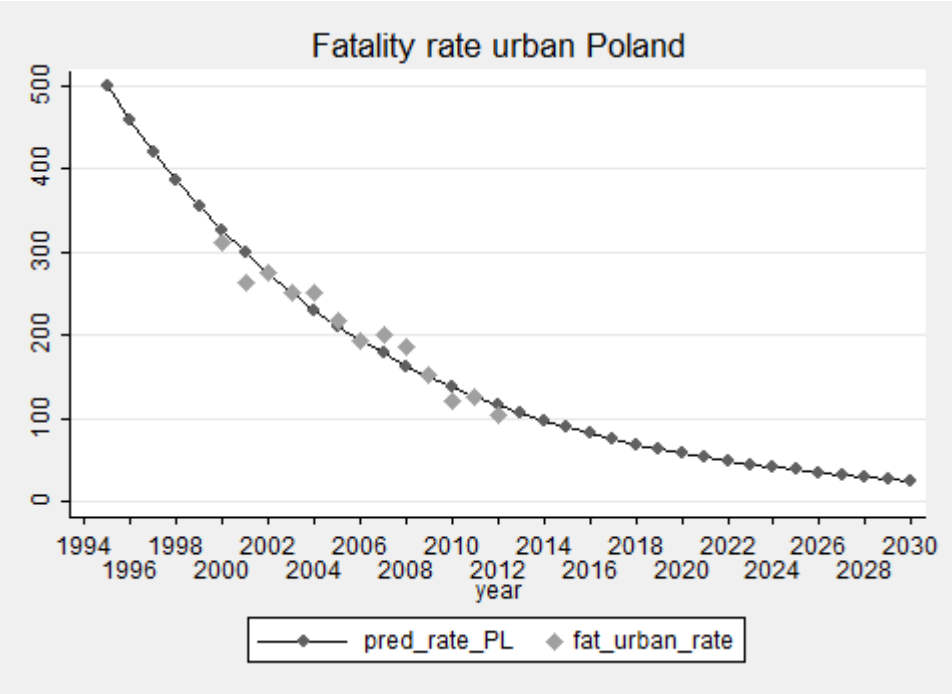


Poland

```
.
. reg ln_fat_urban_rate time if country == "PL"

      Source |       SS       df       MS              Number of obs =      13
-------------+------------------------------           F(  1,    11) =  175.79
       Model |  1.35847871     1  1.35847871           Prob > F      =  0.0000
    Residual |  .085008486    11  .007728044           R-squared     =  0.9411
-------------+------------------------------           Adj R-squared =  0.9358
       Total |   1.4434872    12    .1202906           Root MSE      =  .08791

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0863954   .0065163   -13.26   0.000    -.1007376   -.0720532
       _cons |   6.301733   .0819083    76.94   0.000     6.121454    6.482011
------------------------------------------------------------------------------
```

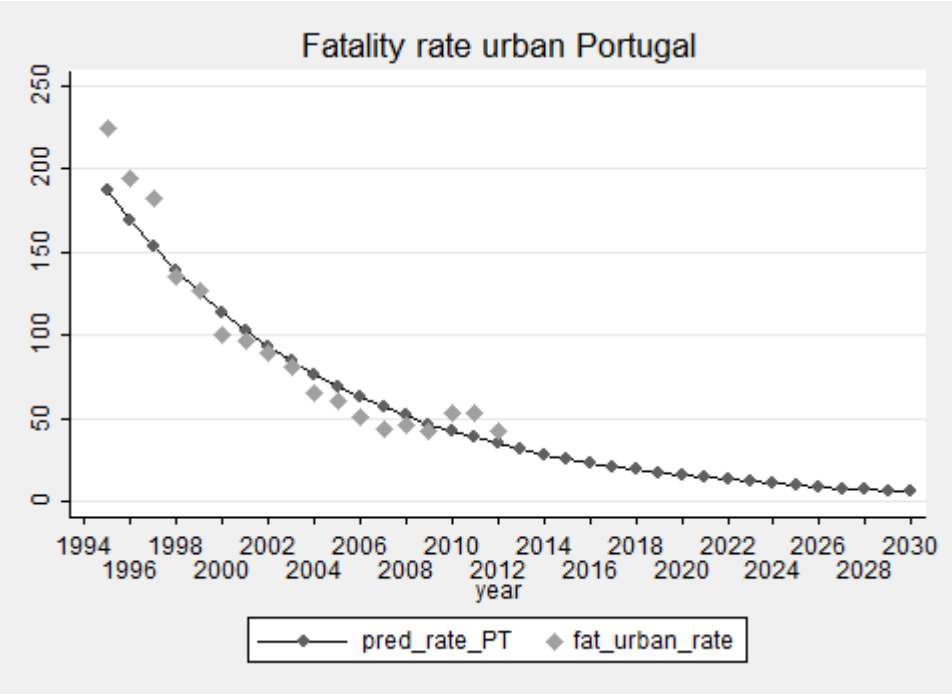


Portugal

```
.
. reg ln_fat_urban_rate time if country == "PT"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  157.33
       Model |  4.78295409     1  4.78295409           Prob > F      =  0.0000
    Residual |  .486404395    16  .030400275           R-squared     =  0.9077
-------------+------------------------------           Adj R-squared =  0.9019
       Total |  5.26935848    17  .309962264           Root MSE      =  .17436

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0993576   .0079212   -12.54   0.000    -.1161499   -.0825654
       _cons |   5.327435   .0857421    62.13   0.000      5.14567      5.5092
------------------------------------------------------------------------------
```

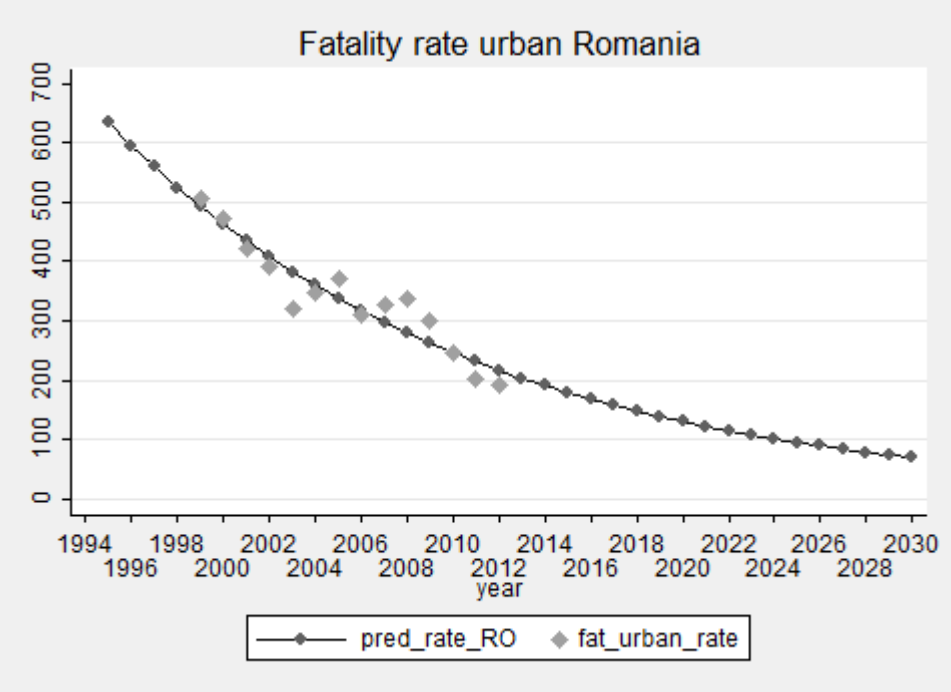


Romania

```
.
. reg ln_fat_urban_rate time if country == "RO"

      Source |       SS       df       MS              Number of obs =      14
-------------+------------------------------           F(  1,    12) =   77.50
       Model |  .903764851     1  .903764851           Prob > F      =  0.0000
    Residual |  .139930947    12  .011660912           R-squared     =  0.8659
-------------+------------------------------           Adj R-squared =  0.8548
       Total |   1.0436958    13  .080284292           Root MSE      =  .10799

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0630285   .0071594    -8.80   0.000    -.0786275   -.0474296
       _cons |   6.514919   .0872446    74.67   0.000     6.324829    6.705009
------------------------------------------------------------------------------
```

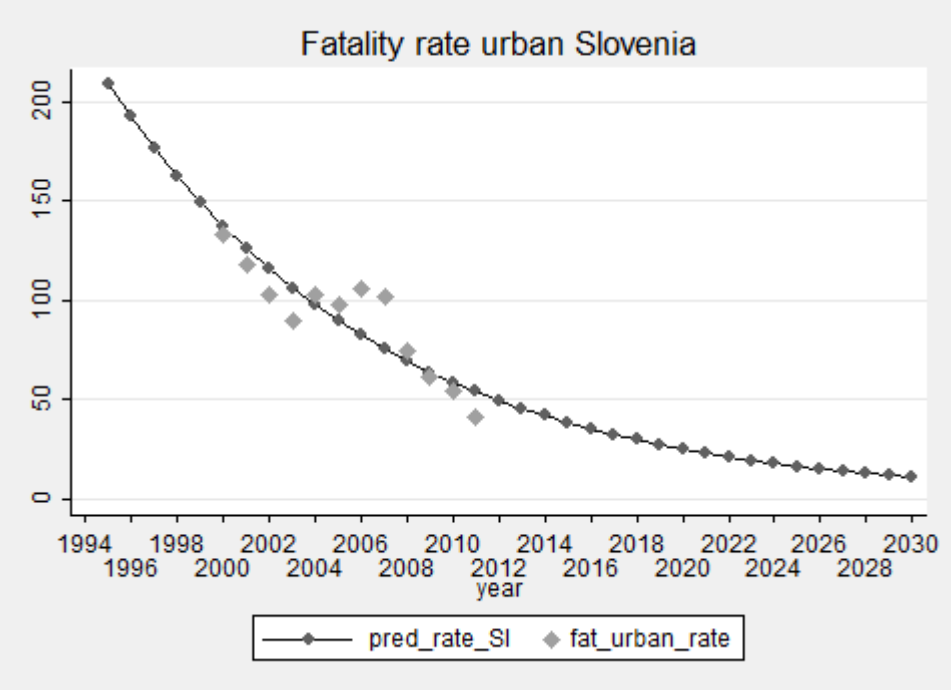


Slovenia

```
.
. reg ln_fat_urban_rate time if country == "SI"

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  1,    10) =   36.07
       Model |  1.02378176     1  1.02378176           Prob > F      =  0.0001
    Residual |  .283809607    10  .028380961           R-squared     =  0.7830
-------------+------------------------------           Adj R-squared =  0.7612
       Total |  1.30759137    11  .118871943           Root MSE      =  .16847

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0846127   .0140879    -6.01   0.000    -.1160025    -.053223
       _cons |   5.428588   .1691523    32.09   0.000     5.051693    5.805483
------------------------------------------------------------------------------
```

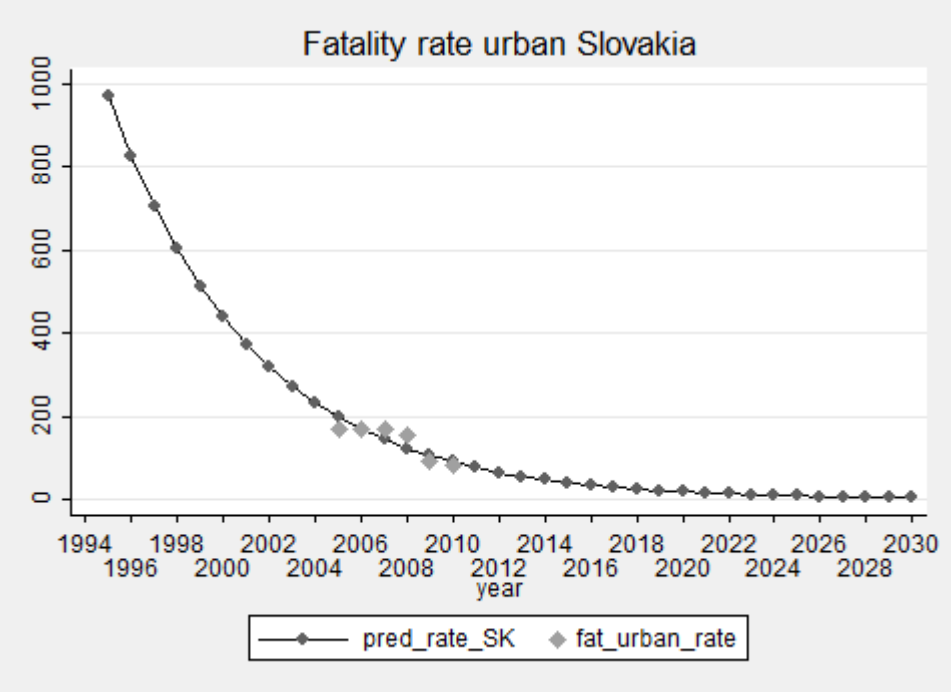


Slovakia

```
. reg ln_fat_urban_rate time if country == "SK"

      Source |       SS       df       MS              Number of obs =       6
-------------+------------------------------           F(  1,     4) =   13.97
       Model |  .441985912     1  .441985912           Prob > F      =  0.0202
    Residual |  .126569877     4  .031642469           R-squared     =  0.7774
-------------+------------------------------           Adj R-squared =  0.7217
       Total |  .568555789     5  .113711158           Root MSE      =  .17788

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1589224   .0425222    -3.74   0.020    -.2769831   -.0408618
       _cons |   7.035332   .5786255    12.16   0.000      5.42881    8.641854
------------------------------------------------------------------------------
```

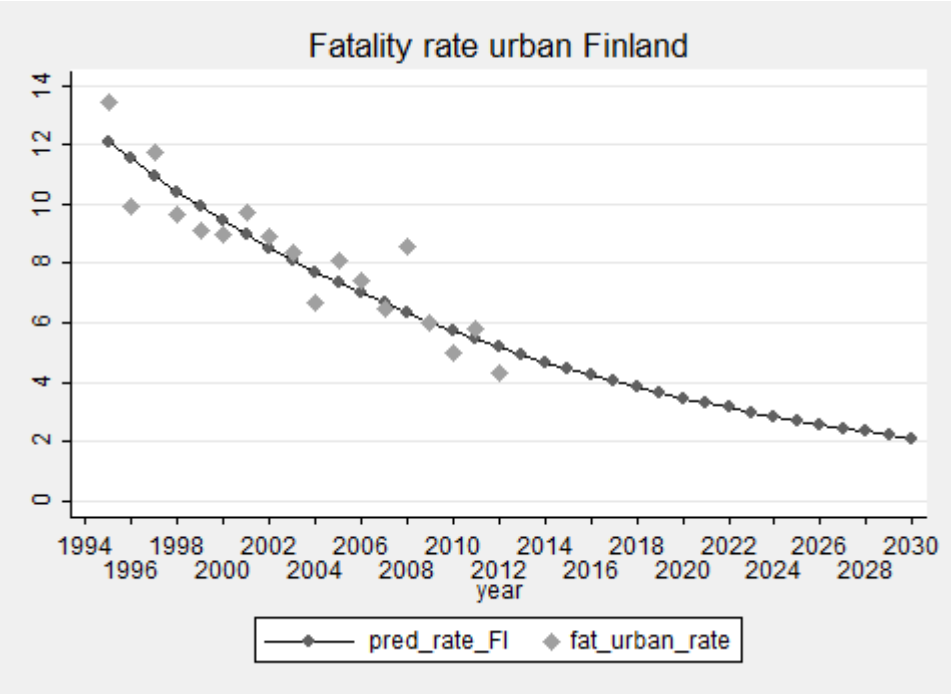


Finland

```
. reg ln_fat_urban_rate time if country == "FI"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   78.18
       Model |  1.20639508     1  1.20639508            Prob > F      =  0.0000
    Residual |  .246895927    16  .015430995           R-squared     =  0.8301
-------------+------------------------------           Adj R-squared =  0.8195
       Total |  1.45329101    17  .085487707           Root MSE      =  .12422

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0498997   .0056435    -8.84   0.000    -.0618634    -.037936
       _cons |   2.543177   .0610875    41.63   0.000     2.413678    2.672677
------------------------------------------------------------------------------
```

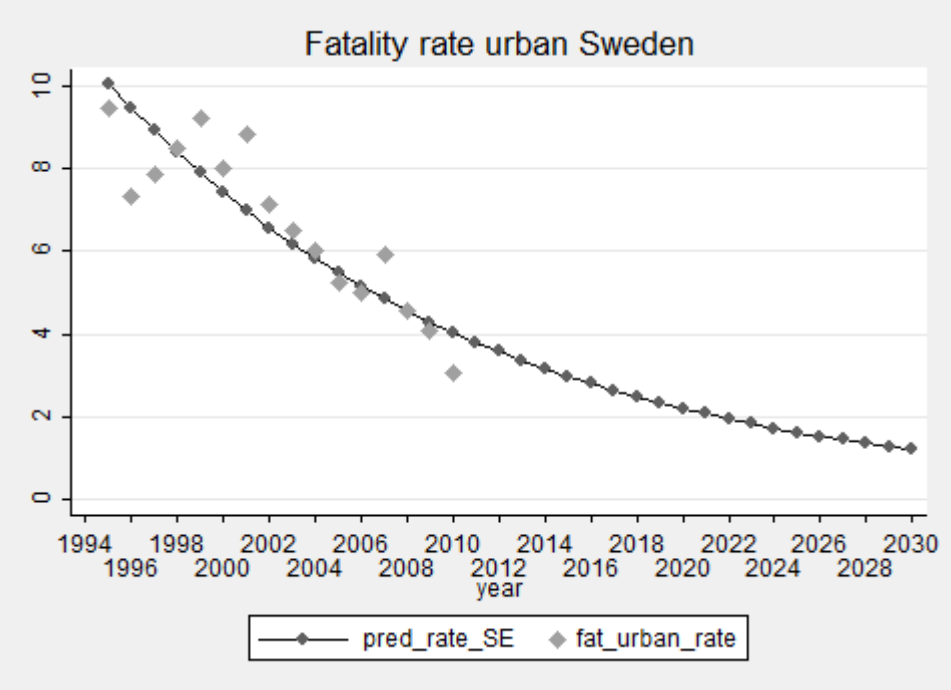


Sweden

```
.
. reg ln_fat_urban_rate time if country == "SE"

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  1,    14) =   58.29
       Model |  1.26053039     1  1.26053039           Prob > F      =  0.0000
    Residual |  .302726652    14  .021623332           R-squared     =  0.8063
-------------+------------------------------           Adj R-squared =  0.7925
       Total |  1.56325704    15  .104217136           Root MSE      =  .14705

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0608888   .0079748    -7.64   0.000    -.0779931   -.0437844
       _cons |   2.370045    .077113    30.73   0.000     2.204654    2.535435
------------------------------------------------------------------------------
```

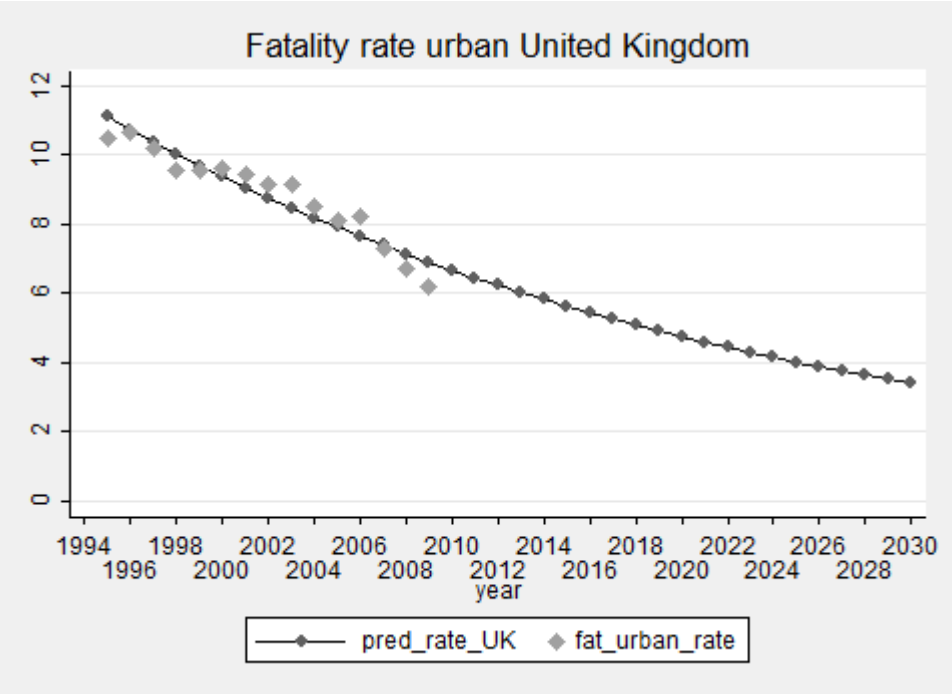


UK

```
.
. reg ln_fat_urban_rate time if country == "UK"

      Source |       SS       df       MS              Number of obs =      15
-------------+------------------------------           F(  1,    13) =  101.44
       Model |  .322039856     1  .322039856           Prob > F      =  0.0000
    Residual |  .041270733    13  .003174672           R-squared     =  0.8864
-------------+------------------------------           Adj R-squared =  0.8777
       Total |  .363310589    14  .025950756           Root MSE      =  .05634

------------------------------------------------------------------------------
ln_fat_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0339137   .0033672   -10.07   0.000    -.0411882   -.0266393
       _cons |   2.440352   .0306151    79.71   0.000     2.374212    2.506492
------------------------------------------------------------------------------
```



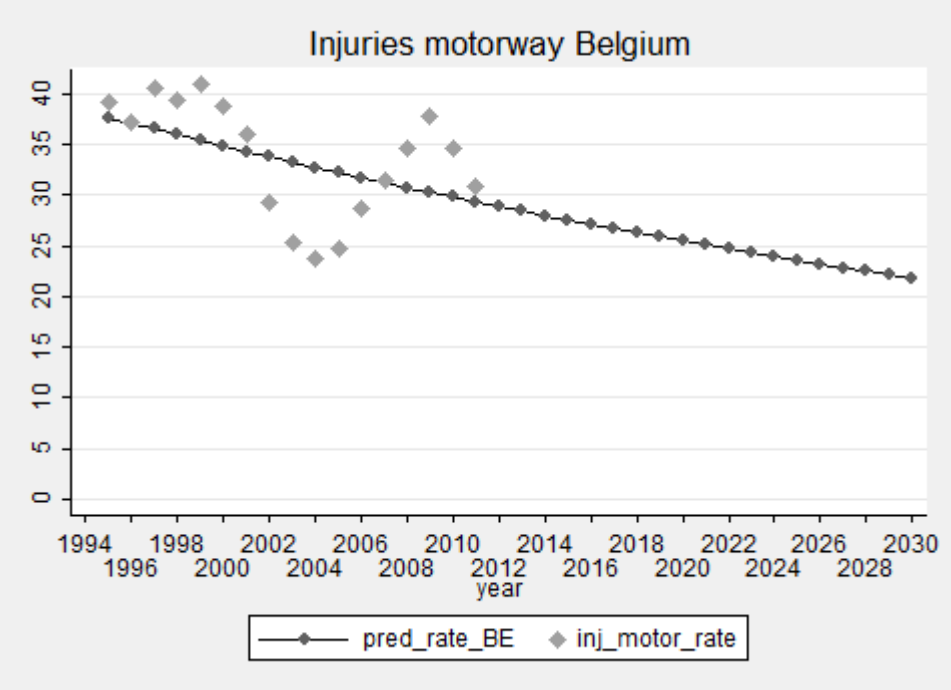
Seriously injured, motorways

Belgium

```
.
. reg ln_inj_motor_rate time if country == "BE"

      Source |       SS       df       MS              Number of obs =      17
-------------+------------------------------           F(  1,    15) =    3.51
       Model |  .099843237     1  .099843237           Prob > F      =  0.0805
    Residual |  .426460435    15  .028430696           R-squared     =  0.1897
-------------+------------------------------           Adj R-squared =  0.1357
       Total |  .526303671    16  .032893979           Root MSE      =  .16861

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0156433   .0083476    -1.87   0.081    -.0334359    .0021492
       _cons |   3.644368   .0855378    42.61   0.000     3.462049    3.826688
------------------------------------------------------------------------------
```

