



Intermediary report - January 2003

**AN ECONOMIC ANALYSIS OF TRANSPORT SAFETY:
THEORY AND APPLICATIONS
CP-38**

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SPSD II



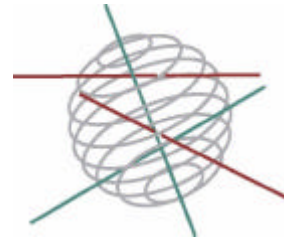
PART 1

SUSTAINABLE PRODUCTION AND CONSUMPTION PATTERNS



This research project is realised within the framework of the Scientific support plan for a sustainable development policy (SPSD II)

Part I “Sustainable production and consumption patterns”



The appendixes to this report are available at :
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**Scientific support plan for a sustainable development policy
(SPSD II) Part I “Sustainable consumption and production
patterns”**

***The Economic Analysis of Traffic Safety:
Theory and Applications***

INTERMEDIARY SCIENTIFIC REPORT

January 2003

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1. Project title

An economic analysis of traffic safety: theory and applications

2. Introduction

2.1. Context and summary

Traffic accidents cause substantial costs to society and there is a widely accepted belief that these costs are excessive and should be reduced. Nevertheless the number of means available to reduce the accident costs is limited and so are the resources available for the scope. The project aims to contribute to the solution of this choice problem by making a theoretical and empirical analysis of various traffic safety measures. For this it uses an innovative interdisciplinary approach, with contributions from both economics and law & economics.

2.2. Objectives

The project analyses the potential and limitations of various transport safety measures and investigates to what extent they are complementary. The focus lies on regulatory measures and their enforcement, liability rules, economic instruments and infrastructure measures. An interdisciplinary approach is used: we aim to integrate insights from economics and law & economics.

- In economics the focus lies on the determination of accident costs and on the evaluation of pricing, infrastructure measures and technical regulation. The legal rules are taken as given.

- The law & economics approach is aimed at two goals: (1) predicting the rational responses of individuals to changes in the legal rules; (2) designing legal rules in such a way that certain goals may be attained in a cost-effective way. Thus, the law & economics approach will be focused on the analysis of the effects of different legal rules on the behaviour of people in situations that may lead to accidents. Once a predictive model is clarified, the desirability of changes in the legal rules can be appreciated in relation to the changes that we want to attain in people's behaviour.

Both approaches can bring new insights to the problem of how to reduce the overall costs of traffic accidents in the most efficient way.

The project approaches the problem both from a theoretical and applied point of view.

2.3. Expected outcomes

The expected outcomes of the research project are both theoretical and empirical. The theoretical analysis should answer the following questions:

- a. Which welfare economic measure is appropriate to assess traffic safety measures?
- b. What is the potential of the various instruments that are available to the policy makers and of their combination?
- c. Which elements play a role in the evaluation?
- d. What type of information is required for the evaluation?
- e. How do the recommendations change when there are restrictions on the available policy instruments?

In the empirical applications a social cost-benefit analysis will be made of concrete traffic safety measures.

3. Detailed description of the scientific methodology

In the first stage of the project the following steps were undertaken:

- *Overview and extension of the theoretical law and economics literature (K.U.Leuven, Ghent University)*

Law & economics is a discipline that studies the law from the perspective of microeconomic theory. Economic models based on game theory and mechanism design theory are employed to study the behaviour of people under different legal rules, and to identify the optimal legal rules given certain policy objectives. In particular, three areas of the law & economics theory are relevant for the analysis.

1- The economic theory of tort liability. The study of how liability rules affect the level of precaution that people take in order to avoid accidents was one of the first and is still one of the most fruitful applications of law & economics. The main references are Calabresi (1970), Shavell (1987), Landes and Posner (1987) and Miceli (1997), besides a number of specific contributions to the subject appeared in the form of scholarly articles.

2- The theory of law enforcement, which studies how people react to criminal and regulatory sanctions and what is the optimal level of enforcement (i.e. the resources that should be sent on policemen, speed detectors, cameras at the traffic lights, and so forth). The importance of the path-breaking studies in this field (Becker, 1968) was recognized with the Nobel prize award in the early nineties. Systematic treatments of the subject can be found in Polinsky and Shavell (2000a and 2000b).

3- The theory of insurance and the interaction between insurance and tort liability and insurance and law enforcement. The economic theory focuses on two issues: the functions of insurance and the effect of insurance on people's behaviour. Apart from Shavell (1987), other references may be found in Skogh (2000).