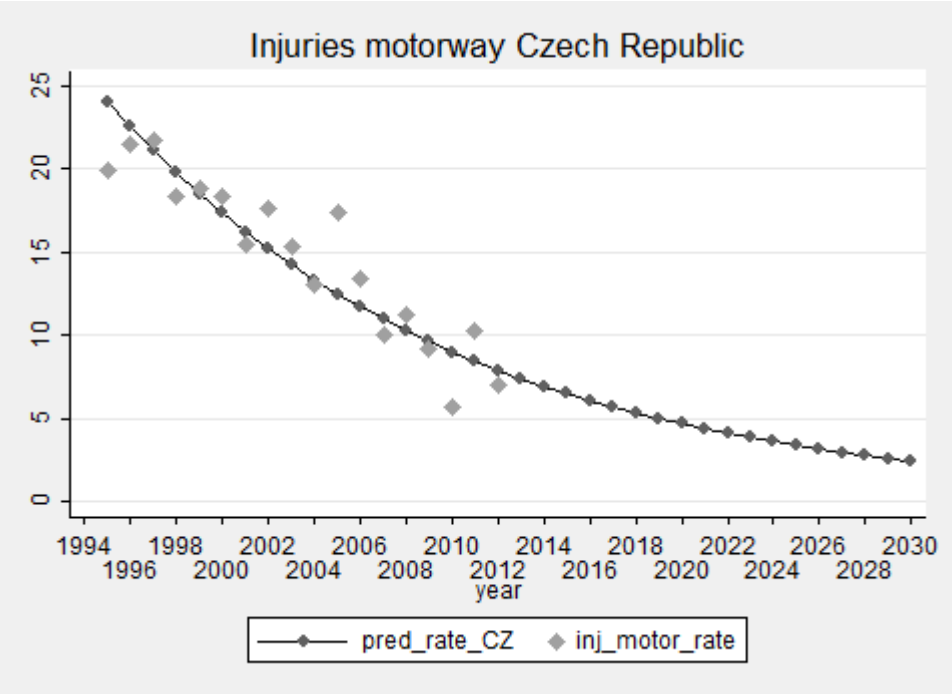


Czech Republic

```
. reg ln_inj_motor_rate time if country == "CZ"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   68.70
       Model |  2.08966279     1  2.08966279           Prob > F      =  0.0000
    Residual |  .486646163    16  .030415385           R-squared     =  0.8111
-------------+------------------------------           Adj R-squared =  0.7993
       Total |  2.57630896    17  .151547586           Root MSE      =   .1744

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0656737   .0079232    -8.29   0.000    -.0824701   -.0488773
       _cons |   3.245208   .0857634    37.84   0.000     3.063398    3.427019
------------------------------------------------------------------------------
```

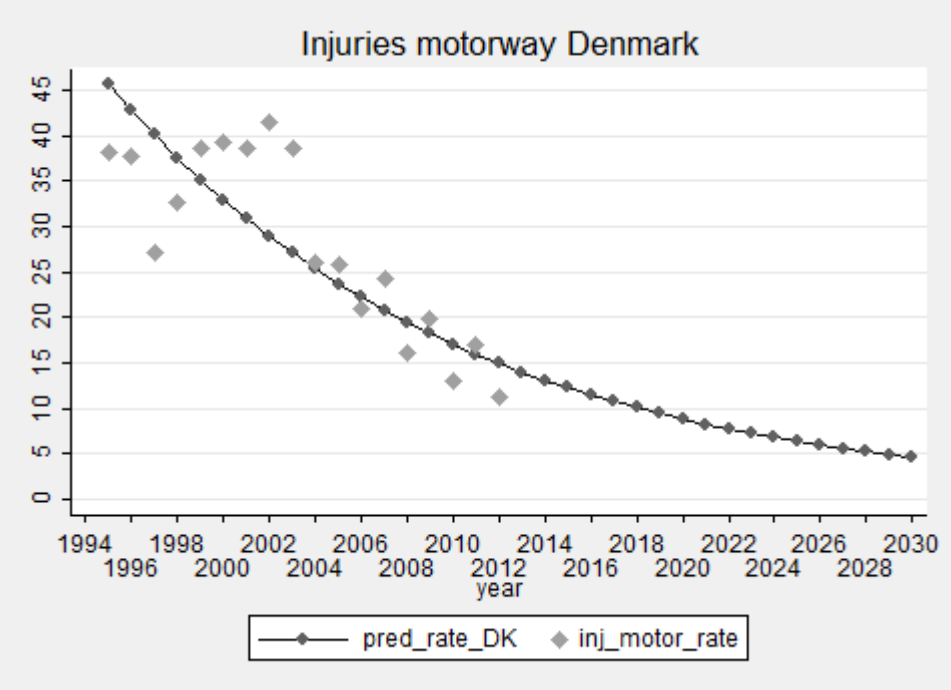


Denmark

```
.
. reg ln_inj_motor_rate time if country == "DK"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   41.51
       Model |   2.0981442     1   2.0981442           Prob > F      =  0.0000
    Residual |  .808677013    16  .050542313           R-squared     =  0.7218
-------------+------------------------------           Adj R-squared =  0.7044
       Total |  2.90682122    17  .170989483           Root MSE      =  .22482

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0658068   .0102136    -6.44   0.000    -.0874588   -.0441548
       _cons |   3.890105   .1105561    35.19   0.000     3.655736    4.124473
------------------------------------------------------------------------------
```

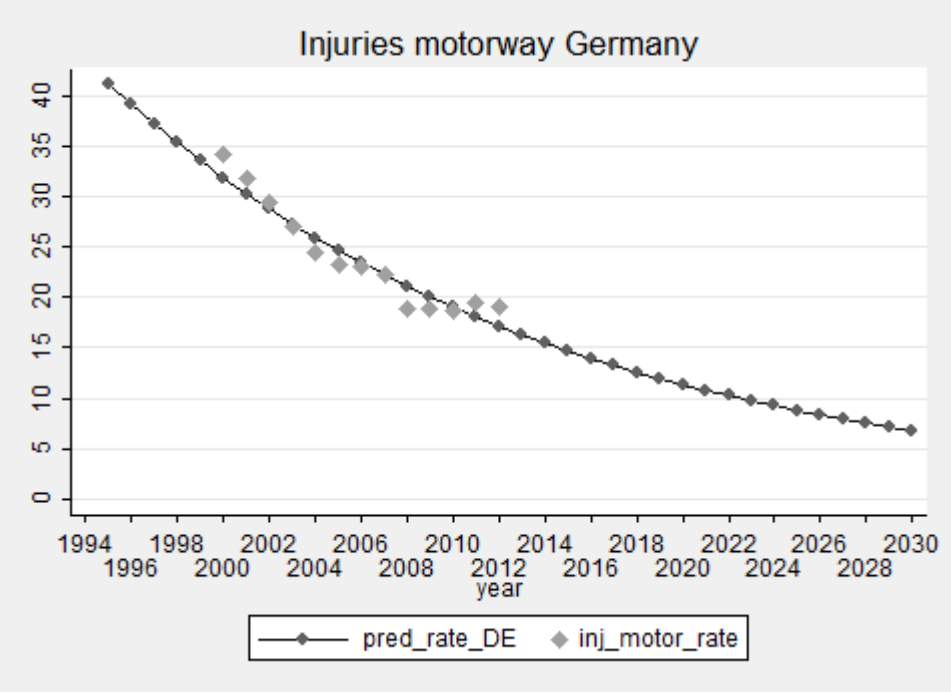


Germany

```
.
. reg ln_inj_motor_rate time if country == "DE"

      Source |       SS       df       MS              Number of obs =      13
-------------+------------------------------           F(  1,    11) =  113.06
       Model |  .483585053     1  .483585053           Prob > F      =  0.0000
    Residual |  .047050677    11  .004277334           R-squared     =  0.9113
-------------+------------------------------           Adj R-squared =  0.9033
       Total |   .53063573    12  .044219644           Root MSE      =   .0654

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0515467   .0048479   -10.63   0.000    -.0622168   -.0408766
       _cons |   3.769809   .0609368    61.86   0.000     3.635688     3.90393
------------------------------------------------------------------------------
```

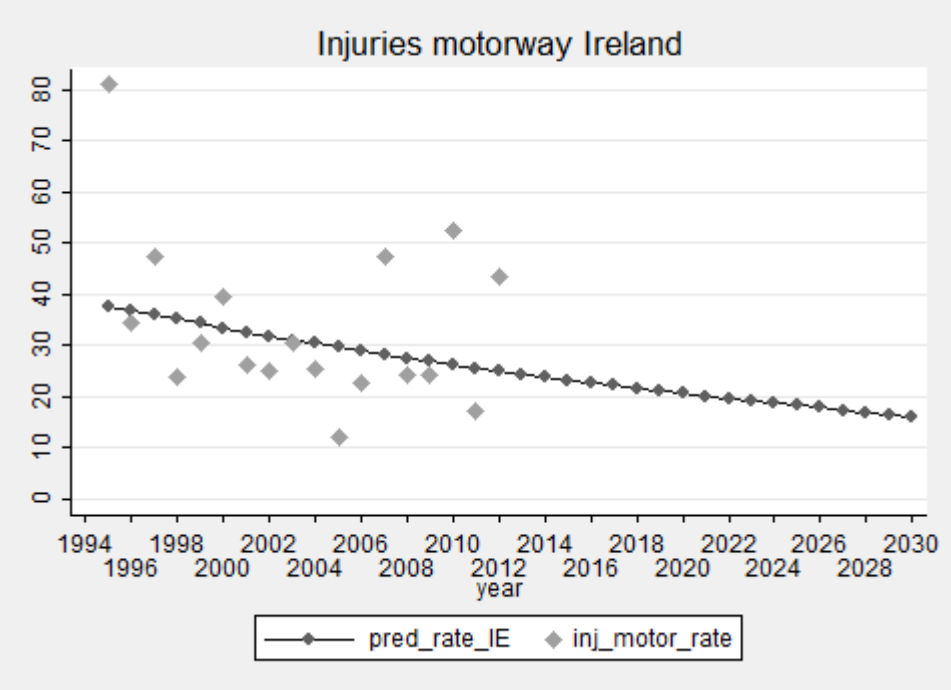


Ireland

```
. reg ln_inj_motor_rate time if country == "IE"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =    1.47
       Model |  .283918711     1  .283918711           Prob > F      =  0.2426
    Residual |  3.08519341    16  .192824588           R-squared     =  0.0843
-------------+------------------------------           Adj R-squared =  0.0270
       Total |  3.36911212    17  .198183066           Root MSE      =  .43912

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0242075   .0199496    -1.21   0.243    -.0664988    .0180838
       _cons |   3.656264   .2159416    16.93   0.000     3.198489     4.11404
------------------------------------------------------------------------------
```

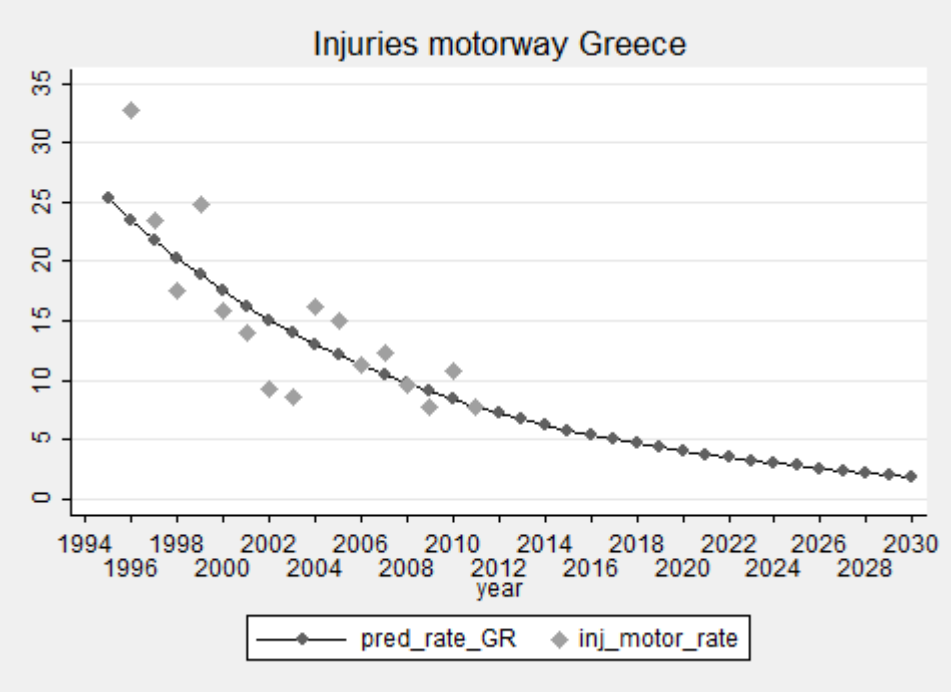


Greece

```
. reg ln_inj_motor_rate time if country == "GR"

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  1,    14) =   27.58
       Model |  1.83423842     1  1.83423842            Prob > F      =  0.0001
    Residual |  .930934625    14   .06649533           R-squared     =  0.6633
-------------+------------------------------           Adj R-squared =  0.6393
       Total |  2.76517304    15   .18434487           Root MSE      =  .25787

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0734494   .0139848    -5.25   0.000    -.1034438    -.043455
       _cons |   3.302508   .1476704    22.36   0.000     2.985786     3.61923
------------------------------------------------------------------------------
```

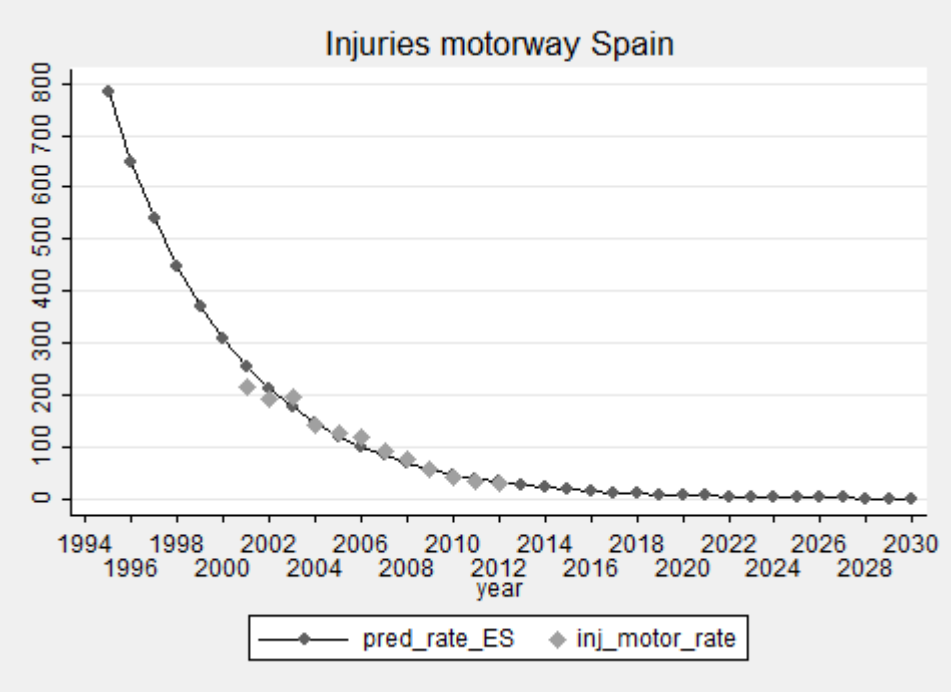


Spain

```
. reg ln_inj_motor_rate time if country == "ES"

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  1,    10) =  356.11
       Model |  4.95946665     1  4.95946665           Prob > F      =  0.0000
    Residual |  .139266393    10  .013926639           R-squared     =  0.9727
-------------+------------------------------           Adj R-squared =  0.9700
       Total |  5.09873305    11  .463521186           Root MSE      =  .11801

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1862299   .0098686   -18.87   0.000    -.2082185   -.1642413
       _cons |   6.848324    .127975    53.51   0.000     6.563177     7.13347
------------------------------------------------------------------------------
```

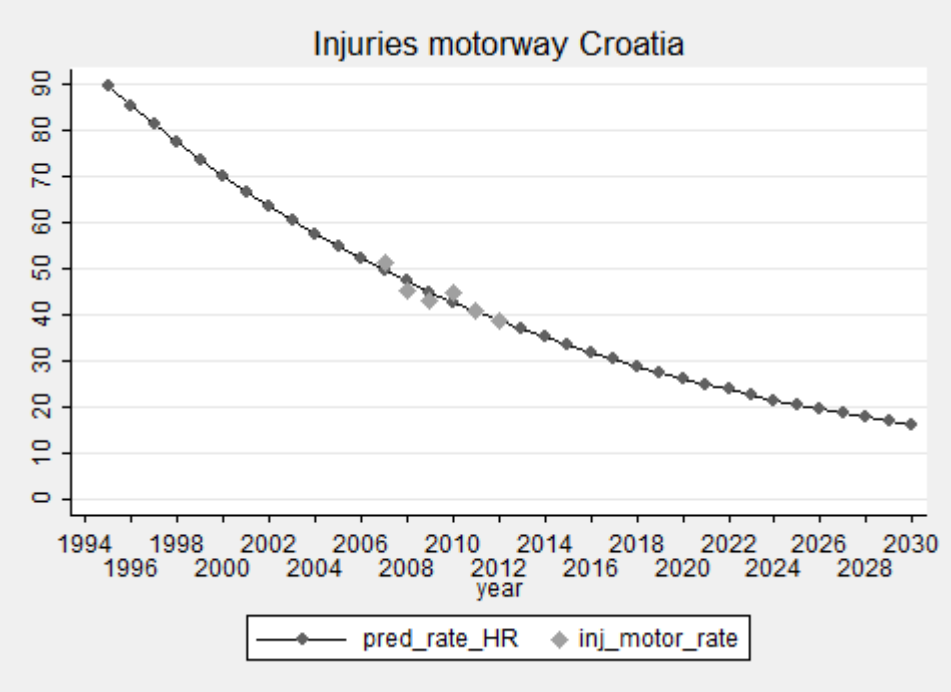


Croatia

```
. reg ln_inj_motor_rate time if country == "HR"

      Source |       SS       df       MS              Number of obs =       6
-------------+------------------------------           F(  1,     4) =   26.27
       Model |  .042305647     1  .042305647           Prob > F      =  0.0069
    Residual |   .00644212     4   .00161053           R-squared     =  0.8678
-------------+------------------------------           Adj R-squared =  0.8348
       Total |  .048747767     5  .009749553           Root MSE      =  .04013

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0491677   .0095932    -5.13   0.007    -.0758028   -.0225326
       _cons |   4.541194   .1495951    30.36   0.000     4.125851    4.956537
------------------------------------------------------------------------------
```

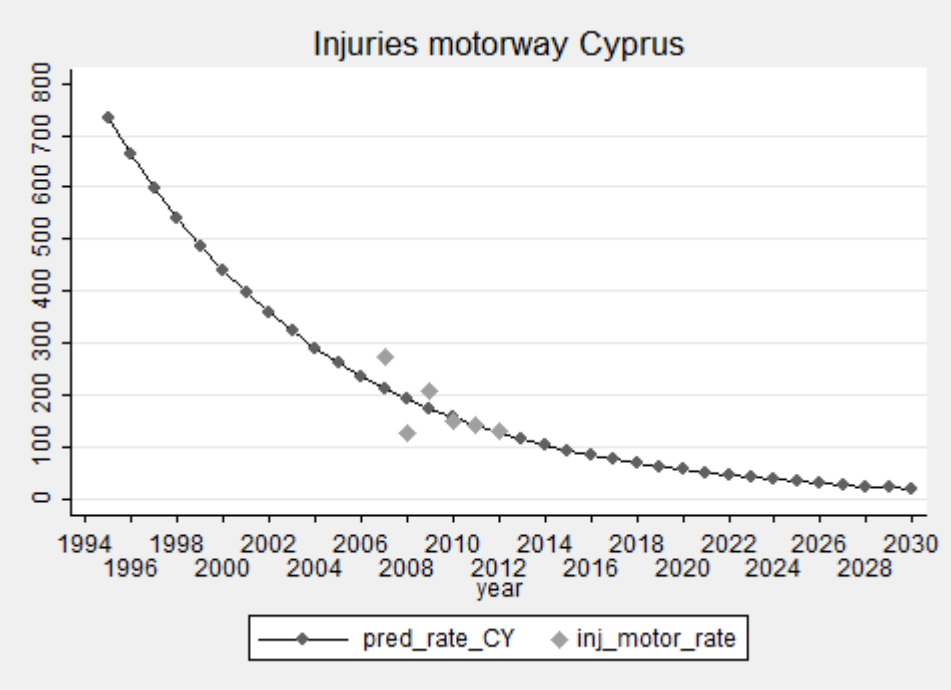


Cyprus

```
. reg ln_inj_motor_rate time if country == "CY"

      Source |       SS       df       MS              Number of obs =       6
-------------+------------------------------           F(  1,     4) =    2.60
       Model |   .18489907     1   .18489907           Prob > F      =  0.1823
    Residual |  .284746551     4  .071186638           R-squared     =  0.3937
-------------+------------------------------           Adj R-squared =  0.2421
       Total |  .469645621     5  .093929124           Root MSE      =  .26681

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1027894   .0637794    -1.61   0.182    -.2798693    .0742905
       _cons |   6.700247   .9945629     6.74   0.003     3.938897    9.461596
------------------------------------------------------------------------------
```

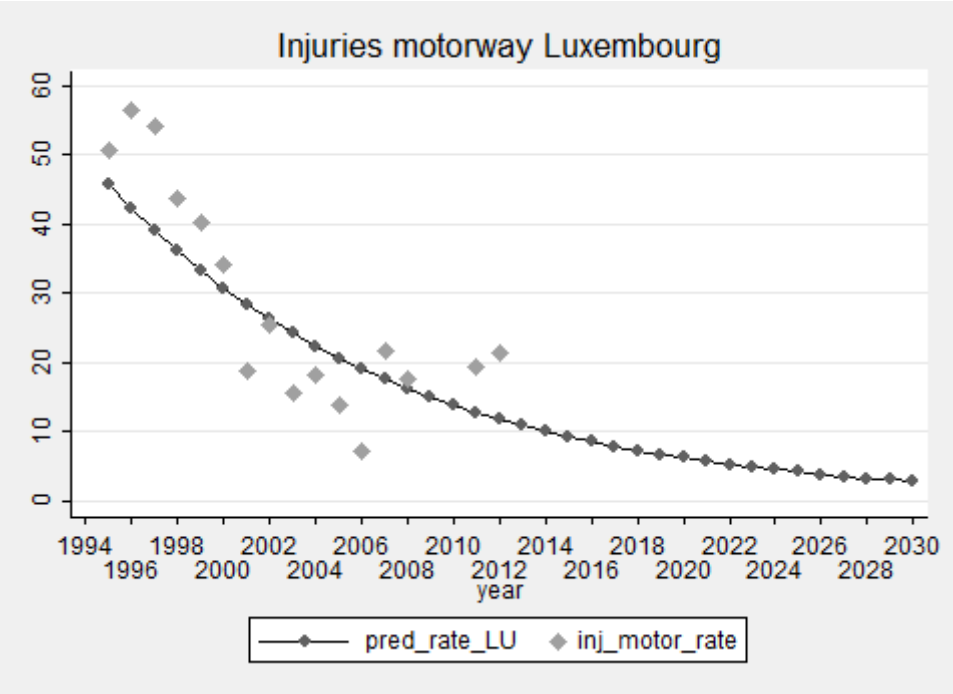


Luxembourg

```
. reg ln_inj_motor_rate time if country == "LU"

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  1,    14) =   15.05
       Model |  2.54895601     1  2.54895601            Prob > F      =  0.0017
    Residual |  2.37035711    14  .169311222           R-squared     =  0.5182
-------------+------------------------------           Adj R-squared =  0.4837
       Total |  4.91931312    15  .327954208           Root MSE      =  .41147

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0795296    .020497    -3.88   0.002    -.1234913   -.0355679
       _cons |   3.903406   .2067557    18.88   0.000     3.459959    4.346853
------------------------------------------------------------------------------
```

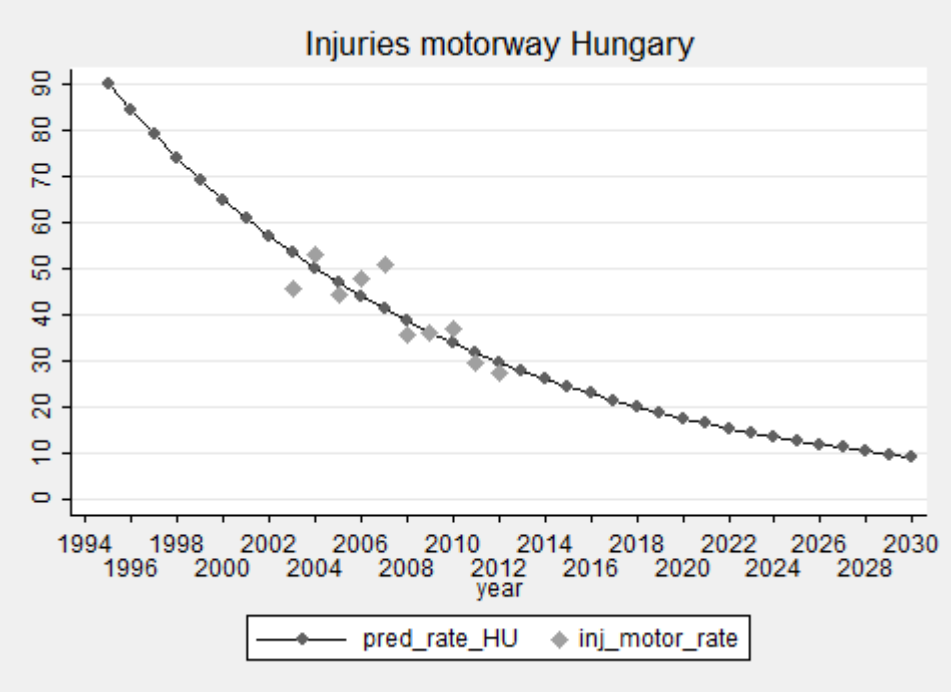


Hungary

```
.
. reg ln_inj_motor_rate time if country == "HU"

      Source |       SS       df       MS              Number of obs =      10
-------------+------------------------------           F(  1,     8) =   26.45
       Model |  .351895645     1  .351895645           Prob > F      =  0.0009
    Residual |  .106444358     8  .013305545           R-squared     =  0.7678
-------------+------------------------------           Adj R-squared =  0.7387
       Total |  .458340002     9  .050926667           Root MSE      =  .11535

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |    -.06531   .0126996    -5.14   0.001    -.0945953   -.0360248
       _cons |    4.56295   .1752818    26.03   0.000     4.158749     4.96715
```

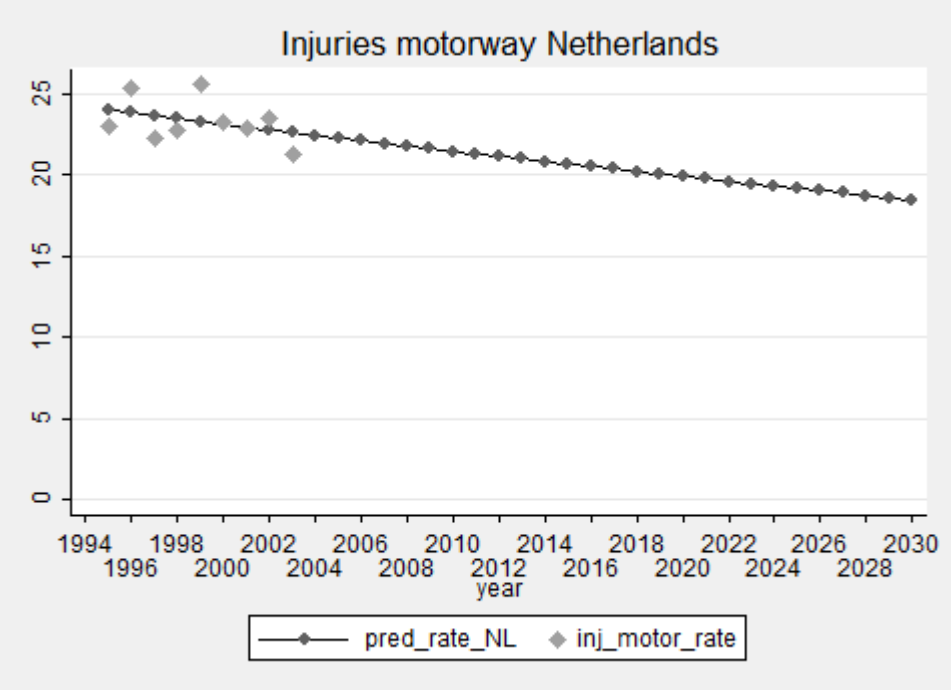


The Netherlands

```
.
. reg ln_inj_motor_rate time if country == "NL"

      Source |       SS       df       MS              Number of obs =       9
-------------+------------------------------           F(  1,     7) =    0.98
       Model |  .003378331     1  .003378331           Prob > F      =  0.3544
    Residual |  .024050256     7  .003435751           R-squared     =  0.1232
-------------+------------------------------           Adj R-squared = -0.0021
       Total |  .027428587     8  .003428573           Root MSE      =  .05862

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0075037   .0075672    -0.99   0.354    -.0253973    .0103899
       _cons |   3.186577    .042583    74.83   0.000     3.085884     3.28727
------------------------------------------------------------------------------
```

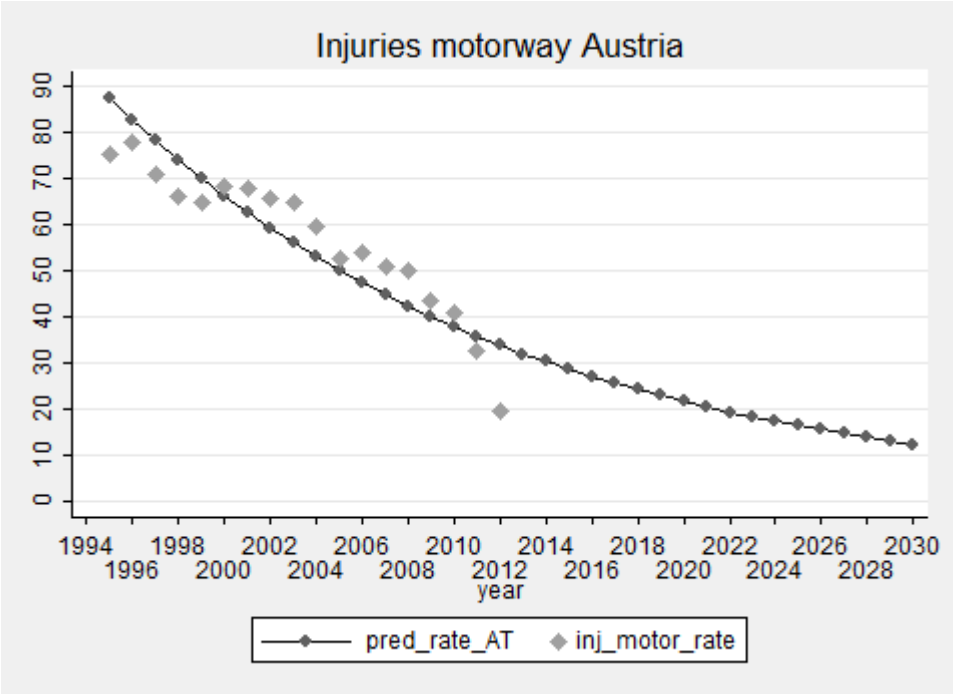


Austria

```
.
. reg ln_inj_motor_rate time if country == "AT"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   48.74
       Model |   1.5132949     1   1.5132949           Prob > F      =  0.0000
    Residual |  .496821884    16  .031051368           R-squared     =  0.7528
-------------+------------------------------           Adj R-squared =  0.7374
       Total |  2.01011679    17  .118242164           Root MSE      =  .17621

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0558875   .0080056    -6.98   0.000    -.0728586   -.0389164
       _cons |   4.524393   .0866554    52.21   0.000     4.340691    4.708094
------------------------------------------------------------------------------
```

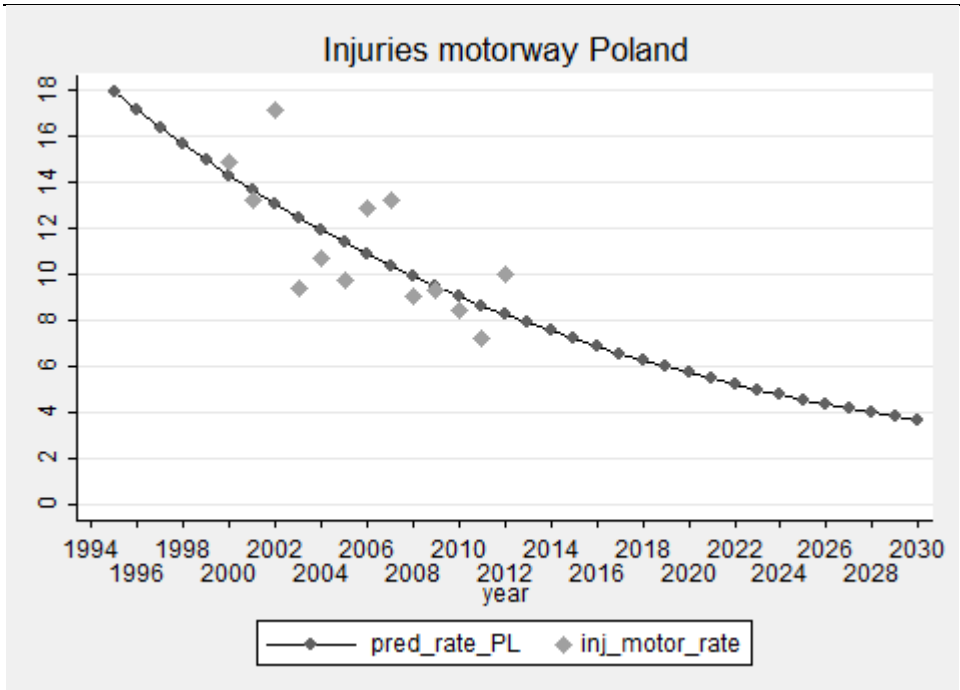


Poland

```
. reg ln_inj_motor_rate time if country == "PL"

      Source |       SS       df       MS              Number of obs =      13
-------------+------------------------------           F(  1,    11) =   11.53
       Model |  .379998135     1  .379998135           Prob > F      =  0.0060
    Residual |  .362534384    11  .032957671           R-squared     =  0.5118
-------------+------------------------------           Adj R-squared =  0.4674
       Total |  .742532519    12   .06187771           Root MSE      =  .18154

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0456936   .0134568    -3.40   0.006    -.0753118   -.0160753
       _cons |    2.93068   .1691497    17.33   0.000     2.558384    3.302976
------------------------------------------------------------------------------
```

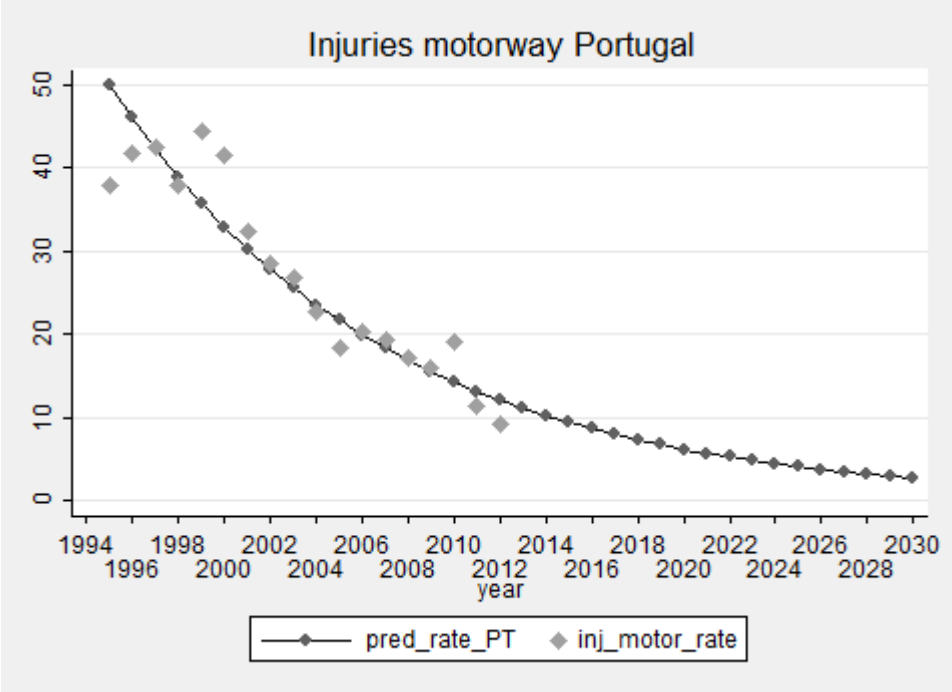


Portugal

```
.
. reg ln_inj_motor_rate time if country == "PT"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  133.74
       Model |  3.40638046     1  3.40638046           Prob > F      =  0.0000
    Residual |  .407522125    16  .025470133           R-squared     =  0.8931
-------------+------------------------------           Adj R-squared =  0.8865
       Total |  3.81390258    17  .224347211           Root MSE      =  .15959

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0838493   .0072505   -11.56   0.000    -.0992197   -.0684789
       _cons |    3.99514   .0784821    50.91   0.000     3.828766    4.161515
------------------------------------------------------------------------------
```

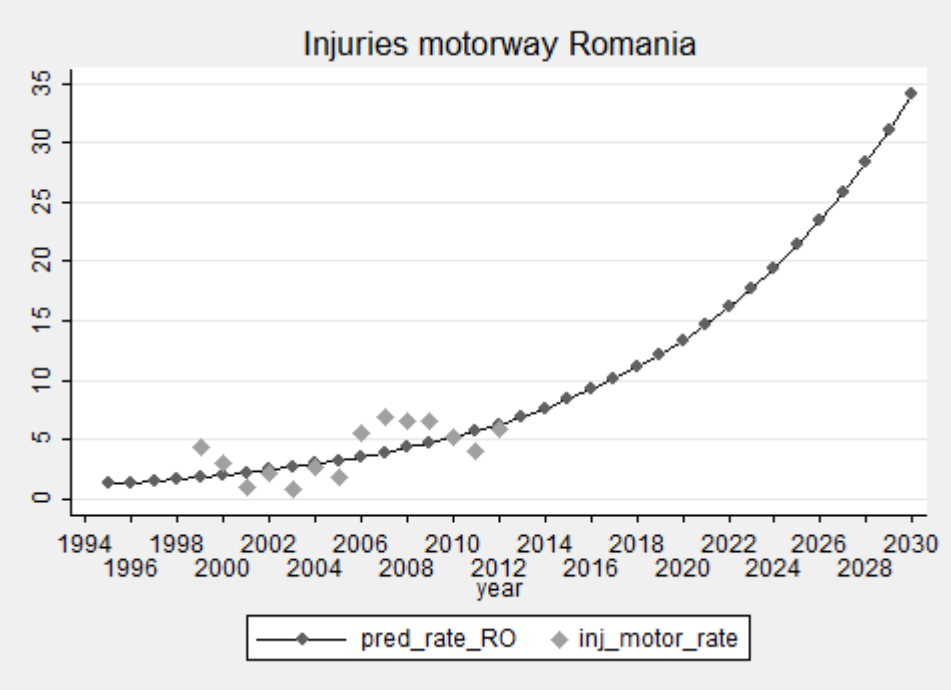


Romania

```
. reg ln_inj_motor_rate time if country == "RO"

      Source |       SS       df       MS              Number of obs =      14
-------------+------------------------------           F(  1,    12) =    6.34
       Model |   1.9965342     1   1.9965342           Prob > F      =  0.0270
    Residual |   3.7779367    12  .314828058           R-squared     =  0.3458
-------------+------------------------------           Adj R-squared =  0.2912
       Total |   5.7744709    13  .444190069           Root MSE      =   .5611

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   .0936802   .0372003     2.52   0.027     .0126278    .1747326
       _cons |   .1587777   .4533246     0.35   0.732    -.8289317    1.146487
------------------------------------------------------------------------------
```

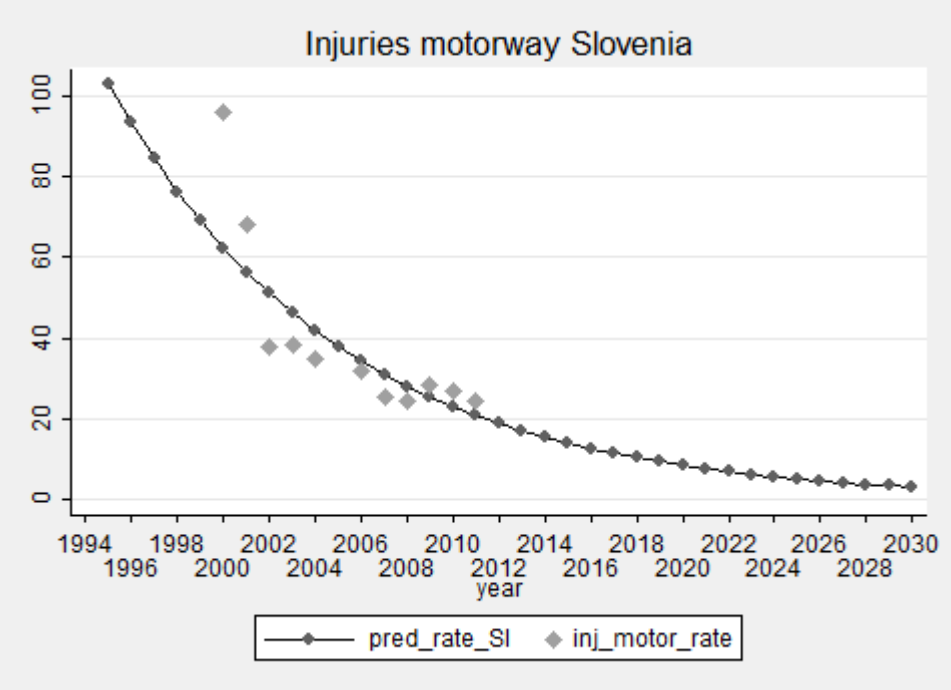


Slovenia

```
.
. reg ln_inj_motor_rate time if country == "SI"

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  1,     9) =   25.68
       Model |  1.44266687     1  1.44266687           Prob > F      =  0.0007
    Residual |  .505637002     9  .056181889           R-squared     =  0.7405
-------------+------------------------------           Adj R-squared =  0.7116
       Total |  1.94830387    10  .194830387           Root MSE      =  .23703

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1005378   .0198401    -5.07   0.001    -.1454193   -.0556563
       _cons |   4.736756   .2399531    19.74   0.000     4.193945    5.279568
------------------------------------------------------------------------------
```

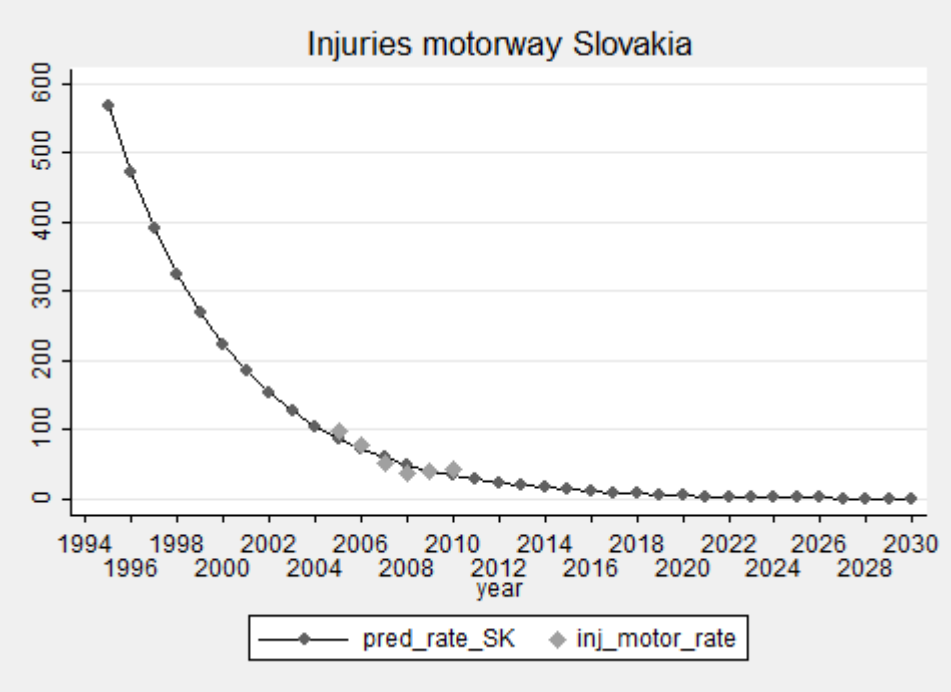


Slovakia

```
. reg ln_inj_motor_rate time if country == "SK"

      Source |       SS       df       MS              Number of obs =       6
-------------+------------------------------           F(  1,     4) =   16.31
       Model |  .612612945     1  .612612945           Prob > F      =  0.0156
    Residual |  .150210159     4   .03755254           R-squared     =  0.8031
-------------+------------------------------           Adj R-squared =  0.7539
       Total |  .762823104     5  .152564621           Root MSE      =  .19378

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1871001   .0463234    -4.04   0.016    -.3157146   -.0584857
       _cons |   6.528389   .6303504    10.36   0.000     4.778256    8.278523
------------------------------------------------------------------------------
```

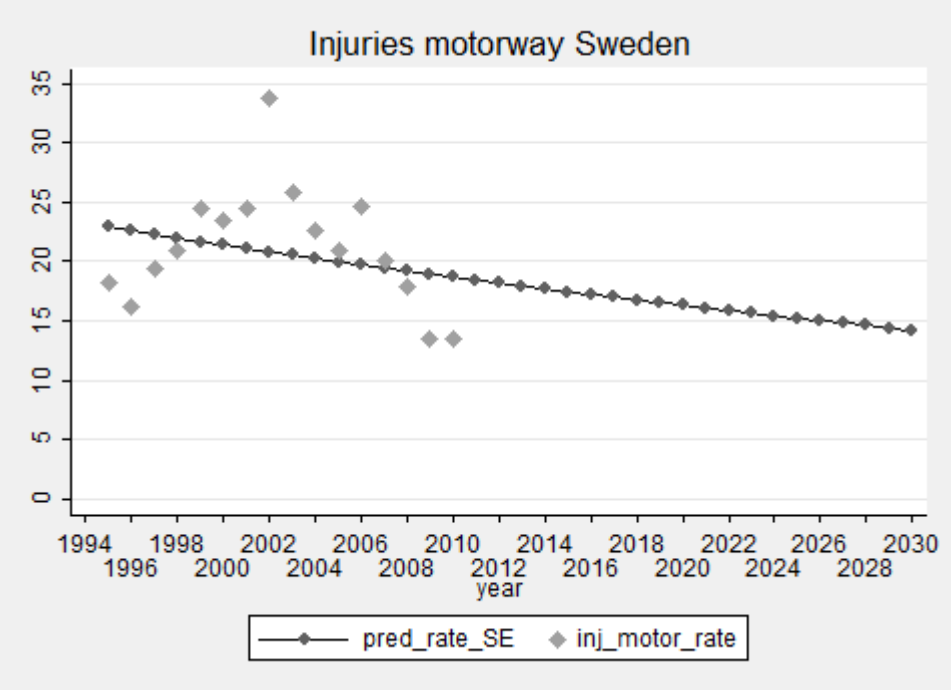


Sweden

```
.
. reg ln_inj_motor_rate time if country == "SE"

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  1,    14) =    1.10
       Model |   .06293815     1   .06293815           Prob > F      =  0.3117
    Residual |  .800024518    14  .057144608           R-squared     =  0.0729
-------------+------------------------------           Adj R-squared =  0.0067
       Total |  .862962667    15  .057530844           Root MSE      =  .23905

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0136056   .0129643    -1.05   0.312    -.0414112       .0142
       _cons |   3.144326   .1253586    25.08   0.000     2.875459    3.413194
------------------------------------------------------------------------------
```