Law & economics is based on rational choice theory, and therefore assumes that people act rationally and respond to incentives. However, there is a growing interest for the analysis of irrational behaviour as well, which may be relevant for the problem of traffic safety. This topic will be given particular attention during the conference that will take place in February (see below).

- *Social cost benefit analysis of roundabouts (K.U.Leuven)*
- *Organisation of a scientific conference on the economic analysis of transport safety (Ghent University)*

4. Detailed description of the intermediary results, preliminary conclusions and recommendations

4.1. Overview and extension of the relevant law & economics theoretical literature (Ghent University)

The research group of Ghent University started working on the project on June 1st, 2002. The focus of the first 7 months of research has been the analysis of the different areas of the law that have an impact on the behaviour of drivers and other individuals that may be involved in traffic accidents, as pedestrians and bicyclists. We have further compared the relative impact of those areas and drafted preliminary recommendations for a general policy for legal changes. Furthermore, we have singled out the directions that further research should take in the second period of the project in order to refine the policy indications and proceed toward a specification of the results. Hereafter we summarize the preliminary results of the research. A full text version of this paper is enclosed.

We have analysed the effect of three legal areas on peoples' behaviour: accident (tort) law, regulation (and criminal law) and insurance. In our view, regulation is the area that is more important in traffic accident prevention and hence the area on which the main attention of the policy maker should be focused, as it provides better incentives than tort law. Tort law and insurance play a subsidiary, though very important role, and should be also taken into careful account, but in a different way than the literature has till now proposed.

Both tort law and regulation generate incentives to take precaution by means of a certain combination of magnitude S and probability p of sanctions. Under tort law, the magnitude of the sanction S corresponds to the harm to be compensated (say €1000) and the probability p is equal to the probability that an accident occurs (say 5%). The resulting expected sanction is $s=pS$, (1000·5%=50, in the example). Albeit that this expected sanction may in general create the correct incentives to take precaution, the same expected

sanction can be generated by an infinite number of different combinations of probability and magnitude (e.g. $50 \cdot 100\% = 50$, $100 \cdot 50\% = 50$, $500 \cdot 10\% = 50$, $2000 \cdot 2.5\% = 50$, $10,000 \cdot 0.5\% = 50$, and so forth). The literature on law enforcement has pointed out that there are several factors bearing on the optimal choice of the mix between probability and magnitude of a sanction given the need of producing certain incentives. We maintain that regulation is superior because, while under tort law the mix is set by nature and can hardly be influenced, regulators are free to set probability and magnitude according to the most efficient combination.

The structure of our discussion below will be as follows. After establishing this result and analyzing the factors bearing on the optimal choice of probability and magnitude of a sanction, we show that if tort law is to be removed and substituted with regulation, mandatory insurance ought to be implemented. In fact, no liability is a liability rule in an economic sense and does not correspond to removal of tort law as the accident loss is simply allocated to the victim. In general, any liability rule simply allocates or shares the loss among the parties. In order to remove the sanction system generated by tort law, both parties to an accident ought to be delivered from the accident loss. Insurance bears this task. In our view, what has been always seen as a deficiency of insurance – the dilution of incentives created by tort law – becomes its strength.

Next, we further elaborate upon these two main points and study the reciprocal relationships between regulation and insurance, on the one hand, and insurance and tort law, on the other. We show that if law enforcement through regulation requires insurance to remove tort law, insurance cannot function as a general delegated control system in the absence of regulation, for economies of scale, public-good problems and perverse incentives for the insurance industry to collude. Moreover, insurance eradicates tort liability from the parties' interaction, but liability rules (including no liability) remain an irremovable device to split costs among insurers. In this sense residual tort law should be set in such a way to minimize the administrative costs of the insurance system. We will then study the financing of the insurance system as a way to control parties' activity level, which is closely related to corrective taxation.

In the last part of our study, we address issues concerning the administrative costs and the information requirements of the regulation and tort system and derive the conditions under which these costs make the

implementation of the regulation-plus-insurance model unfeasible, leaving room for tort law or tort law and regulation combined.