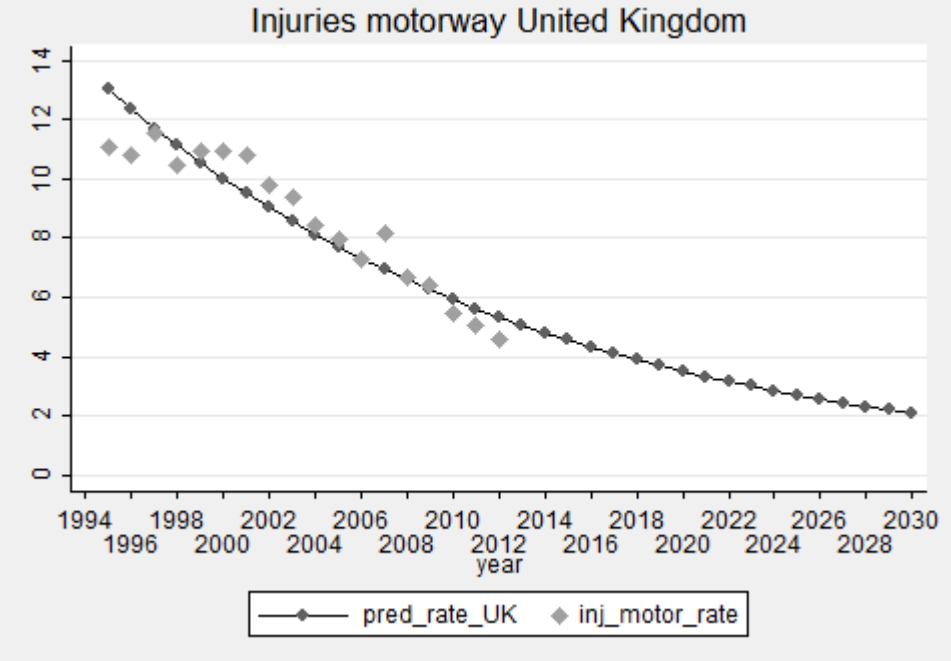


UK

```
. reg ln_inj_motor_rate time if country == "UK"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  131.71
       Model |  1.32334846     1  1.32334846            Prob > F      =  0.0000
    Residual |  .160753812    16  .010047113           R-squared     =  0.8917
-------------+------------------------------           Adj R-squared =  0.8849
       Total |  1.48410227    17  .087300134           Root MSE      =  .10024

------------------------------------------------------------------------------
ln_inj_mot~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0522625   .0045538   -11.48   0.000    -.0619161   -.0426089
       _cons |   2.617207   .0492919    53.10   0.000     2.512712    2.721701
```



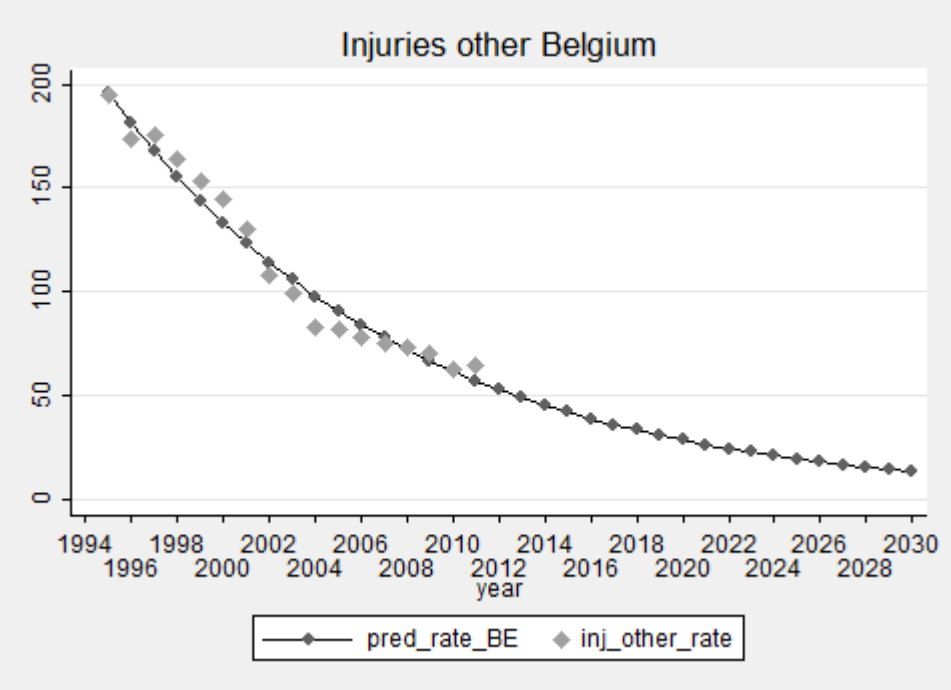
Seriously injured, rural roads

Belgium

```
.
. reg ln_inj_other_rate time if country == "BE"

      Source |       SS       df       MS              Number of obs =      17
-------------+------------------------------           F(  1,    15) =  394.65
       Model |  2.40791654     1  2.40791654            Prob > F      =  0.0000
    Residual |  .091521273    15  .006101418           R-squared     =  0.9634
-------------+------------------------------           Adj R-squared =  0.9609
       Total |  2.49943781    16  .156214863           Root MSE      =  .07811

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0768229   .0038671   -19.87   0.000    -.0850654   -.0685804
       _cons |   5.351149    .039626   135.04   0.000     5.266688    5.43561
------------------------------------------------------------------------------
```

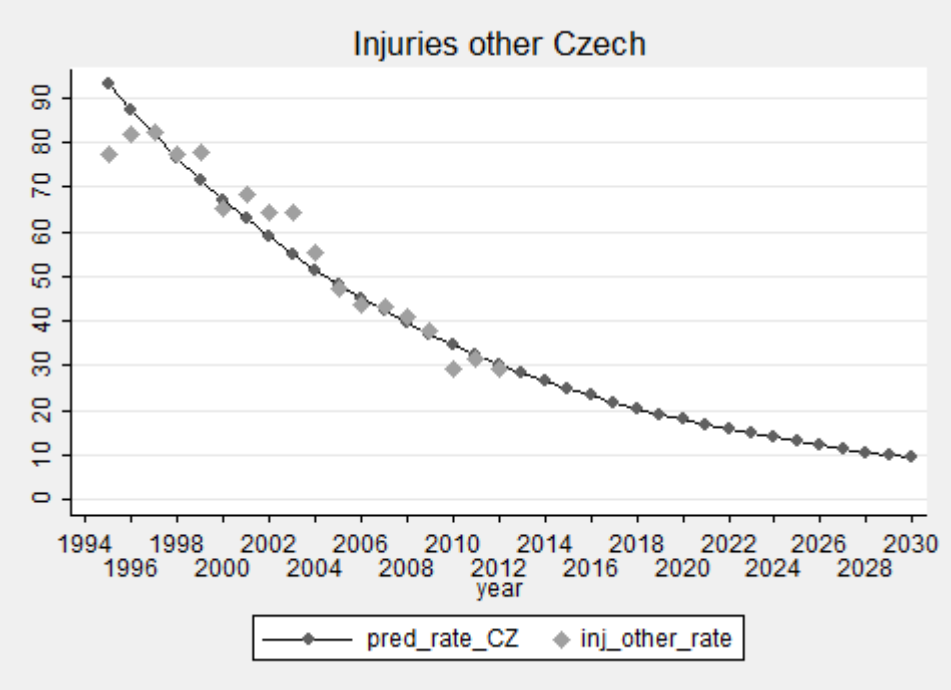


Czech Republic

```
. reg ln_inj_other_rate time if country == "CZ"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  266.07
       Model |  2.11472589     1  2.11472589            Prob > F      =  0.0000
    Residual |  .127165972    16  .007947873           R-squared     =  0.9433
-------------+------------------------------           Adj R-squared =  0.9397
       Total |  2.24189186    17  .131875992           Root MSE      =  .08915

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0660663   .0040502   -16.31   0.000    -.0746524   -.0574802
       _cons |   4.602292    .043841   104.98   0.000     4.509354    4.695231
------------------------------------------------------------------------------
```

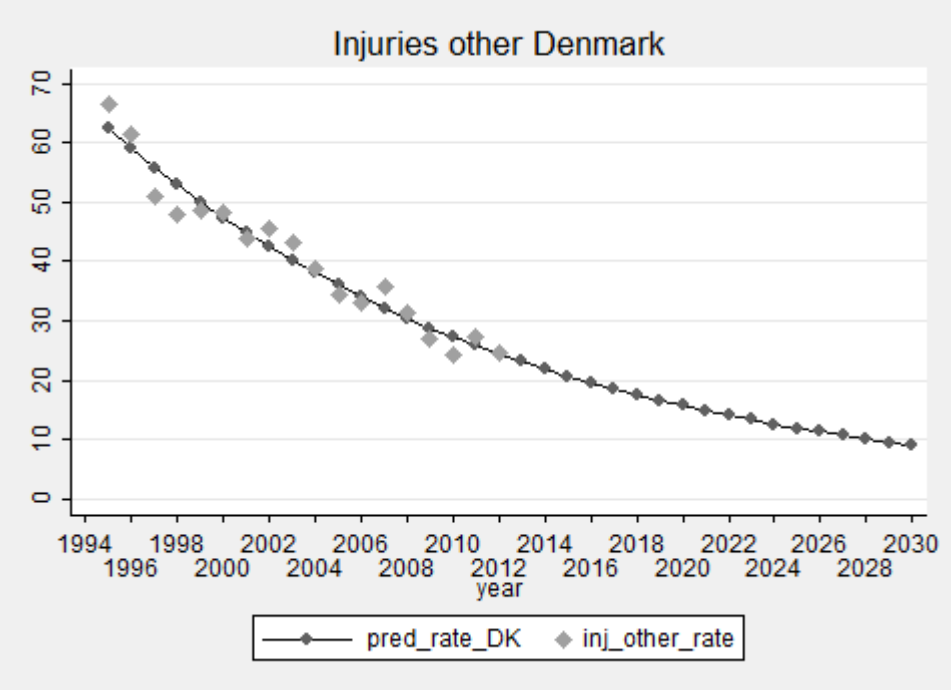


Denmark

```
.
. reg ln_inj_other_rate time if country == "DK"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  329.28
       Model |  1.46485737     1  1.46485737           Prob > F      =  0.0000
    Residual |  .071178544    16  .004448659           R-squared     =  0.9537
-------------+------------------------------           Adj R-squared =  0.9508
       Total |  1.53603591    17  .090355054           Root MSE      =   .0667

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0549858   .0030302   -18.15   0.000    -.0614095   -.0485621
       _cons |   4.186897   .0327997   127.65   0.000     4.117365    4.256429
------------------------------------------------------------------------------
```

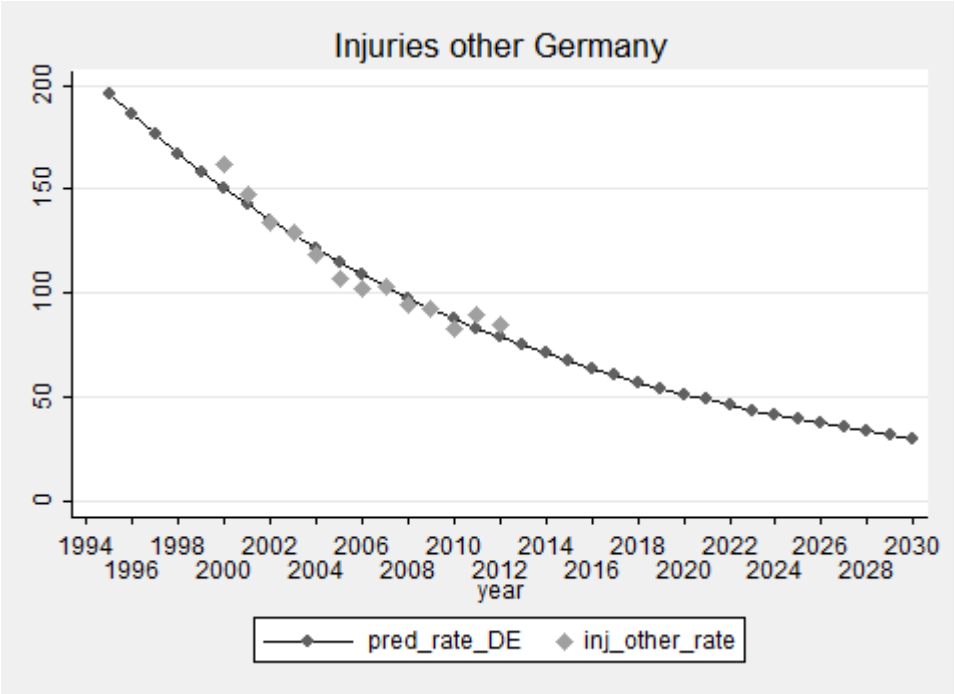


Germany

```
. reg ln_inj_other_rate time if country == "DE"

      Source |       SS       df       MS              Number of obs =      13
-------------+------------------------------           F(  1,    11) =  180.47
       Model |  .521019199     1  .521019199           Prob > F      =  0.0000
    Residual |  .031757056    11  .002887005           R-squared     =  0.9425
-------------+------------------------------           Adj R-squared =  0.9373
       Total |  .552776254    12  .046064688           Root MSE      =  .05373

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0535046   .0039828   -13.43   0.000    -.0622707   -.0447385
       _cons |   5.332412    .050063   106.51   0.000     5.222224      5.4426
------------------------------------------------------------------------------
```

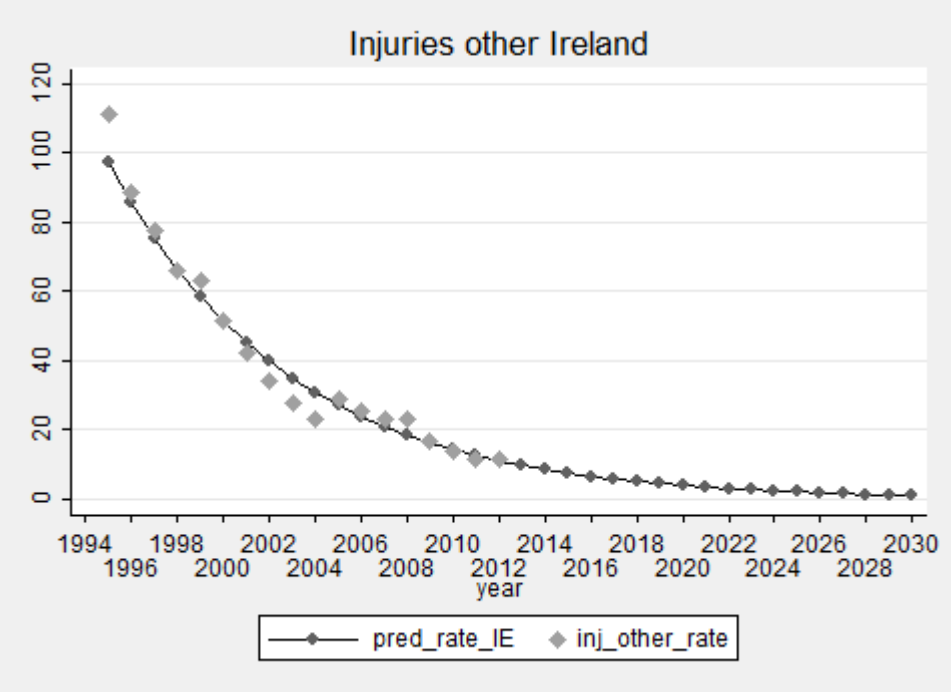


Ireland

```
.
. reg ln_inj_other_rate time if country == "IE"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  469.09
       Model |  7.93208087     1  7.93208087           Prob > F      =  0.0000
    Residual |  .270554875    16   .01690968           R-squared     =  0.9670
-------------+------------------------------           Adj R-squared =  0.9650
       Total |  8.20263574    17  .482507985           Root MSE      =  .13004

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1279519   .0059077   -21.66   0.000    -.1404757    -.115428
       _cons |   4.704635   .0639474    73.57   0.000     4.569072    4.840197
------------------------------------------------------------------------------
```

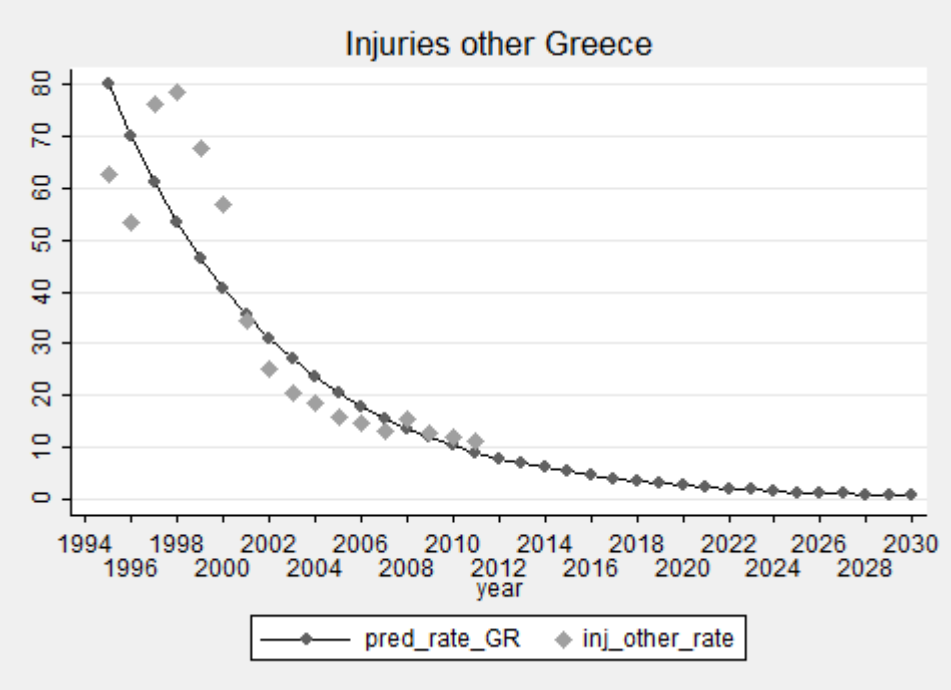


Greece

```
. reg ln_inj_other_rate time if country == "GR"

      Source |       SS       df       MS              Number of obs =      17
-------------+------------------------------           F(  1,    15) =  117.41
       Model |  7.57913442     1  7.57913442           Prob > F      =  0.0000
    Residual |  .968307067    15  .064553804           R-squared     =  0.8867
-------------+------------------------------           Adj R-squared =  0.8792
       Total |  8.54744149    16  .534215093           Root MSE      =  .25407

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1362949   .0125786   -10.84   0.000    -.1631055   -.1094844
       _cons |    4.52092   .1288919    35.08   0.000     4.246194    4.795647
------------------------------------------------------------------------------
```

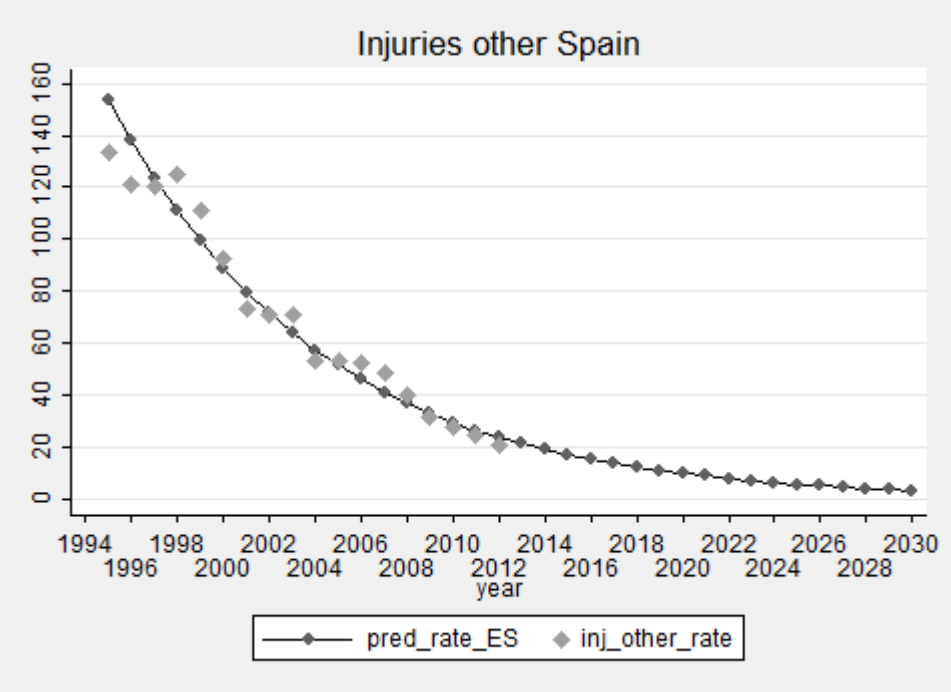


Spain

```
. reg ln_inj_other_rate time if country == "ES"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  552.14
       Model |  5.82991438     1  5.82991438           Prob > F      =  0.0000
    Residual |  .168939865    16  .010558742           R-squared     =  0.9718
-------------+------------------------------           Adj R-squared =  0.9701
       Total |  5.99885425    17  .352873779           Root MSE      =  .10276

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1096943   .0046683   -23.50   0.000    -.1195907    -.099798
       _cons |   5.145548   .0505314   101.83   0.000     5.038426     5.25267
------------------------------------------------------------------------------
```

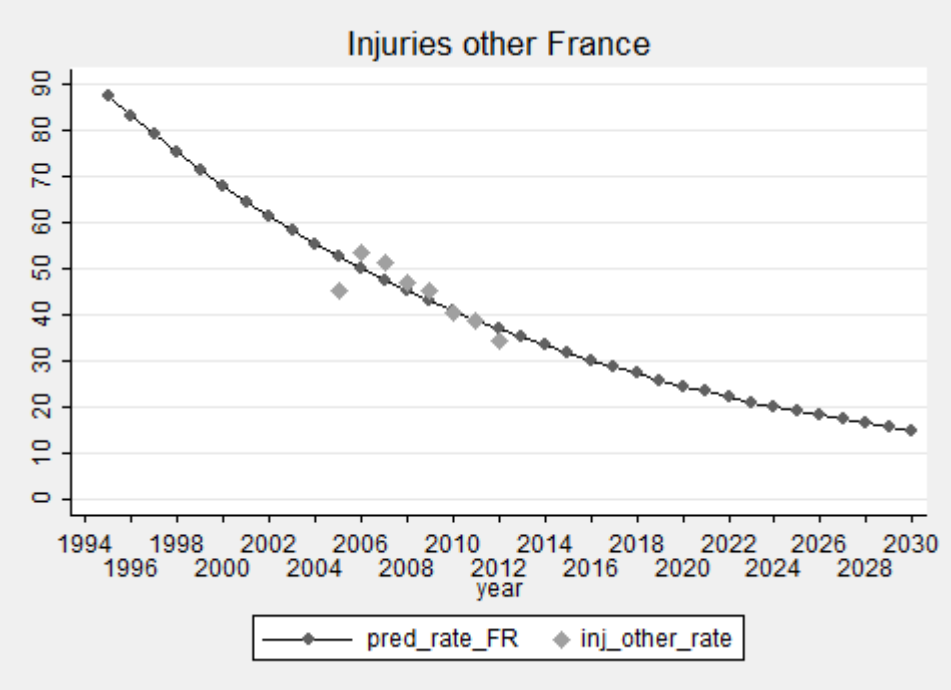


France

```
. reg ln_inj_other_rate time if country == "FR"

      Source |       SS       df       MS              Number of obs =       8
-------------+------------------------------           F(  1,     6) =   15.51
       Model |  .108270288     1  .108270288           Prob > F      =  0.0076
    Residual |  .041889142     6  .006981524           R-squared     =  0.7210
-------------+------------------------------           Adj R-squared =  0.6745
       Total |   .15015943     7  .021451347           Root MSE      =  .08356

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0507727   .0128929    -3.94   0.008    -.0823204   -.0192249
       _cons |   4.519153   .1892667    23.88   0.000     4.056035    4.982272
------------------------------------------------------------------------------
```

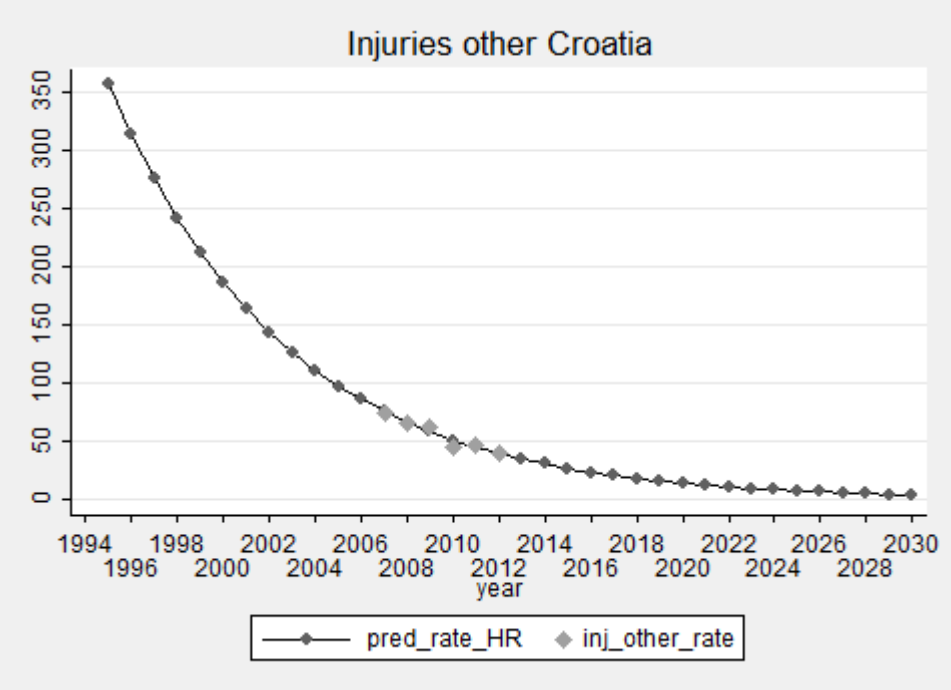


Croatia

```
. reg ln_inj_other_rate time if country == "HR"

      Source |       SS       df       MS              Number of obs =       6
-------------+------------------------------           F(  1,     4) =   61.75
       Model |   .29608641     1   .29608641           Prob > F      =  0.0014
    Residual |  .019179414     4  .004794853           R-squared     =  0.9392
-------------+------------------------------           Adj R-squared =  0.9240
       Total |  .315265823     5  .063053165           Root MSE      =  .06924

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1300739   .0165527    -7.86   0.001    -.1760316   -.0841163
       _cons |   6.011543   .2581194    23.29   0.000     5.294889    6.728198
------------------------------------------------------------------------------
```