4.1.1. The superiority of regulation over tort law

By tort law we mean the functioning of the system under which victims can claim compensation from injurers through the judiciary, according to certain liability rules. By regulation we mean those situations in which a (administrative or criminal, monetary or non-monetary) sanction is levied upon a certain behaviour by an enforcer (the police, a governmental agency, or a criminal court). Regulation is intrinsically superior to tort liability as a device to generate incentives to take precaution; while under tort liability the probability and the magnitude of the sanction are blindly set by nature and correspond to the probability of an accident and the magnitude of the harm, respectively, regulators may attain the same expected sanction $s=pS$ by means of a virtually infinite number of combinations of p and S . This flexibility allows regulation to respond to factors that would impair the effectiveness of the incentives produced by tort law. We do not claim that tort law is completely irresponsive to these aspects, but its receptivity is clearly limited to the setting of S , while p does not directly depend on public policy. Let us further elaborate on this point.

Under tort law, the magnitude of the sanction correlates with the magnitude of the harm. Notwithstanding, legal systems make at times an attempt to reset it. Punitive damages, undercompensation and average or inaccurate compensation of the harm are examples of instances in which the natural setting of the magnitude of the sanction is overturned by legal dictates or judicial precedents. Nevertheless, the attainability of different levels of p from the level set by nature is very limited, as p basically depends on two factors that are not in the direct control of the policy maker: the possibility for the injurer to escape detection, which mainly rests on the nature of the externality or on the context in which the externality takes place, and the willingness of victims to sue, that in turn mainly depends on the cost of litigation, the probability of success and the measure of the compensation. The cost of litigation may be determined at a policy level, and hence influence p , but the determination of the measure of the compensation will affect at the same time p and S , potentially yielding undesired outcomes. Moreover, even if p may be reduced, it is hard to imagine how p could be possibly increased over the level at which injurers pay compensation for all accidents they cause. The steadiness of p undermines the effects on the setting of S , as it ties any

change in S with a correspondent change in the expected sanction s , which may in turn be undesirable in the specific circumstances. Consequently, tort law appears seriously constrained in the setting of p and S .

Regulation may instead rely on a rather uncontrived set of possibilities to determine p and S independently. The probability of the sanction depends in fact on the level of enforcement and can be pushed either beyond or below the probability of causing an accident, as police control may regard parties' levels of ex ante precaution directly, rather than being activated by the actual occurrence of an accident. Tort law, in fact, only sanctions inattentive motorists if an accident occurs, while police controlling speed limits sanction motorists in any case their speed was excessive, before and irrespective of the occurrence of accidents. Regulation may therefore set p at virtually any level between 0 (no police on the street) and 1 (an electronic speed control device on every street), while tort law may in the best scenario only set p between 0 and p_t , the probability that an accident occurs, which is in general lower than 1.

Concerning the sanction, not only does a regulatory approach allow for the determination of the magnitude independently of the probability, but it also caters for the need to substitute at times a monetary sanction with a non-monetary one, a choice that is generally not available under tort liability. Moreover, the implementation of sanctions through the regulatory system makes the sanction only related to the production of incentives and tailored on the violators' behaviour only, while the compensation of victims is left to the insurance system that we will analyze in a next section. Tort law inevitably groups these two functions together with unavoidable conflicting tendencies. Furthermore, the regulatory approach allows to deal with the risk attitude of parties in a more specific way, as violator are considered while setting the probability and the magnitude of sanctions, while victims are considered while setting the modality of harm compensation. Again tort law only provides for the allocation of risk to a party or another, while the curbing of risk generally dilutes incentives.

The study has also explored a number of factors bearing on the setting of p and S : enforcement costs, sanctioning costs, risk aversion, maximum feasible probability, maximum feasible sanction and generic versus specific enforcement. For a detailed discussion of the results, the reader is referred to Annex 3.

4.1.2. Insurance as a way to remove tort liability

If control over people's production of negative externalities is to be passed from tort law to regulation in order to readjust p and S at different levels from those set by nature, tort liability must be removed. From a legal perspective the removal of tort law corresponds to the absence of liability. However, as the function of tort law is to determine which party should bear the accident loss, no liability simply means that the loss will be borne by the victim. In an economic perspective no liability is a liability rule along strict liability, simple negligence, comparative negligence and so forth. The only difference is in the party that bears the accident loss. Moreover, tort liability does not remove the loss from the victim, but it simply reallocates it, if this is the case, to the injurer.