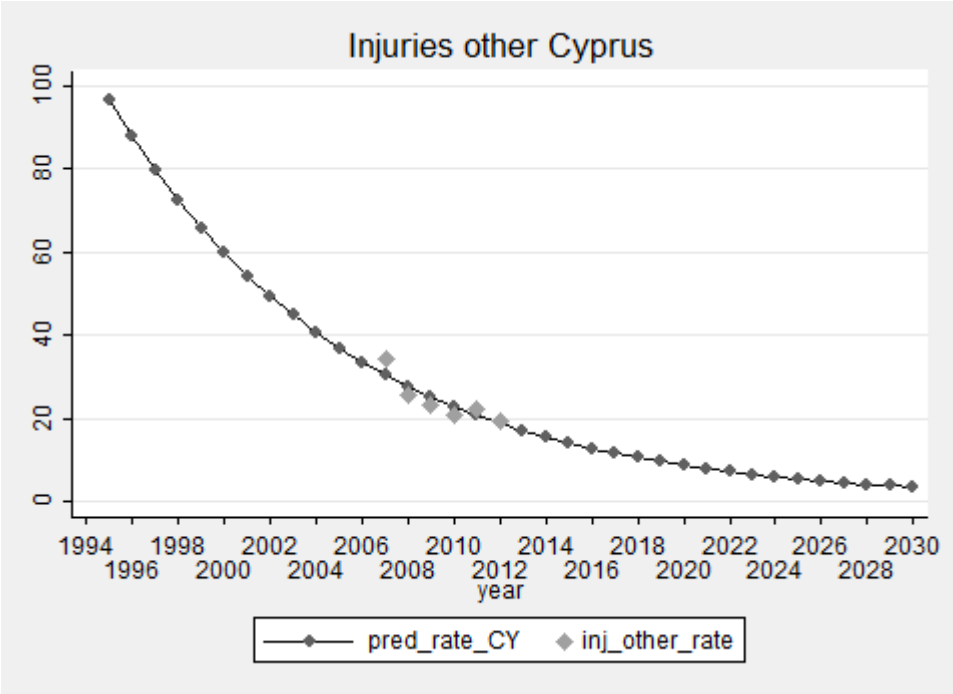


Cyprus

```
. reg ln_inj_other_rate time if country == "CY"

      Source |       SS       df       MS              Number of obs =       6
-------------+------------------------------           F(  1,     4) =   15.57
       Model |  .163025954     1  .163025954           Prob > F      =  0.0169
    Residual |   .04189243     4  .010473107           R-squared     =  0.7956
-------------+------------------------------           Adj R-squared =  0.7445
       Total |  .204918384     5  .040983677           Root MSE      =  .10234

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0965182   .0244635    -3.95   0.017    -.1644398   -.0285966
       _cons |   4.667171   .3814791    12.23   0.000     3.608015    5.726326
------------------------------------------------------------------------------
```

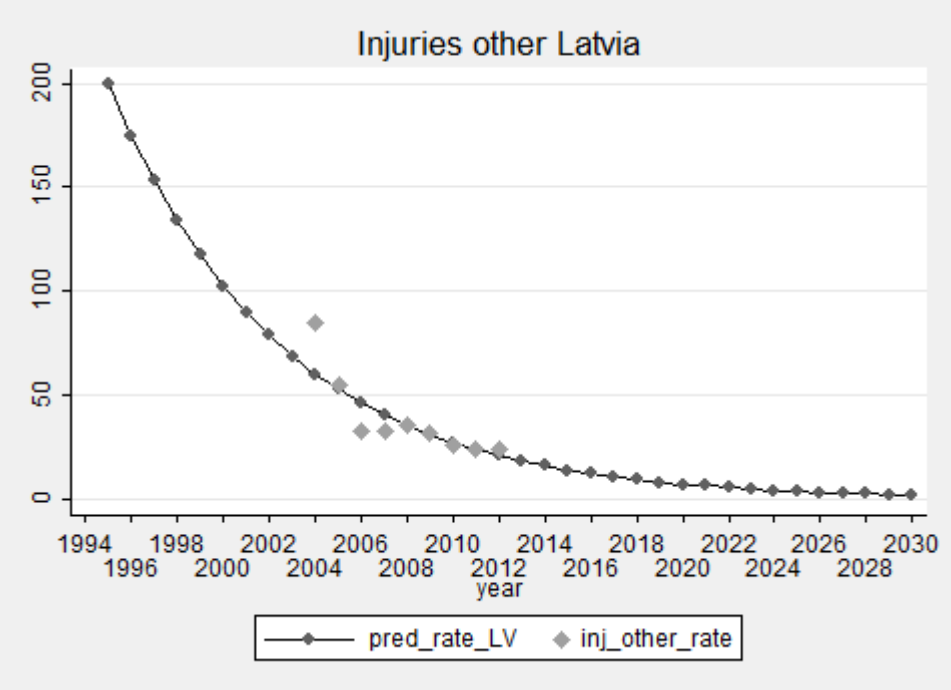


Latvia

```
. reg ln_inj_other_rate time if country == "LV"

      Source |       SS       df       MS              Number of obs =       9
-------------+------------------------------           F(  1,     7) =   24.79
       Model |  1.06117239     1  1.06117239           Prob > F      =  0.0016
    Residual |  .299612403     7  .042801772           R-squared     =  0.7798
-------------+------------------------------           Adj R-squared =  0.7484
       Total |   1.3607848     8    .1700981           Root MSE      =  .20689

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1329895   .0267089    -4.98   0.002    -.1961459   -.0698331
       _cons |   5.428549     .38023    14.28   0.000     4.529448     6.32765
------------------------------------------------------------------------------
```

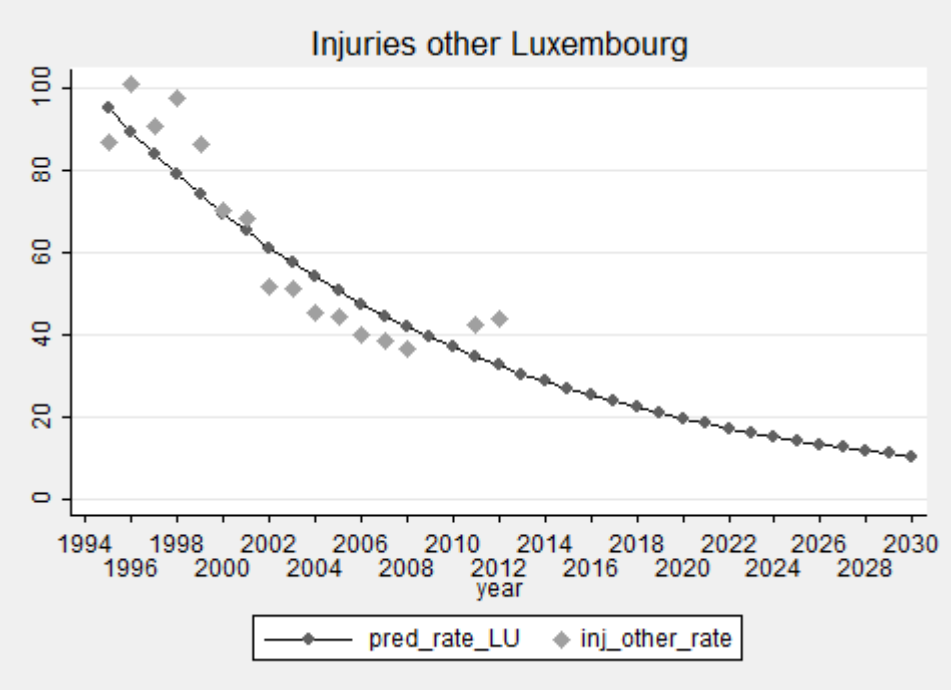


Luxembourg

```
. reg ln_inj_other_rate time if country == "LU"

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  1,    14) =   56.75
       Model |   1.6172585     1   1.6172585           Prob > F      =  0.0000
    Residual |  .398974392    14  .028498171           R-squared     =  0.8021
-------------+------------------------------           Adj R-squared =  0.7880
       Total |  2.01623289    15  .134415526           Root MSE      =  .16881

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0633486   .0084092    -7.53   0.000    -.0813846   -.0453126
       _cons |   4.620556   .0848249    54.47   0.000     4.438625    4.802488
------------------------------------------------------------------------------
```

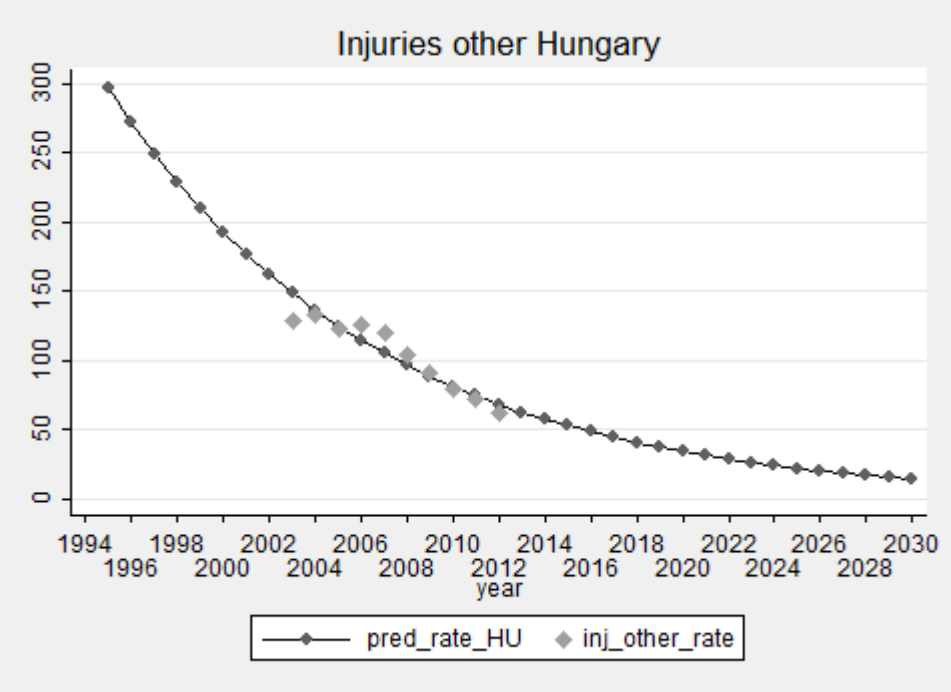


Hungary

```
. reg ln_inj_other_rate time if country == "HU"

      Source |       SS       df       MS              Number of obs =      10
-------------+------------------------------           F(  1,     8) =   77.30
       Model |  .611612328     1  .611612328           Prob > F      =  0.0000
    Residual |  .063294638     8   .00791183           R-squared     =  0.9062
-------------+------------------------------           Adj R-squared =  0.8945
       Total |  .674906966     9  .074989663           Root MSE      =  .08895

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0861016   .0097929    -8.79   0.000    -.1086841   -.0635191
       _cons |   5.776051   .1351634    42.73   0.000     5.464364    6.087738
------------------------------------------------------------------------------
```

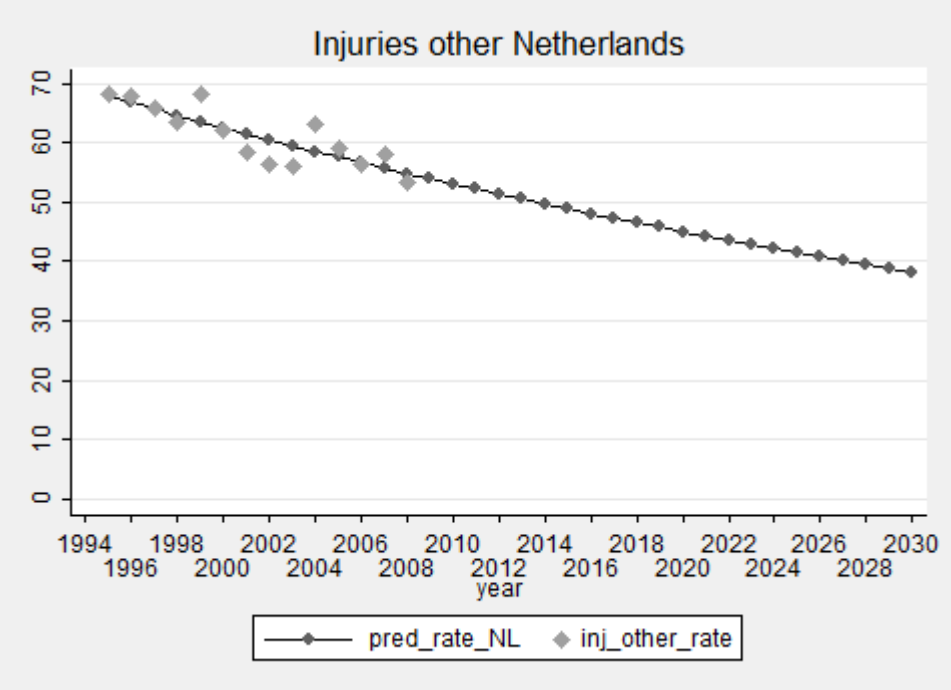


The Netherlands

```
. reg ln_inj_other_rate time if country == "NL"

      Source |       SS       df       MS              Number of obs =      14
-------------+------------------------------           F(  1,    12) =   28.08
       Model |  .061431352     1  .061431352           Prob > F      =  0.0002
    Residual |  .026252184    12  .002187682           R-squared     =  0.7006
-------------+------------------------------           Adj R-squared =  0.6757
       Total |  .087683537    13  .006744887           Root MSE      =  .04677

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0164325    .003101    -5.30   0.000     -.023189    -.009676
       _cons |   4.233865    .026404   160.35   0.000     4.176335    4.291394
------------------------------------------------------------------------------
```

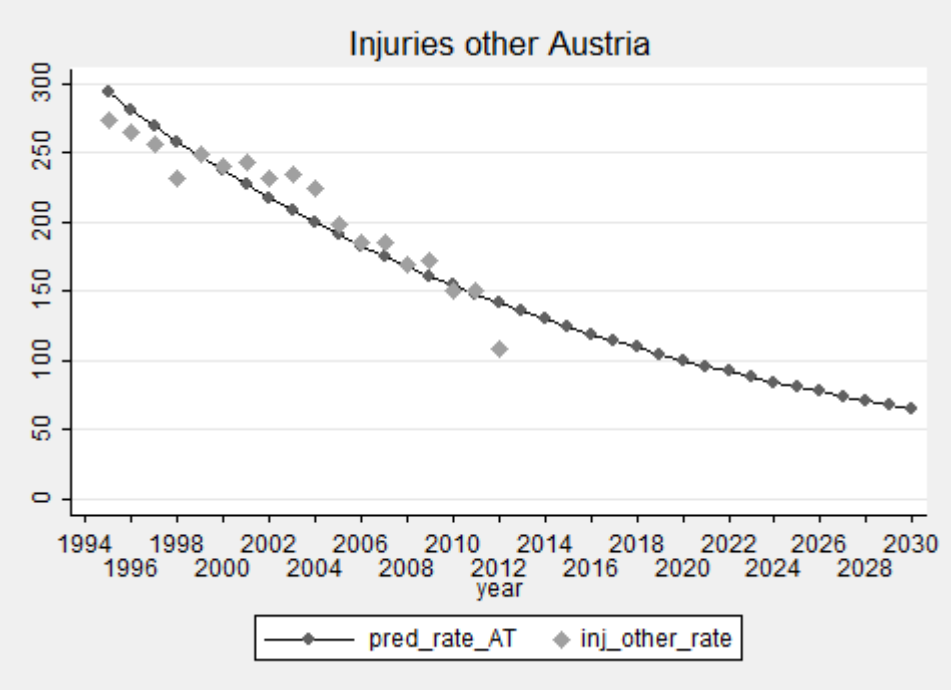


Austria

```
. reg ln_inj_other_rate time if country == "AT"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   99.66
       Model |  .892611076     1  .892611076           Prob > F      =  0.0000
    Residual |  .143297846    16  .008956115           R-squared     =  0.8617
-------------+------------------------------           Adj R-squared =  0.8530
       Total |  1.03590892    17  .060935819           Root MSE      =  .09464

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0429224   .0042995    -9.98   0.000    -.0520369    -.033808
       _cons |   5.724248   .0465388   123.00   0.000     5.625591    5.822906
------------------------------------------------------------------------------
```

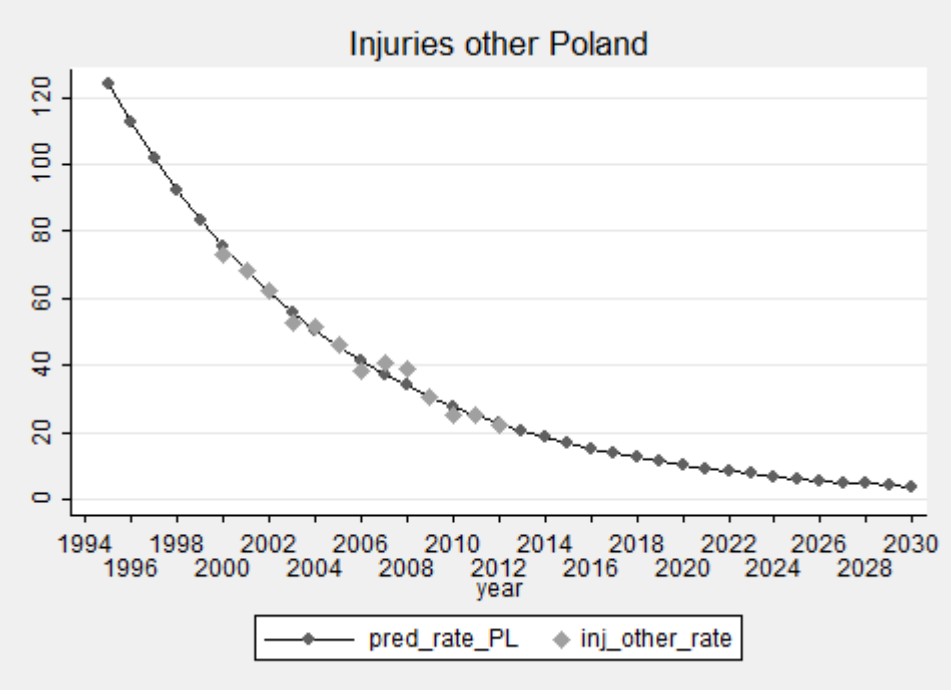


Poland

```
.
. reg ln_inj_other_rate time if country == "PL"

      Source |       SS       df       MS              Number of obs =      13
-------------+------------------------------           F(  1,    11) =  441.66
       Model |  1.81941703     1  1.81941703           Prob > F      =  0.0000
    Residual |  .045314169    11   .00411947           R-squared     =  0.9757
-------------+------------------------------           Adj R-squared =  0.9735
       Total |   1.8647312    12  .155394266           Root MSE      =  .06418

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   -.099984   .0047576   -21.02   0.000    -.1104553   -.0895126
       _cons |   4.921665   .0598017    82.30   0.000     4.790042    5.053287
------------------------------------------------------------------------------
```

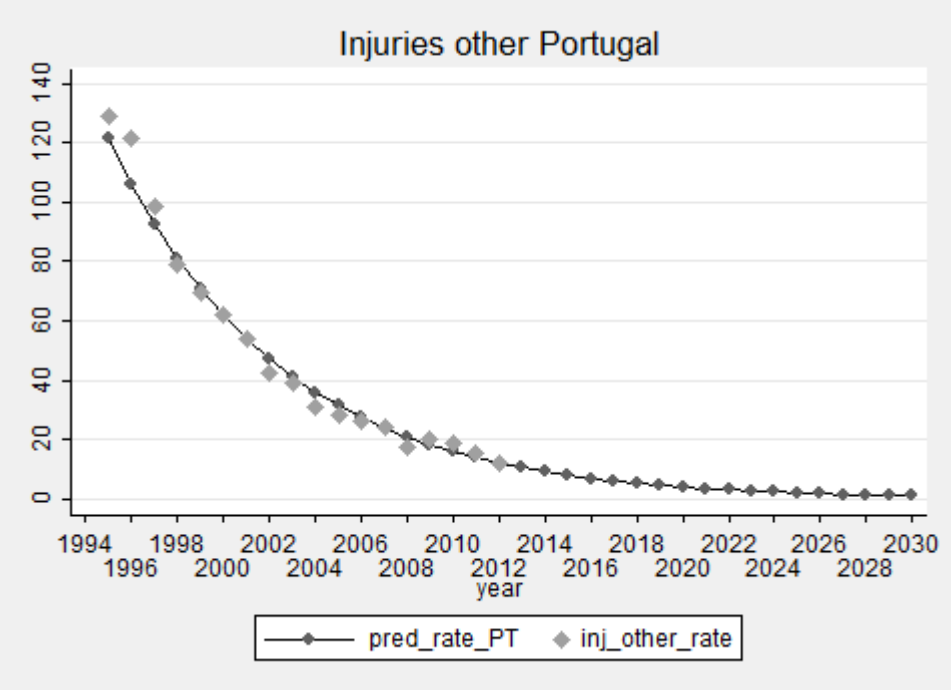


Portugal

```
. reg ln_inj_other_rate time if country == "PT"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  850.45
       Model |  8.89129156     1  8.89129156           Prob > F      =  0.0000
    Residual |  .167277709    16  .010454857           R-squared     =  0.9815
-------------+------------------------------           Adj R-squared =  0.9804
       Total |  9.05856926    17  .532857016           Root MSE      =  .10225

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1354676   .0046453   -29.16   0.000    -.1453152   -.1256201
       _cons |   4.936733   .0502822    98.18   0.000      4.83014    5.043326
------------------------------------------------------------------------------
```

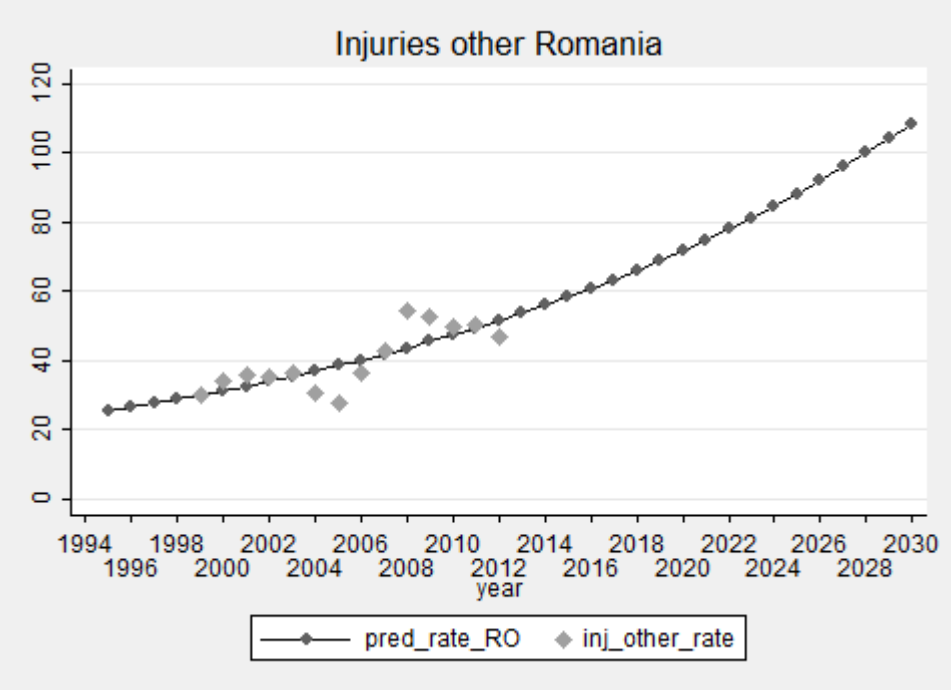


Romania.

```
. reg ln_inj_other_rate time if country == "RO"

      Source |       SS       df       MS              Number of obs =      14
-------------+------------------------------           F(  1,    12) =   18.63
       Model |   .38885627     1   .38885627           Prob > F      =  0.0010
    Residual |  .250431991    12  .020869333           R-squared     =  0.6083
-------------+------------------------------           Adj R-squared =  0.5756
       Total |  .639288261    13   .04917602           Root MSE      =  .14446

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   .0413432   .0095778     4.32   0.001      .020475    .0622113
       _cons |   3.197552    .116715    27.40   0.000     2.943251    3.451852
------------------------------------------------------------------------------
```

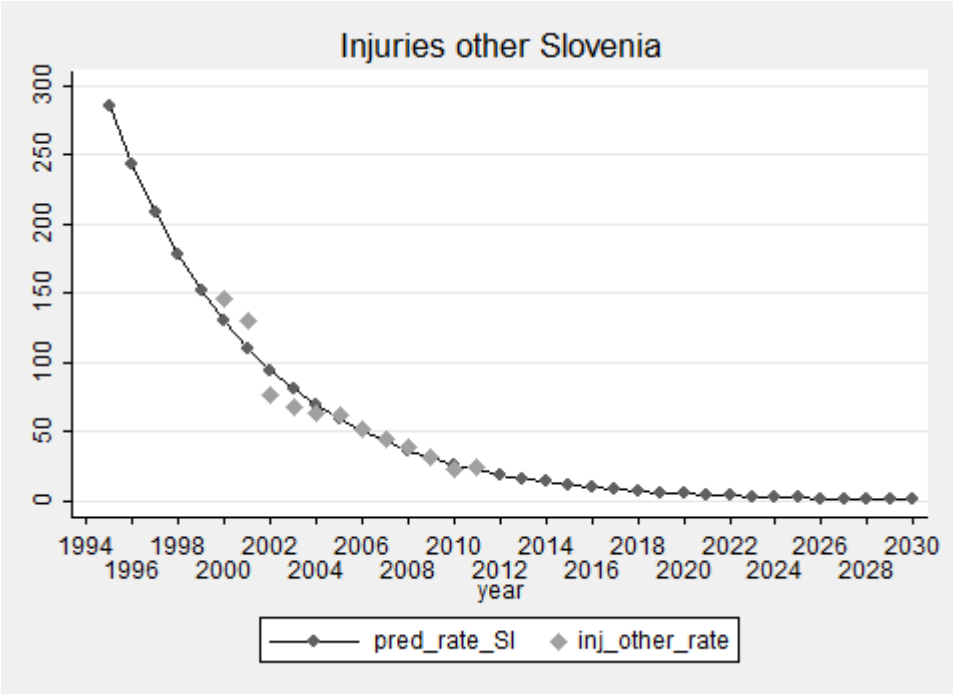


Slovenia

```
. reg ln_inj_other_rate time if country == "SI"

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  1,    10) =  248.38
       Model |  3.57134276     1  3.57134276           Prob > F      =  0.0000
    Residual |  .143784574    10  .014378457           R-squared     =  0.9613
-------------+------------------------------           Adj R-squared =  0.9574
       Total |  3.71512733    11  .337738848           Root MSE      =  .11991

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   -.158033   .0100274   -15.76   0.000    -.1803754   -.1356906
       _cons |   5.811853   .1203984    48.27   0.000     5.543589    6.080117
------------------------------------------------------------------------------
```

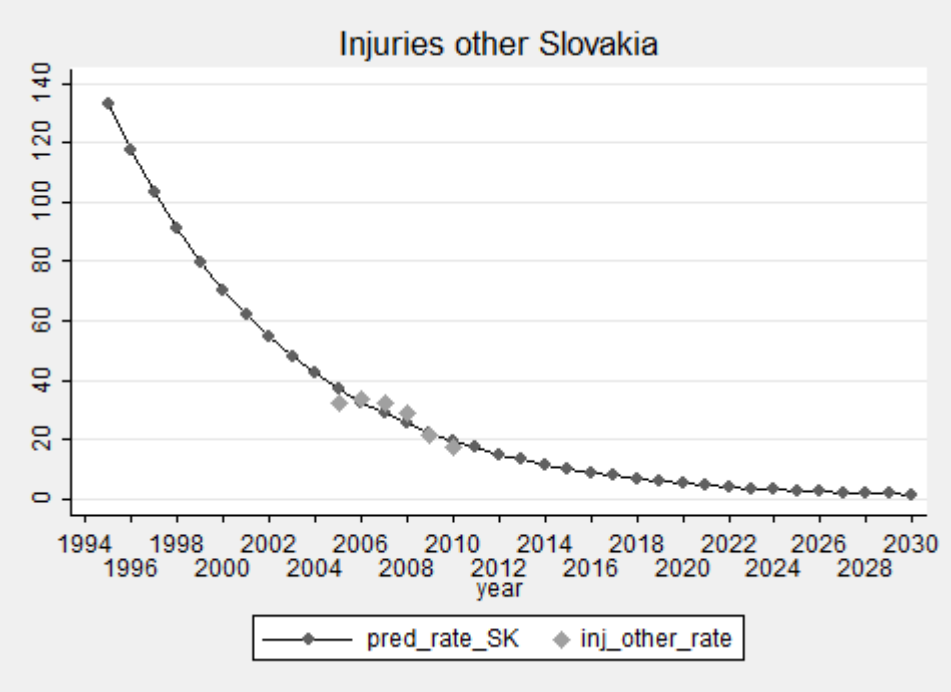


Slovakia

```
.
. reg ln_inj_other_rate time if country == "SK"

      Source |       SS       df       MS              Number of obs =       6
-------------+------------------------------           F(  1,     4) =   17.83
       Model |  .285710334     1  .285710334           Prob > F      =  0.0134
    Residual |  .064095857     4  .016023964           R-squared     =  0.8168
-------------+------------------------------           Adj R-squared =  0.7710
       Total |   .34980619     5  .069961238           Root MSE      =  .12659

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1277744   .0302598    -4.22   0.013    -.2117891   -.0437598
       _cons |   5.020355    .411763    12.19   0.000     3.877117    6.163592
```

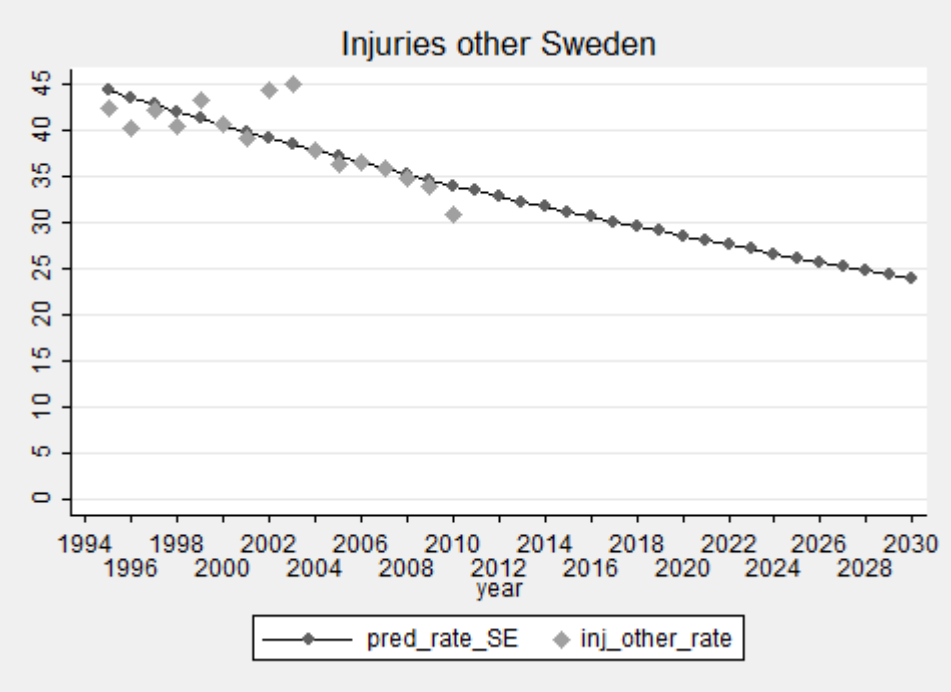


Sweden

```
.
. reg ln_inj_other_rate time if country == "SE"

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  1,    14) =   23.29
       Model |  .104668918     1  .104668918           Prob > F      =  0.0003
    Residual |  .062921088    14  .004494363           R-squared     =  0.6246
-------------+------------------------------           Adj R-squared =  0.5977
       Total |  .167590006    15  .011172667           Root MSE      =  .06704

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0175456   .0036358    -4.83   0.000    -.0253436   -.0097477
       _cons |   3.805465   .0351561   108.24   0.000     3.730063    3.880868
------------------------------------------------------------------------------
```

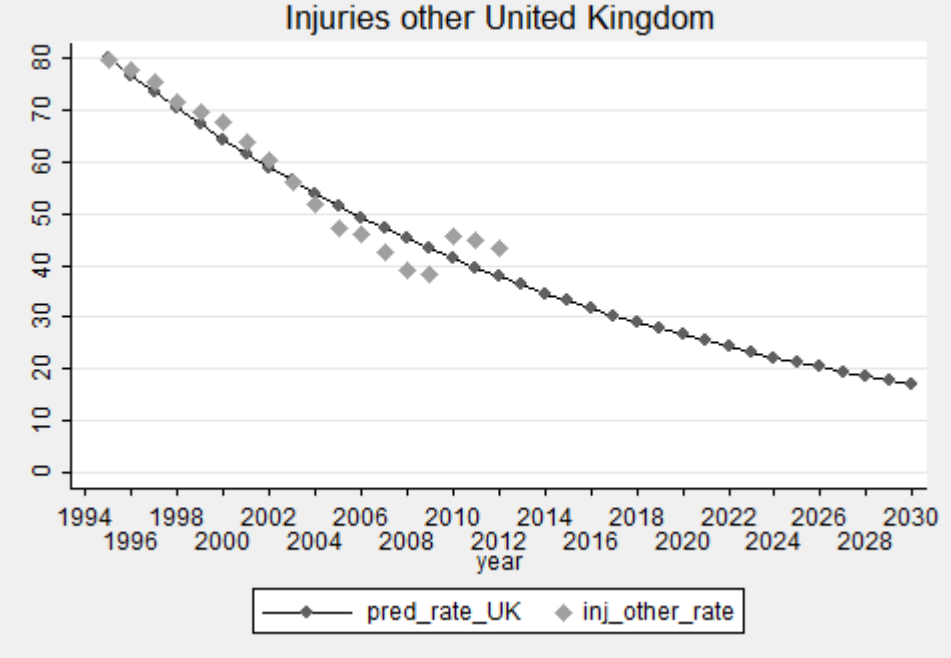


UK

```
. reg ln_inj_other_rate time if country == "UK"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  136.76
       Model |  .948298001     1  .948298001            Prob > F      =  0.0000
    Residual |  .110947591    16  .006934224            R-squared     =  0.8953
-------------+------------------------------           Adj R-squared =  0.8887
       Total |  1.05924559    17  .062308564            Root MSE      =  .08327

------------------------------------------------------------------------------
ln_inj_oth~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0442411   .0037831   -11.69   0.000     -.052261   -.0362212
       _cons |   4.429412     .04095   108.17   0.000     4.342602    4.516222
------------------------------------------------------------------------------
```



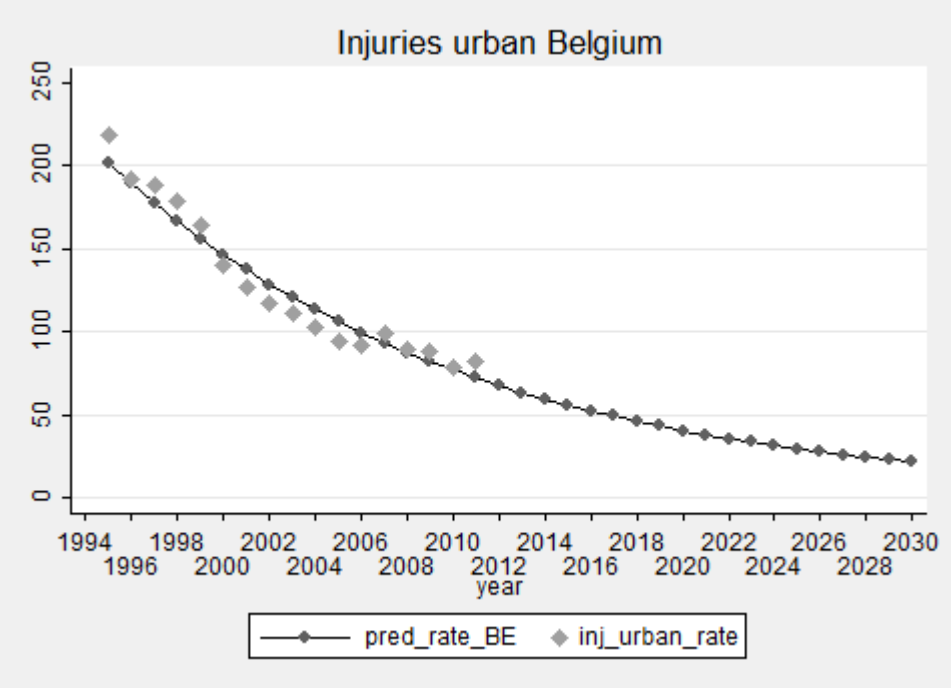
Seriously injured, urban roads.

Belgium

```
.
. reg ln_inj_urban_rate time if country == "BE"

      Source |       SS       df       MS              Number of obs =      17
-------------+------------------------------           F(  1,    15) =  259.60
       Model |   1.6895573     1   1.6895573           Prob > F      =  0.0000
    Residual |  .097625941    15  .006508396           R-squared     =  0.9454
-------------+------------------------------           Adj R-squared =  0.9417
       Total |  1.78718324    16  .111698953           Root MSE      =  .08067

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0643512    .003994   -16.11   0.000    -.0728641   -.0558382
       _cons |   5.369411   .0409262   131.20   0.000     5.282179    5.456643
------------------------------------------------------------------------------
```

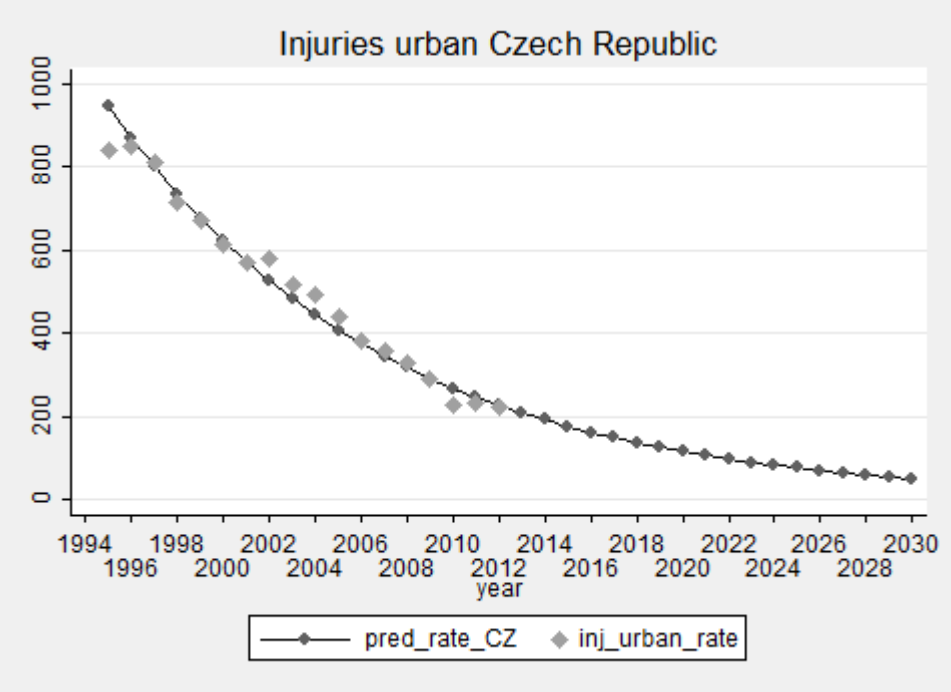


Czech Republic

```
.
. reg ln_inj_urban_rate time if country == "CZ"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  695.81
       Model |   3.4457717     1   3.4457717           Prob > F      =  0.0000
    Residual |    .0792347    16  .004952169           R-squared     =  0.9775
-------------+------------------------------           Adj R-squared =  0.9761
       Total |   3.5250064    17  .207353317           Root MSE      =  .07037

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0843328   .0031971   -26.38   0.000    -.0911102   -.0775553
       _cons |   6.937084   .0346061   200.46   0.000     6.863722    7.010445
------------------------------------------------------------------------------
```

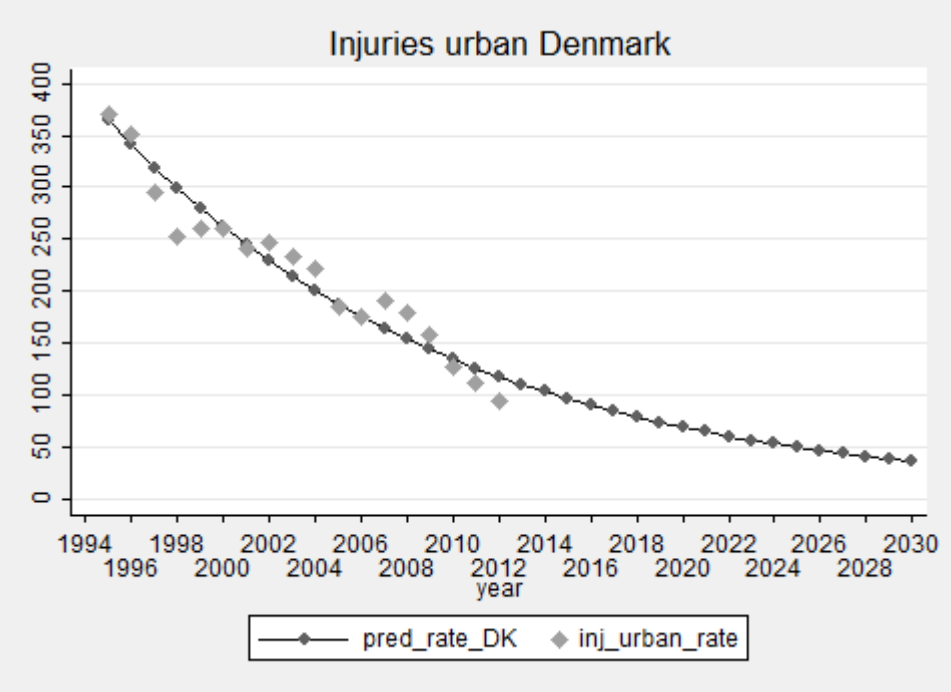


Denmark

```
.
. reg ln_inj_urban_rate time if country == "DK"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  185.58
       Model |  2.13222303     1  2.13222303           Prob > F      =  0.0000
    Residual |  .183828077    16  .011489255           R-squared     =  0.9206
-------------+------------------------------           Adj R-squared =  0.9157
       Total |  2.31605111    17  .136238301           Root MSE      =  .10719

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0663391   .0048697   -13.62   0.000    -.0766623   -.0560158
       _cons |   5.963835    .052711   113.14   0.000     5.852093    6.075577
```

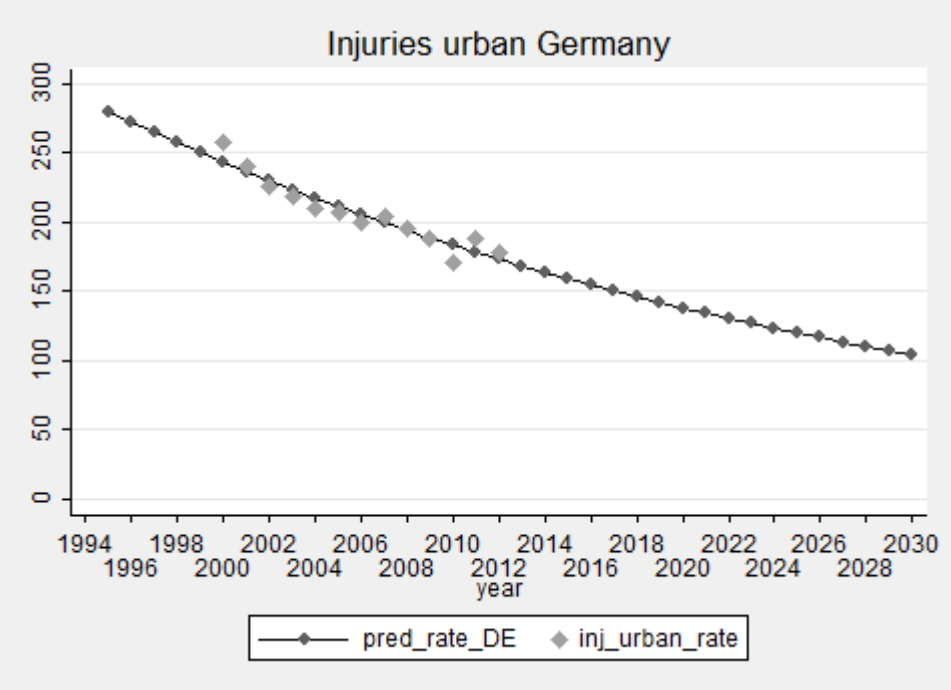


Germany

```
.
. reg ln_inj_urban_rate time if country == "DE"

      Source |       SS       df       MS              Number of obs =      13
-------------+------------------------------           F(  1,    11) =  102.18
       Model |  .144707596     1  .144707596           Prob > F      =  0.0000
    Residual |  .015578409    11  .001416219           R-squared     =  0.9028
-------------+------------------------------           Adj R-squared =  0.8940
       Total |  .160286005    12  .013357167           Root MSE      =  .03763

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0281975   .0027895   -10.11   0.000    -.0343372   -.0220578
       _cons |   5.661077   .0350637   161.45   0.000     5.583903    5.738252
------------------------------------------------------------------------------
```

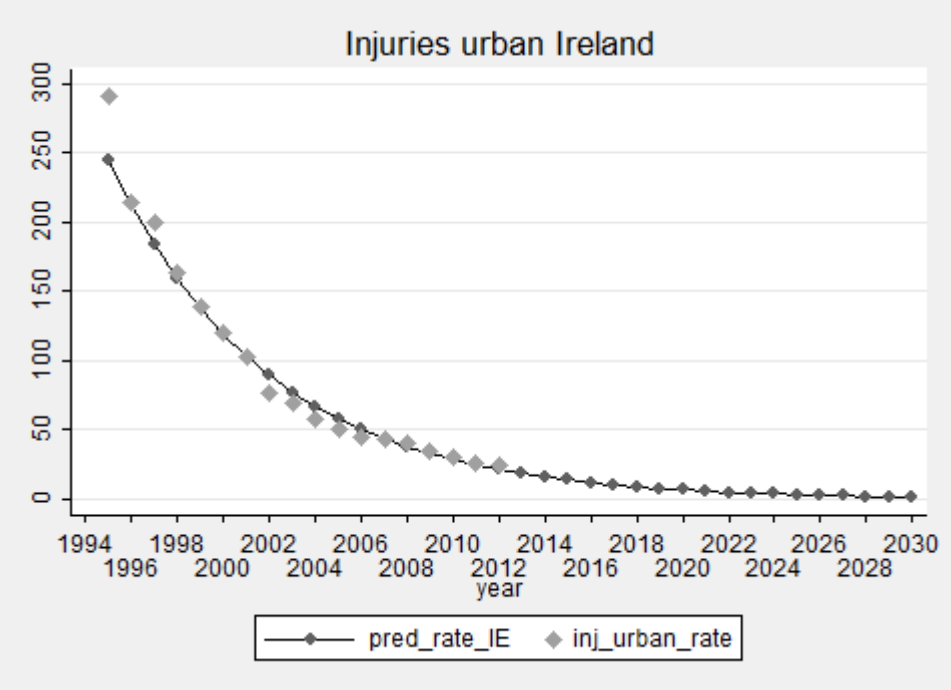


Ireland

```
.
. reg ln_inj_urban_rate time if country == "IE"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) = 1006.14
       Model |  10.0354608     1  10.0354608           Prob > F      =  0.0000
    Residual |  .159587039    16   .00997419           R-squared     =  0.9843
-------------+------------------------------           Adj R-squared =  0.9834
       Total |  10.1950478    17  .599708694           Root MSE      =  .09987

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1439202   .0045372   -31.72   0.000    -.1535387   -.1343017
       _cons |   5.644085   .0491127   114.92   0.000     5.539971    5.748199
```