In order to remove completely the incentives produced by tort law and clear the field for the functioning of regulation, the accident loss should be eradicated, in the sense that neither the victim nor the injurer should bear it. Mandatory insurance is the solution, as it may provide compensation to the victim – thus removing the loss from him – without charging it onto the injurer. Insurance works under any liability arrangements, as it can be always designed to cover the liability or the accident loss borne by the liable party, being that party either the injurer or the victim.

By mandatory insurance we mean a (publicly or privately organized) system that provides compensation to the victim in the case of an accident, so that neither party has to pay for it. The fact that either party might be required to pay for the insurance coverage does not affect the incentives as the choice of the level of precaution usually intervenes after the insurance premium has been paid. Nevertheless, the financing of the insurance coverage will be considered in the proceeding in two respects: the control of parties' activity level and the function of insurance as delegated control system potentially competing with regulation. In the latter perspective we will account for the moulding of the premium to the behaviour of the insured and the direct monitoring of the behaviour itself. Insurance ought to be mandatory for at least two reasons: adverse selection might impair the functioning of insurance and private incentives not to buy an insurance coverage might yield the same result.

4.1.3. Regulation as a way to enable the functioning of insurance

Mandatory insurance can be regarded as a delegated control system inasmuch as the insurer is able to influence the insured's behaviour through adjusting the premium to past behaviour or directly monitoring it. The question is whether the insurance is able to organize a system of control for insured's behaviour and interested in doing so; insurers could act as enforcers and hence render regulation superfluous. Put metaphorically, police officers might be paid by the insurance companies rather than by taxpayers. In a competitive insurance market, there exist incentives for individual insurance companies to set up efficient systems of control so to improve the insured's behaviour and reduce the price of the coverage.

Controlling people's behaviour shows at times economies of scale (one unique electronic speed-control device that monitors all motorists cost less than as many devices as many insurance companies each of which only monitors the motorists insured with a specific company) and public good problems (a police officer hired by company A might serve as a deterrent for the motorists insured with company B and C, from which it would be difficult to collect). For the former two reason is seems in general more desirable to have a unique and centralized system of control, although the question remains of whether such system should be paid by the insurance industry or by the tax payers.

It seems that the insurance industry as a whole would not have sufficient incentives to set up and manage such system, even after leaving aside collective action problems that might impair the grouping of the interests of different individual companies. In fact, both the cost of administering the control system and the cost of not having the system at all (in terms of greater accident losses) would be ultimately paid by the insured, in terms of higher premiums. We shall conclude, thus, that a centrally and publicly organized control system is necessary in order to provide incentives to take precaution in the first place and lower the cost of the insurance system as a consequence. We shall account in a next section for the role of some residual incentives that may be produced by individual insurance companies by means of *bonus-malus* or similar clauses and their interaction with regulatory incentives.

4.1.4. Tort liability as a way to lower the administrative costs of insurance

We have said that insurance removes tort liability and frees parties from the incentive effects thereof. However, tort liability remains inevitably in place as a rule that allocates the accident loss among insurance companies. Again we must emphasize that no liability simply allocates the loss either to the insurer or to the victim. What should then be the criterion for the setting of liability if incentives are no longer a concern for this area of the law? Our contention is that liability rules should be designed in order to reduce the administrative costs of the insurance system, as they are irrelevant for the parties' behaviour in the presence of full insurance coverage.

It has been observed that the insurance system is a much cheaper system than the liability system as a way to provide injured parties with compensation. The designing of tort liability might reduce even further such costs by catering for simple and easily applicable rules, avoiding the implementation of complex negligence inquiry and curbing litigation by enhancing certainty and foreseeability of the rules.

4.1.5. Financing the insurance coverage and exposing insured to risk as ways to control the activity level

In the economic literature on tort law, the efficiency of different liability rules is commonly discussed in relation to two elements: the level of care and the level of activity. Activity level and care are different forms of precaution and the split between the two resides in the judicial inquiry over parties' negligence. The precautionary measures that are investigated while deciding issues of negligence are to be considered as care. In car accidents for example, speed, condition of the brakes and stopping at the zebra crossing are likely to be considered by the judge while deciding whether or not the motorist is to be considered at fault. However, not all precautionary measures are included into the negligence inquiry, as some of them are extremely difficult or costly to measure. The determination of negligence is for example likely not to be a question of whether or not a motorist used correctly the rear mirror, or of whether or not it would have been more desirable to leave the car at home and use public transportation (an extreme form of precaution, after all).

Likewise, regulation cannot in general target all the parties' precautionary measures and some of them will escape enforcement. Also with respect to regulation, therefore, we can speak about a set of precautionary measure that will remain untaken and that we can denominate as activity level, for homogeneity with the results attained in tort law and economics. The problem of how and to what extent incentives should be provided with respect to the activity level will be discussed here. We wish to emphasize two points.

First of all, the economic theory of torts has found that, under normal tort liability, incentives to reduce the expected accident loss by adjusting the activity level are produced by the bearing of the residual loss, which is the accident loss that anyway occurs albeit the parties were non-negligent. The party that bears the residual loss has incentives to curb the level of his activity and in general to take precautionary measures that escape the negligence inquiry. Likewise, under regulation, parties have incentives to take precautionary measures that escape apprehension if they bear some costs in the event of an accident.

This result suggests two possible solutions. A sanction could be imposed upon occurrence of an accident irrespective of whether parties have previously complied with the regulatory requirements. The sanction could be actually imposed through the insurance system by means of an increase in future premiums. In this respect, insurance companies might enjoy lower costs than a centralized regulatory system, as apprehension would be granted by the fact that the insurance is called upon while compensating the victim and hence the increase in the premium of the insured will be attained at very low administrative costs, presumably lower than the cost for the enforcer to do the same. A straightforward way to do so might be the commonly used *bonus-malus* clause. In this respect, competitive forces will drive insurance companies to set ex post sanctions efficiently, as to attract consumers. It is also sensible to believe that a graduation of the ex post sanction according to the causal contribution to the accident will yield positive results in terms of accident prevention and, hence, cost of the insurance coverage. In the economic literature on tort law, the importance of a correct determination of the issue of causation has been defended as well as the advantages of sharing the residual burden among causally co-responsible parties, both in order to overcome problems of causal uncertainty and to control the activity level of different parties simultaneously, rather than focusing on one party

only. These arguments suggest that the same might apply to the charging of increased premiums to those parties who cause more accidents.

A second important point is how the insurance coverage should be financed. There are three main possibilities: the injurers should buy third-party insurance, the victims should buy first-party insurance or they should both contribute to the system in the same measure (for example the insurance could be paid by taxpayers and be publicly provided). This issue also affects the considerations made supra, and the need to control either party activity level bears on the choice of the financing system. Moreover, while the first solution disincentivizes injurers (in car accidents, for example, compulsory third-party insurance increases the overall cost of driving), the second disincentivizes victims (in car accidents, for example, it increases the cost of being a pedestrian), while the third method is rather neutral.

Therefore, the choice of how to finance the insurance coverage should be guided by consideration about the desirability of certain activities in the first place. The same issue, however, can be addressed from the point of view of the administrative costs that it triggers. It has been remarked that a system of first-party insurance might have lower administrative costs and for this reason some countries have abandoned the traditional injurer-pays paradigm and opted for a generalized first-party insurance system.

4.1.6. Administrative costs, information and mixed solutions to the problem of providing incentives to take precaution

In this section we will address the issues of the information requirements of alternative incentive systems and the administrative costs thereof.

Information costs

It is often maintained that a tort law system, being based on a decentralized decision process, is more efficient with respect to gathering information than a regulatory and hence centralized system. In particular, under strict liability the optimal level of precaution is selected by the injurer and the legal and judicial systems need not to collect any information concerning it. However, once a negligence rule is in place, the due level of care must be set by the judiciary, the legislature or a regulatory body and the informational advantage of tort law only remains inasmuch as liability rules allow an individualized setting of the negligence criterion by the judge and parties are well placed for the ex

post production of the relevant information and the ex ante prediction of the due level of care that will be applied in the case of litigation.

When parties are rather uniform in terms of costs and benefits, the individualization of the due level of care is too costly, or the production and acquisition of information are better dealt with at a centralized level, regulation appears to gain an advantage over tort liability also in terms of information costs.

Traffic safety may provide with a convincing example of a situation in which a centralized traffic authority is better placed than individual motorists, bicyclists and pedestrians, on the one hand, and judges, on the other hand, for the determination of the optimal levels of precaution. Moreover, the optimal levels of precaution seem to be very similar if not identical for injurers and victims within a certain class, and there might still be the possibility to differentiate among different classes of individuals (children, bicyclists, pedestrians, lorry drivers, car drivers, and so forth).