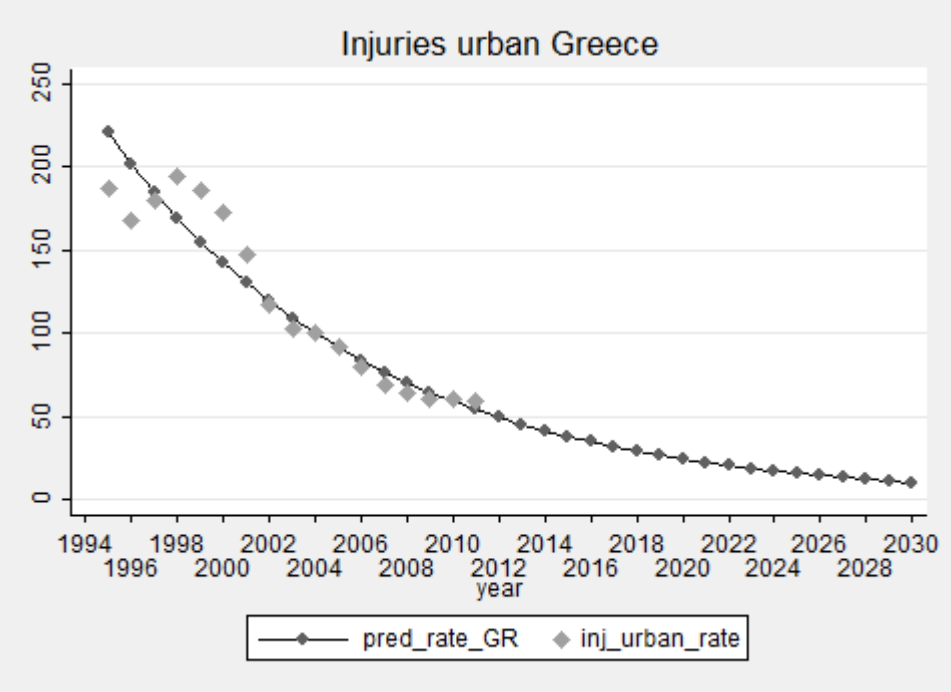


Greece

```
.
. reg ln_inj_urban_rate time if country == "GR"

      Source |       SS       df       MS              Number of obs =      17
-------------+------------------------------           F(  1,    15) =  228.20
       Model |  3.17775161     1  3.17775161           Prob > F      =  0.0000
    Residual |  .208876726    15  .013925115           R-squared     =  0.9383
-------------+------------------------------           Adj R-squared =  0.9342
       Total |  3.38662834    16  .211664271           Root MSE      =    .118

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0882531   .0058421   -15.11   0.000    -.1007052   -.0758009
       _cons |   5.482955   .0598638    91.59   0.000     5.355358    5.610551
------------------------------------------------------------------------------
```

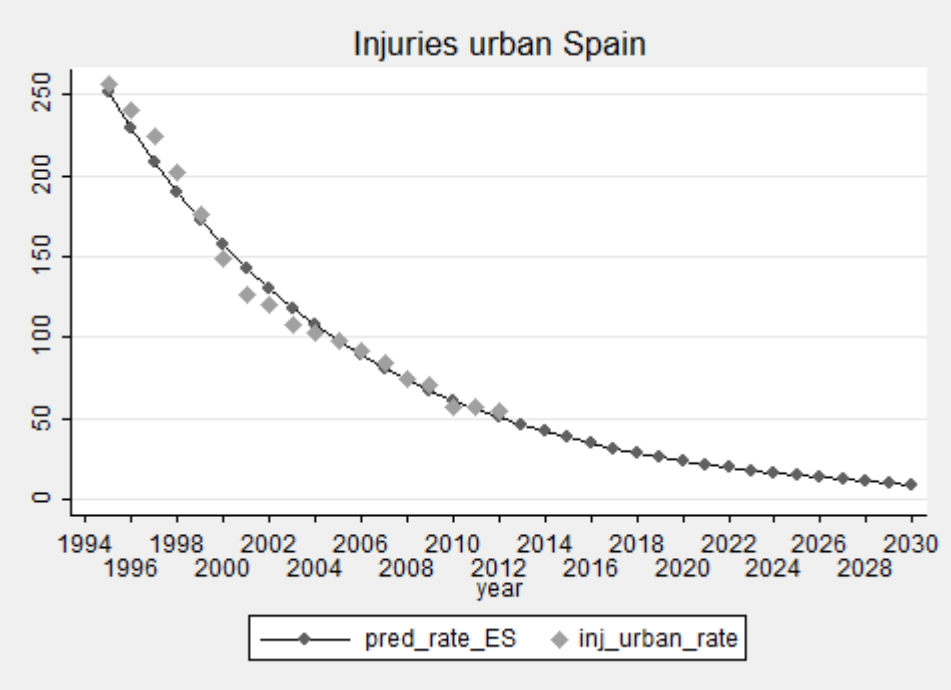


Spain

```
.
. reg ln_inj_urban_rate time if country == "ES"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) = 1094.96
       Model |  4.30148779     1  4.30148779           Prob > F      =  0.0000
    Residual |  .062855368    16  .003928461           R-squared     =  0.9856
-------------+------------------------------           Adj R-squared =  0.9847
       Total |  4.36434316    17  .256726068           Root MSE      =  .06268

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0942242   .0028475   -33.09   0.000    -.1002606   -.0881878
       _cons |   5.621828   .0308224   182.39   0.000     5.556487    5.687168
------------------------------------------------------------------------------
```

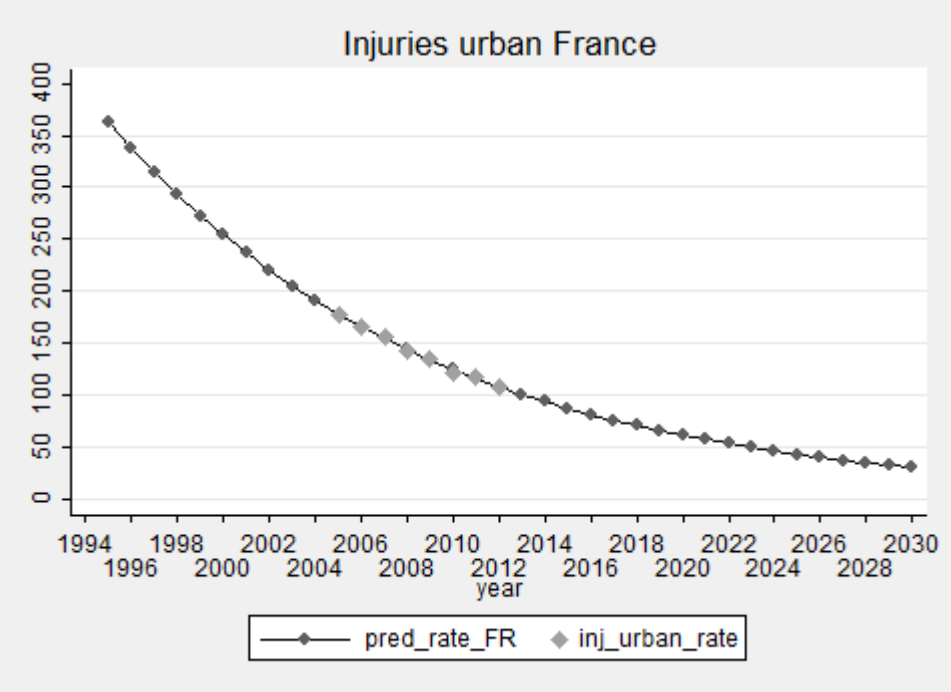


France

```
.
. reg ln_inj_urban_rate time if country == "FR"

      Source |       SS       df       MS              Number of obs =       8
-------------+------------------------------           F(  1,     6) =  884.21
       Model |  .211670288     1  .211670288           Prob > F      =  0.0000
    Residual |  .001436337     6   .00023939           R-squared     =  0.9933
-------------+------------------------------           Adj R-squared =  0.9921
       Total |  .213106625     7  .030443804           Root MSE      =  .01547

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0709913   .0023874   -29.74   0.000    -.0768331   -.0651495
       _cons |   5.962311   .0350471   170.12   0.000     5.876553    6.048068
------------------------------------------------------------------------------
```

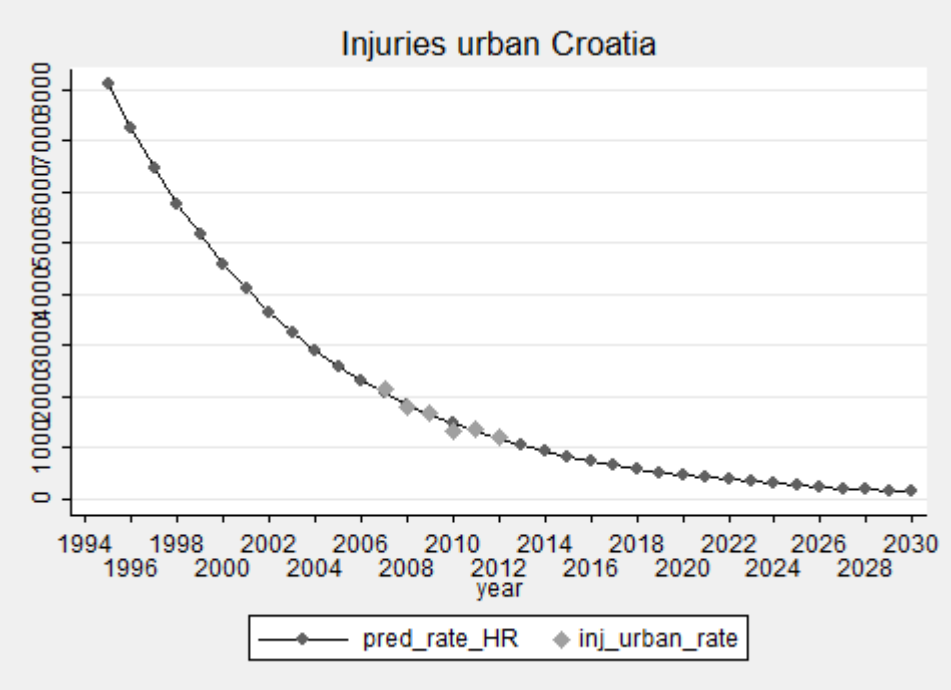


Croatia

```
. reg ln_inj_urban_rate time if country == "HR"

      Source |       SS       df       MS              Number of obs =       6
-------------+------------------------------           F(  1,     4) =   47.10
       Model |   .22682351     1   .22682351           Prob > F      =  0.0024
    Residual |  .019262329     4  .004815582           R-squared     =  0.9217
-------------+------------------------------           Adj R-squared =  0.9022
       Total |  .246085839     5  .049217168           Root MSE      =  .06939

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1138479   .0165884    -6.86   0.002    -.1599048    -.067791
       _cons |   9.115819   .2586768    35.24   0.000     8.397617    9.834021
```

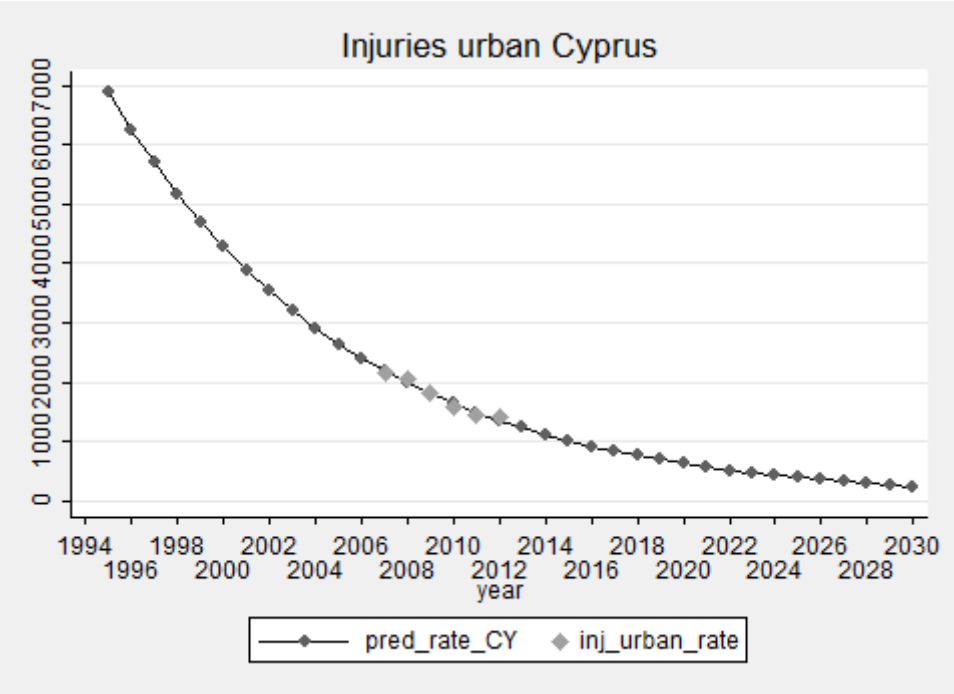


Cyprus

```
.
. reg ln_inj_urban_rate time if country == "CY"

      Source |       SS       df       MS              Number of obs =       6
-------------+------------------------------           F(  1,     4) =  120.97
       Model |  .159765503     1  .159765503           Prob > F      =  0.0004
    Residual |  .005282632     4  .001320658           R-squared     =  0.9680
-------------+------------------------------           Adj R-squared =  0.9600
       Total |  .165048136     5  .033009627           Root MSE      =  .03634

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0955482   .0086871   -11.00   0.000    -.1196675   -.0714289
       _cons |   8.932958   .1354653    65.94   0.000     8.556846     9.30907
------------------------------------------------------------------------------
```

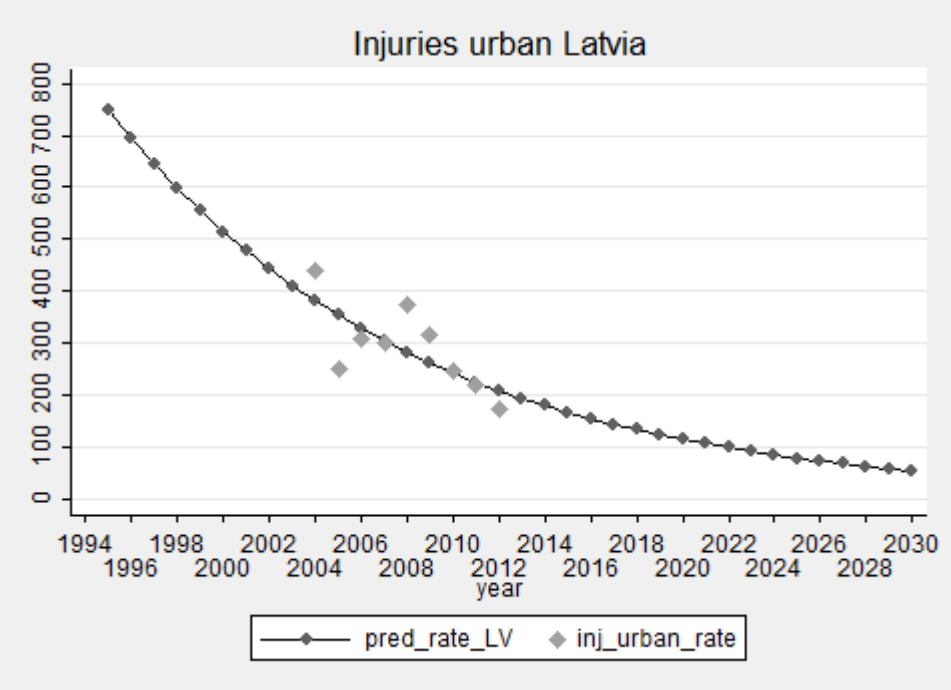


Latvia

```
.
. reg ln_inj_urban_rate time if country == "LV"

      Source |       SS       df       MS              Number of obs =       9
-------------+------------------------------           F(  1,     7) =    7.95
       Model |  .336404832     1  .336404832           Prob > F      =  0.0258
    Residual |  .296382836     7  .042340405           R-squared     =  0.5316
-------------+------------------------------           Adj R-squared =  0.4647
       Total |  .632787668     8  .079098459           Root MSE      =  .20577

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0748782   .0265645    -2.82   0.026    -.1376933   -.0120631
       _cons |   6.691692   .3781752    17.69   0.000      5.79745    7.585935
```

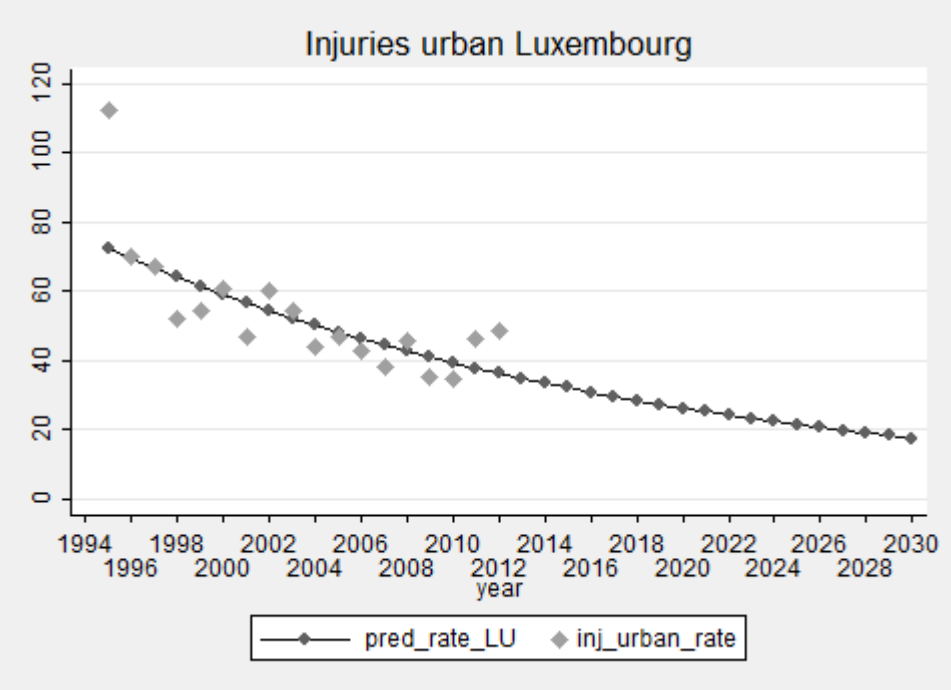


Luxembourg

```
.
. reg ln_inj_urban_rate time if country == "LU"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   24.82
       Model |  .796818149     1  .796818149           Prob > F      =  0.0001
    Residual |  .513658424    16  .032103651           R-squared     =  0.6080
-------------+------------------------------           Adj R-squared =  0.5835
       Total |  1.31047657    17  .077086857           Root MSE      =  .17917

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0405539   .0081401    -4.98   0.000    -.0578102   -.0232976
       _cons |   4.322401   .0881115    49.06   0.000     4.135613    4.509189
------------------------------------------------------------------------------
```

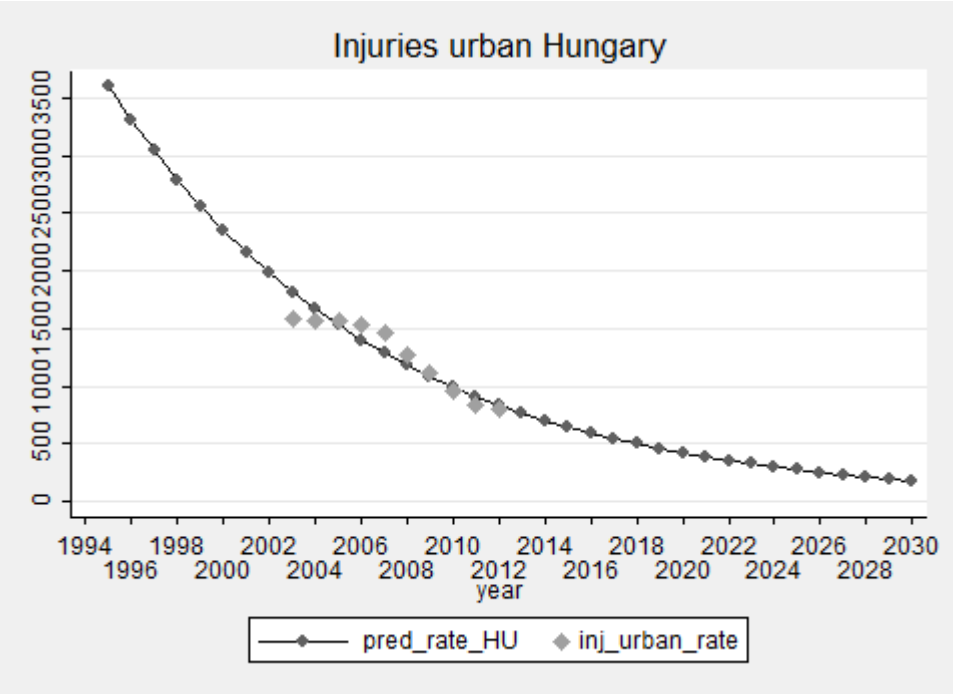


Hungary

```
.
. reg ln_inj_urban_rate time if country == "HU"

      Source |       SS       df       MS              Number of obs =      10
-------------+------------------------------           F(  1,     8) =   74.35
       Model |  .611512688     1  .611512688           Prob > F      =  0.0000
    Residual |  .065795247     8  .008224406           R-squared     =  0.9029
-------------+------------------------------           Adj R-squared =  0.8907
       Total |  .677307936     9  .075256437           Root MSE      =  .09069

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0860946   .0099845    -8.62   0.000    -.1091188   -.0630703
       _cons |   8.277478   .1378075    60.07   0.000     7.959693    8.595262
------------------------------------------------------------------------------
```

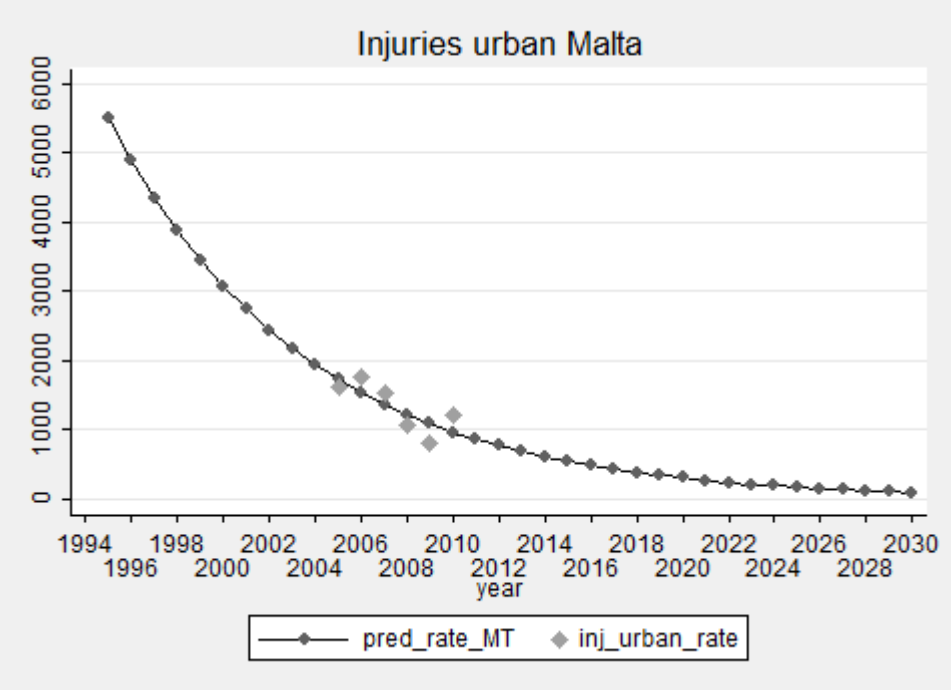


Malta

```
.
. reg ln_inj_urban_rate time if country == "MT"

      Source |       SS       df       MS              Number of obs =       6
-------------+------------------------------           F(  1,     4) =    5.18
       Model |  .233835815     1  .233835815           Prob > F      =  0.0852
    Residual |  .180632423     4  .045158106           R-squared     =  0.5642
-------------+------------------------------           Adj R-squared =  0.4552
       Total |  .414468237     5  .082893647           Root MSE      =   .2125

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1155943   .0507983    -2.28   0.085    -.2566329    .0254443
       _cons |   8.724832   .6912422    12.62   0.000     6.805636    10.64403
```