Administrative costs

Regulation triggers high enforcement and sanctioning costs, and insurance is costly to administer, but tort law is rather costly an incentive device too. Courts trigger a cost that can only be avoided by implementing no liability; lawyers' fees and the overall time and energy that parties spend in litigation or settlements amount to a social cost. Empirical studies have revealed that compensating victims through liability has an enormous cost if compared with the cost of compensating victims through insurance. Moreover, the administrative costs of collecting fines or in general imposing sanctions are supposedly lower than the costs of making injurers pay damage compensation.

It is also true however, that some litigation might arise even in the presence of regulation plus insurance and that residual tort law will still yield a cost, albeit the determination of liability between litigants seems to be a simpler problem if the litigants are insurance companies rather than individuals.

It is again an empirical question whether in specific circumstances the overall administrative costs of a system based on regulation and insurance overcome the advantages in terms of more efficient accident prevention and total removal of risk from individual parties. It is conceivable, however, that regulation plus insurance will be superior in situations in which the number of

parties is large, the technology is known by the regulatory body, the optimal mix of probability and magnitude of sanctions lies far away from the natural levels set by tort law and parties are seriously risk averse. Traffic safety seems again to match these requirements.

Extreme versus mixed solutions to the problem of accident prevention

When the requirements discussed above are not met, there will still be situations where the optimal solution is provided by tort law, as the administrative costs of implementing a centralized regulatory system might be too high, as for example for activities that are rarely practiced, or are practiced by few individuals and do not yield particular risks or employ a new technology on which information would be difficult to acquire by regulators. Moreover, the literature has emphasized the existence of cases in which combining regulation and liability yields an improvement in terms of accident prevention.

4.2. Overview and extension of theoretical law & economics literature (K.U.Leuven)

The research team of the K.U.Leuven first made an overview of how different liability rules influence people and secondly, looked at the joint use of liability and regulation in a traffic context. Here we briefly state the main findings of our research up to now.

4.2.1. The role of liability rules in the case of pure pecuniary losses.

Liability rules confront the car drivers with the real costs of their driving and by that, influence their behaviour. The overview paper considers the consequences of different liability rules in victim-injurer accidents. These are accidents where only one party has losses. Then we look at a model where both parties have losses. The losses are assumed to be purely pecuniary. We want to know the conditions under which liability rules reduce efficiently the accident costs of society.

For both models we consider the case in which people are risk neutral and then introduce risk adversity and insurance. For the victim-injurer model with risk neutral agents we also look at what happens if we relax some assumptions.

In the first model, a victim-injurer model with risk neutral agents, in which both parties can influence the probability of an accident, there exist rules that lead to efficient care levels for both parties. This is the case for all rules involving negligence. However, there does not exist a liability rule that results in optimal activity levels for both parties. For this model we look at what happens if we relax some of our assumptions. First, with a rule of strict liability, an error of the court in assessing damages distorts, but that random errors have no influence. With a rule of negligence errors in setting due care distort more than errors in damages and vague standards lead to excessive precaution. We also looked at the role of administrative cost and non-uniform parties

For the second model, a victim-injurer model with risk averse parties in which only the injurer influences the probability of an accident, two conditions should be met for a socially ideal solution. First of all, the level of care and activities should minimise the expected accident losses plus the cost of care and secondly, risk averse parties should be left with the same wealth regardless of whether an accident occurs. A social optimum can be realised under a rule of strict liability if the injurer is risk neutral or if insurers have perfect information.

In our third model both parties have losses and both can influence the probability of an accident. The social optimal level of care and activity turns out to be the same as in our first model. Again we can obtain the social optimal level of care, but now none of the parties exercises the optimal activity level.

This is only a first attempt in analysing the effects of liability rules. There are many possible extensions. First of all, what if the losses are not purely pecuniary. Death, invalidity... can alter the utility of the parties and this will have major consequences on our analysis. Furthermore, how do the results of the second model change if both parties can influence accident losses. Another possible extension is to complement liability rules with other instruments.

A full text version of this paper is enclosed in Annex 4.