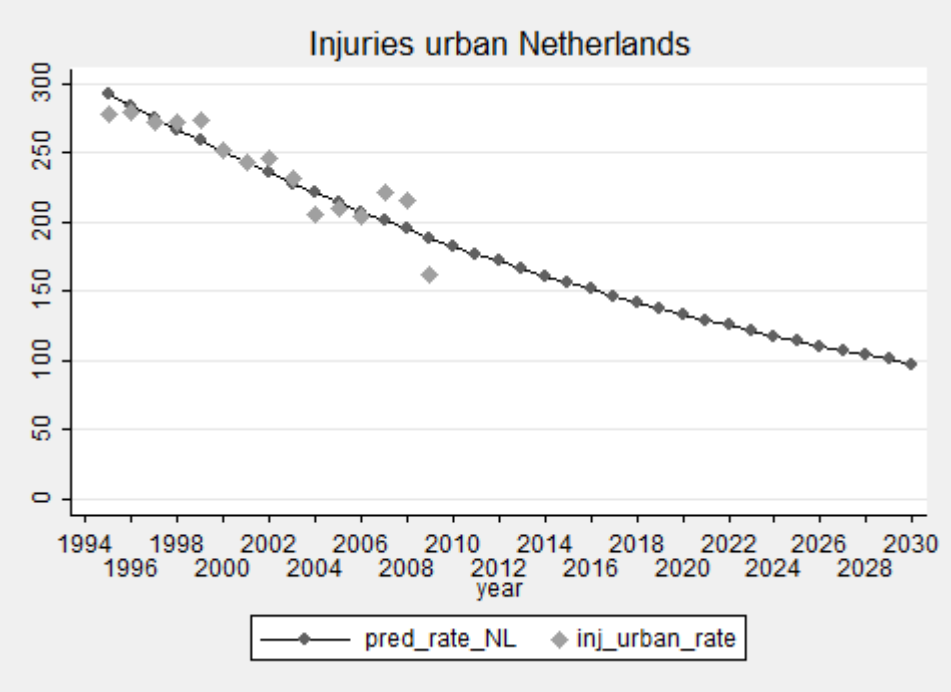


The Netherlands

```
.
. reg ln_inj_urban_rate time if country == "NL"

      Source |       SS       df       MS              Number of obs =      15
-------------+------------------------------           F(  1,    13) =   61.24
       Model |  .276191039     1  .276191039           Prob > F      =  0.0000
    Residual |  .058629553    13  .004509966           R-squared     =  0.8249
-------------+------------------------------           Adj R-squared =  0.8114
       Total |  .334820592    14  .023915757           Root MSE      =  .06716

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   -.031407   .0040134    -7.83   0.000    -.0400773   -.0227366
       _cons |   5.711077   .0364899   156.51   0.000     5.632246    5.789909
```

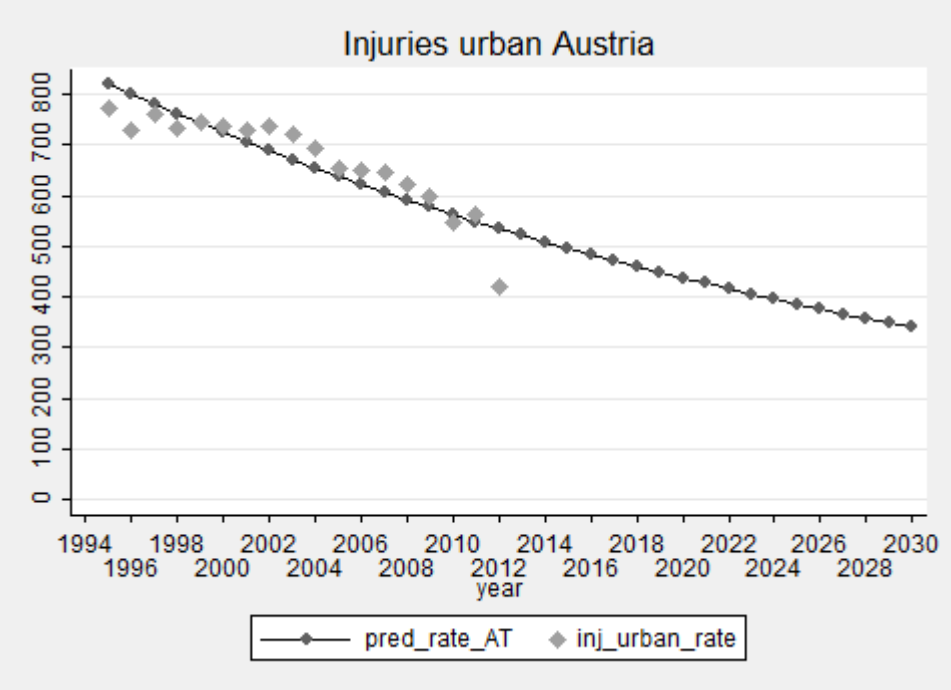


Austria

```
.
. reg ln_inj_urban_rate time if country == "AT"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =   48.68
       Model |   .30869917     1   .30869917           Prob > F      =  0.0000
    Residual |  .101466703    16  .006341669           R-squared     =  0.7526
-------------+------------------------------           Adj R-squared =  0.7372
       Total |  .410165873    17  .024127404           Root MSE      =  .07963

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0252418   .0036179    -6.98   0.000    -.0329114   -.0175723
       _cons |   6.737754   .0391613   172.05   0.000     6.654736    6.820772
------------------------------------------------------------------------------
```

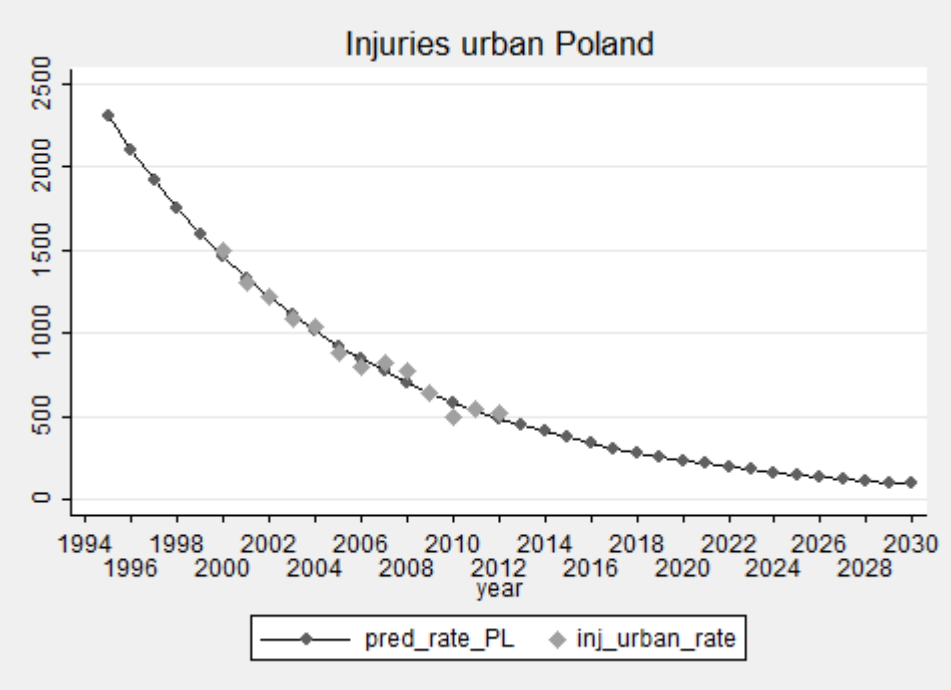


Poland

```
. reg ln_inj_urban_rate time if country == "PL"

      Source |       SS       df       MS              Number of obs =      13
-------------+------------------------------           F(  1,    11) =  308.86
       Model |  1.52372173     1  1.52372173           Prob > F      =  0.0000
    Residual |  .054267157    11  .004933378           R-squared     =  0.9656
-------------+------------------------------           Adj R-squared =  0.9625
       Total |  1.57798889    12  .131499074           Root MSE      =  .07024

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0914992   .0052064   -17.57   0.000    -.1029583     -.08004
       _cons |   7.831661   .0654433   119.67   0.000     7.687621    7.975701
------------------------------------------------------------------------------
```

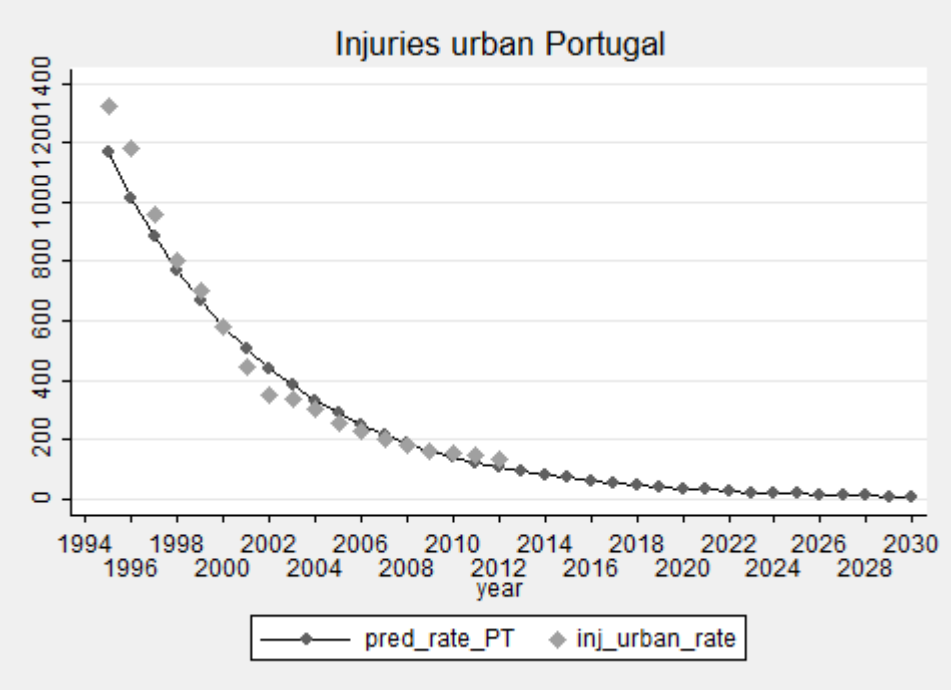


Portugal

```
. reg ln_inj_urban_rate time if country == "PT"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  594.70
       Model |  9.43561942     1  9.43561942            Prob > F      =  0.0000
    Residual |  .253857457    16  .015866091           R-squared     =  0.9738
-------------+------------------------------           Adj R-squared =  0.9722
       Total |  9.68947687    17  .569969228           Root MSE      =  .12596

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1395527   .0057225   -24.39   0.000    -.1516839   -.1274215
       _cons |    7.20008   .0619427   116.24   0.000     7.068767    7.331393
------------------------------------------------------------------------------
```

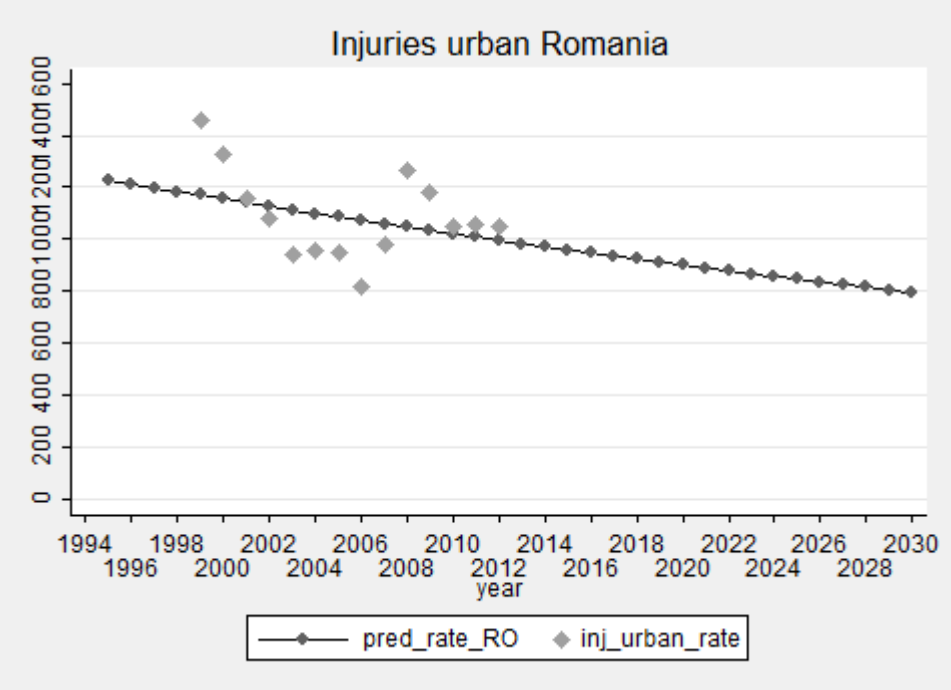


Romania

```
. reg ln_inj_urban_rate time if country == "RO"

      Source |       SS       df       MS              Number of obs =      14
-------------+------------------------------           F(  1,    12) =    1.54
       Model |   .03504603     1   .03504603           Prob > F      =  0.2377
    Residual |  .272249507    12  .022687459           R-squared     =  0.1140
-------------+------------------------------           Adj R-squared =  0.0402
       Total |  .307295537    13  .023638118           Root MSE      =  .15062

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0124116   .0099862    -1.24   0.238    -.0341698    .0093465
       _cons |   7.125853   .121693     58.56   0.000     6.860707    7.390999
------------------------------------------------------------------------------
```

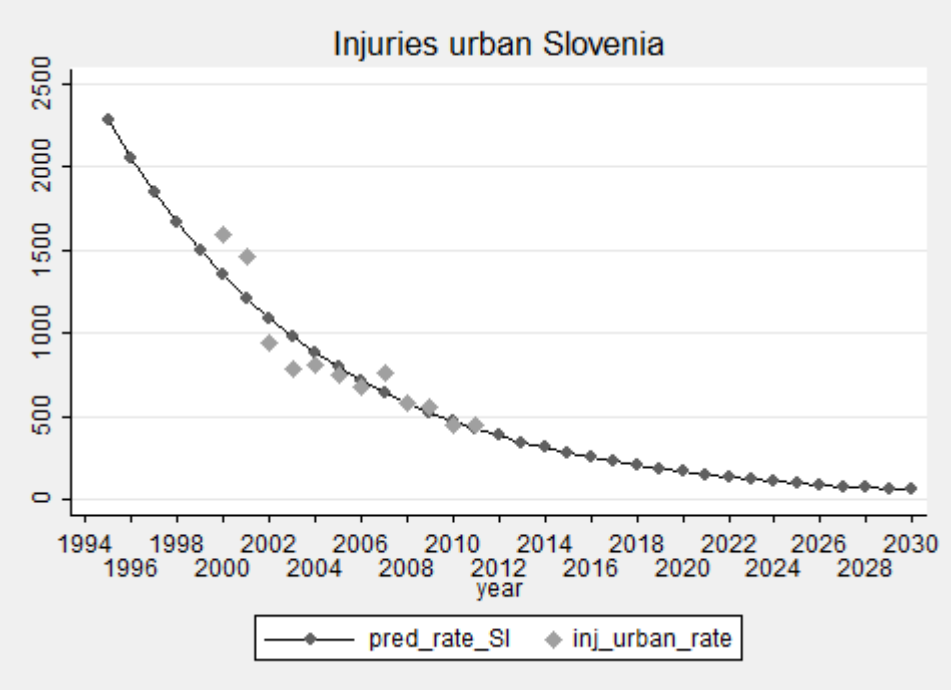


Slovenia

```
.
. reg ln_inj_urban_rate time if country == "SI"

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  1,    10) =   84.25
       Model |  1.58922044     1  1.58922044           Prob > F      =  0.0000
    Residual |  .188637174    10  .018863717           R-squared     =  0.8939
-------------+------------------------------           Adj R-squared =  0.8833
       Total |  1.77785762    11   .16162342           Root MSE      =  .13735

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1054203   .0114854    -9.18   0.000    -.1310113   -.0798292
       _cons |   7.837353   .1379044    56.83   0.000     7.530083    8.144624
------------------------------------------------------------------------------
```

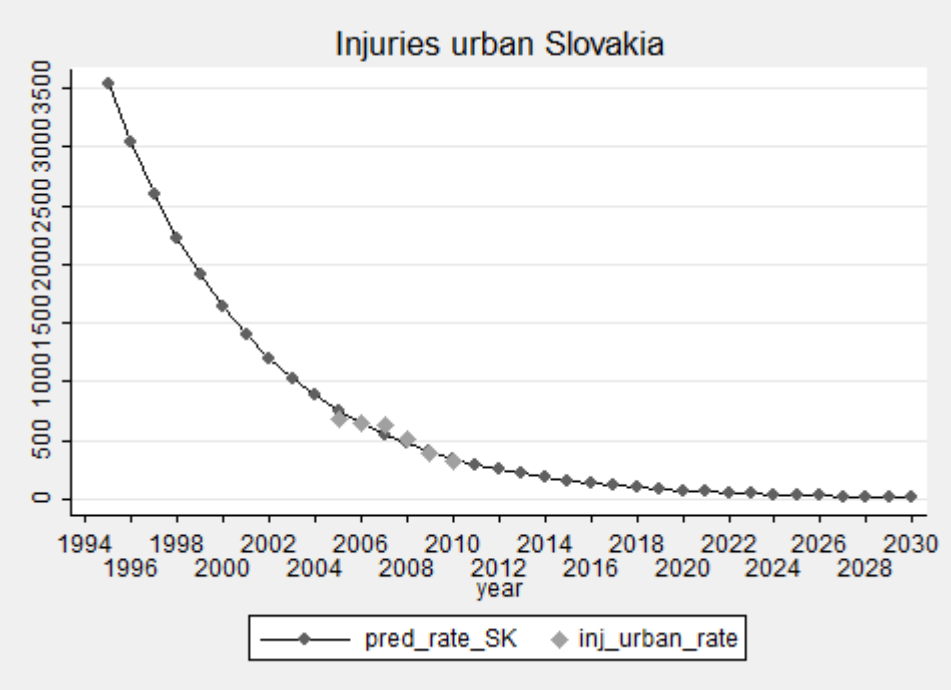


Slovakia

```
.
. reg ln_inj_urban_rate time if country == "SK"

      Source |       SS       df       MS              Number of obs =       6
-------------+------------------------------           F(  1,     4) =   38.77
       Model |  .418398841     1  .418398841           Prob > F      =  0.0034
    Residual |  .043171262     4  .010792815           R-squared     =  0.9065
-------------+------------------------------           Adj R-squared =  0.8831
       Total |  .461570103     5  .092314021           Root MSE      =  .10389

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1546238   .0248341    -6.23   0.003    -.2235743   -.0856733
       _cons |   8.327375   .3379323    24.64   0.000     7.389124    9.265625
```

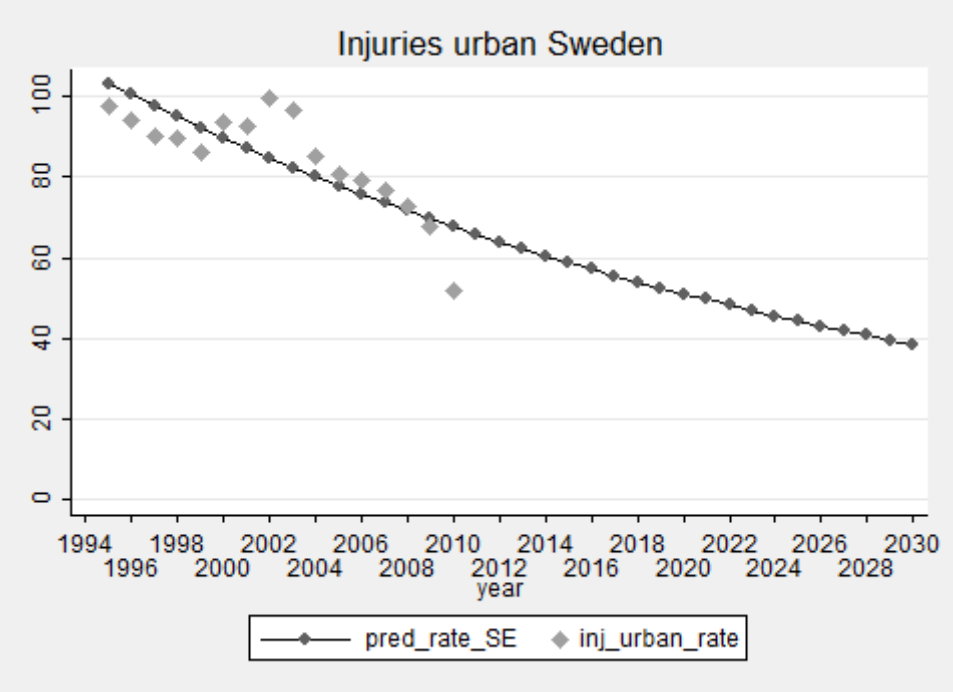


Sweden

```
.
. reg ln_inj_urban_rate time if country == "SE"

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  1,    14) =   23.42
       Model |  .270940008     1  .270940008           Prob > F      =  0.0003
    Residual |   .16195285    14  .011568061           R-squared     =  0.6259
-------------+------------------------------           Adj R-squared =  0.5992
       Total |  .432892858    15  .028859524           Root MSE      =  .10755

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0282291    .005833    -4.84   0.000    -.0407396   -.0157186
       _cons |   4.666547   .0564023    82.74   0.000     4.545576    4.787518
------------------------------------------------------------------------------
```

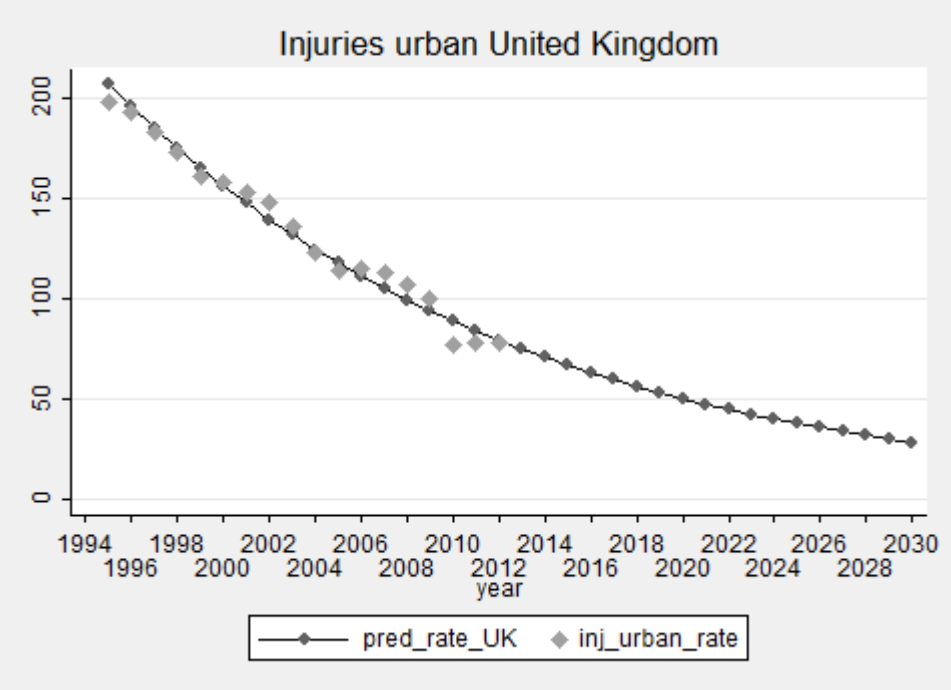


UK

```
.
. reg ln_inj_urban_rate time if country == "UK"

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  1,    16) =  496.51
       Model |  1.55850213     1  1.55850213            Prob > F      =  0.0000
    Residual |  .050222134    16  .003138883           R-squared     =  0.9688
-------------+------------------------------           Adj R-squared =  0.9668
       Total |  1.60872426    17  .094630839           Root MSE      =  .05603

------------------------------------------------------------------------------
ln_inj_urb~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0567162   .0025453   -22.28   0.000     -.062112   -.0513203
       _cons |   5.390929   .0275513   195.67   0.000     5.332523    5.449336
------------------------------------------------------------------------------
```


Injuries urban United Kingdom
200
150
100
50
0
1994
1996
1998
2000
2002
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2008
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2016
2018
2020
2022
2024
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2028
2030
year
pred_rate_UK
inj_urban_rate