4.2.2. The joint use of liability and regulation in a traffic context

In this part of the research we develop a theoretical model of traffic accidents in which we examine the use of regulation and the use of strict liability as means of controlling accident risks. Car drivers may be induced to drive at a reasonable speed by letting them bear the accident cost (liability) and/or by organising speed controls and sanctioning those who violate the limit (regulation). Most of the literature studies the separate use of these instruments. They try to assess which instruments should be used under which circumstances. However, in reality we see that both are used simultaneously. We therefore look at them as complements, rather than as substitutes. The analysis is based on Shavell (1984). According to the model, regulation does not result in the appropriate reduction of risk – because the regulator lacks perfect information – nor does liability result in that outcome – because the incentives it creates are diluted by the chance that parties would not be sued for harm done or would not be able to pay fully for it. Thus neither liability nor regulation is necessarily better than the other, and joint use is generally socially advantageous. This will be applied to traffic accidents, by reinterpreting the parameters, by making people differ in their cost of precaution and by making an application.

Possible extensions to this paper are the introduction of enforcement cost, activity level of the drivers, adding risk-averse drivers and considering the effects of insurance. A first version of the paper will be presented at the conference in Ghent.

4.3. Cost-Benefit analysis of the transformation of junctions into roundabouts (K.U.Leuven)

1500 people die every year on the roads of Belgium. A large share of these accidents happens on junctions. The roundabout seems to be a solution to lower the number and the severity of accidents. In the article, we look at the effects of rebuilding a crossing with traffic lights into a roundabout. The aim was to investigate if it is economically efficient to make this investment. The analysis takes into account the differences in accidents, time, air pollution, maintenance and construction costs. The change in demand is also taken into account. Given the assumptions, the main conclusion is that the transformation of a medium-sized junction with traffic lights into a roundabout results in a benefit. A sensitivity analysis shows that the results are very robust to changes in accident, time and infrastructure costs.

The results are reported in:

Delhaye E. (2002), Kosten-Baten analyse van het vervangen van een geregeld kruispunt door een rotonde, *Tijdschrift voor economie en management*, vol. XLVII, 577-605.

A full text version of the paper is enclosed in Annex 2.

4.4. Organisation of a scientific conference on the economic analysis of transport safety (Ghent University)

The research team of Ghent University organises a conference on the economic analysis of traffic safety, scheduled for February 26th, 2003 at Ghent University. An improved and expanded version of the results summarized above will be presented to the academic community in order to receive comments, suggestions and feedback for scholars working in the same or in neighbouring fields of research. The following universities will be represented in the meeting, besides Ghent University and the Catholic University of Leuven: University of Illinois (USA), George Mason University (USA), Pompeu Fabra University (Spain), Utrecht School of Economics (NL), Erasmus University Rotterdam (NL), Maastricht University (NL) and Limburg University Centre.

Among others, professor Thomas Ulen of University of Illinois (the author of the leading textbook in law and economics) and professor Francesco Parisi of George Mason University (one of the most fertile and creative scholars in law and economics) will be present.

We expect a great deal of suggestions, ideas, comments and research synergies for the conference. Moreover, the topics of the presentations have been chosen in such a way to cover legal aspects, economic aspects and technological aspects of the problem of traffic safety in order to enhance the interdisciplinarity of the approach and the practical relevance of the policy recommendations. The latter aspect will be particularly taken into account in the discussion that will follow each presentation. We expect many comments and suggestions, hence, also from the participants at the conference, which we hope will include not only the academic community and the users committee but also those institutions that deal at the national or European level with the practical problems concerning traffic safety.

The conference program is enclosed in Annex 5.

5. Future prospects and future planning

The results attained so far will serve as a baseline for the research agenda of the coming period. We expect great impulse from the intermediate conference at Ghent University. The focus will continue to lie on the complementarity between different policy measures. In addition, the theoretical results will be illustrated by means of empirical applications.

The time schedule for the coming period will be as scheduled in the technical annex of the contract.

Annex 1: References

(additional references are listed in the enclosed documents containing detailed results of the analysis)

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Annex 2: Publications

Delhaye, E. (2002), Kosten-Baten analyse van het vervangen van een geregeld kruispunt door een rotonde, *Tijdschrift voor economie en management*, vol. XLVII, 577-605.

Annex 3:

De Geest, G. and G. Dari Mattiacci (2002), On the intrinsic superiority of regulation and insurance over tort law, Universiteit Utrecht en Universiteit Gent.

Annex 4:

Delhay, E. (2002), Accident Analysis: The Role of Liability Rules – Pecuniary Losses, Centrum voor Economische Studiën, K.U.Leuven.

Annex 5: DWTC conference on the economic analysis of traffic safety