The Costs of Avoiding Accidents. Selective Compliance and the 'Peltzman Effect' in Italy

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Abstract

This paper investigates the relationship between deterrent and compensating effects ('Peltzman effect') under the point - record driving license system. We argue that, by inducing drivers to re-direct their penalty points towards the most rewarding offenses, this system generates selective compliance. In turn, this latter effect may determine offsetting behaviors. Evidence on traffic fatalities and seat belt use in Italy confirms our intuition. After the introduction of the point - record mechanism, road accidents decreased, but only selective compliance with seat belt use occurred, inducing significant offsetting effects with respect to non - occupant fatalities and driving intensity. Some adjustments are thus needed on traffic enforcement design to prevent these unintended consequences.

Keywords: *offsetting behavior, point - record driving license, seat belts, traffic law enforcement, traffic fatalities.*

JEL Classifications: *D02, K32, K42,L51.*

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1. Introduction[*]

About forty years ago, Guido Calabresi (1970) argued: "our society is not committed to preserving life at any cost". This unpleasant truth still holds today. Road traffic injuries represent the ninth most important cause of the global burden of disease and injury, and they are expected to become the fifth main determinant in about twenty years (WHO (2009)). Among the main policy tools for road safety, the enforcement design known as the *point - record driving license* (PRDL) is deemed to successfully reduce traffic fatalities (WHO (2004)).

A PRDL is an enforcement mechanism which attaches to each recorded traffic offense a fine and a corresponding amount of penalty points. When penalty points reach a given threshold, an 'incapacitation' measure is enforced in the form of driver's license suspension. It is actually a mechanism which couples a system of *warnings* (Nyborg and Telle (2004)) with one of *specific enforcement* against repeat offenders (Bourgeon and Picard (2007); Basili and Nicita (2005)). By tracking drivers' offense history through the progressive assignment of penalty points, a PRLD puts on a given infraction a weight which increases with the number of previously detected infractions. Thus the higher the number of past detected offenses, the greater the probability, at the margin, of exceeding the established threshold of penalty points that triggers the non - monetary sanction of license suspension, as a powerful device against repeated offenders (Polinsky and Rubinfeld (1991); Polinsky and Shavell (1998)).

While a vast empirical literature has measured the deterrent effect of the point - record mechanism on traffic offenses and road accidents, its impact on encouraging *offsetting behaviors* or *compensating effects* has been largely neglected.

In this paper we attempt to fill this gap, by disentangling deterrent and compensating effects associated with the recent introduction of a point - record driving license mechanism in Italy. We thus investigate the implicit cost, if any, of avoiding the costs of accidents through PRDL. To our knowledge this is the first paper dealing with this issue.

One of the most investigated instances of offsetting behaviors in road safety is associated with seat belt usage and is known as the 'Peltzman effect' (Peltzman (1975)): mandatory seat belt usage, by encouraging careless driving, may indirectly

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generate adverse effects on road safety, leading to more road accidents, as, for instance, non - occupant fatalities. In this paper we investigate whether the coming into force of the point - record driving license mechanism in Italy has induced or exacerbated such a seat belt usage compensating effect and to what extent.

We are specifically interested in two questions:

1. To what extent and through which channels does the mechanism of the point - record driving license increase compliance?

2. Does the induced compliance generate offsetting behaviors?

First, the point - record mechanism increases deterrence, as proxied by a reduction in traffic offenses. Our results confirms our previous analyses in this respect (Benedettini and Nicita 2009a, 2009b), whereas in this paper we further contribute to the topics by investigating whether the increase in deterrence induced by the PRDL determined in turn a perverse effect on driving behaviors.

Second, we outline how the observed deterrent effect was fairly limited in Italy, revealing *selective compliance* mainly with mandatory seat belt usage. We ascribe the observed selective compliance to a specific effect induced by the point - record mechanism: rational drivers, in fact, resulted having re-directed the penalty points that would have been otherwise 'spent' in seat belt offenses, to other more rewarding traffic law violations (we define the latter a 'substitution effect'). This substitution effect was further exacerbated by the simultaneous steep increase in fines for seat belt infractions which occurred in Italy under the new point – record driving license system.

Third, the observed selective compliance with the seat belt law produced perverse effects on road safety - i.e. an increase in non - occupant fatalities - as drivers engaged in more hazardous behaviors. We show that this latter effect has thus been exacerbated by the 'substitution effect' induced by PRDL.

Fourth, the occurrence of the two observed combined outcomes - from selective compliance to seat belt usage ('substitution effect'), and from the latter to road fatalities ('compensating effect') - generated an additional increase in dangerous speeding and drunk driving.

Our regressions clearly show the appearance of selective compliance after the introduction of PRDL in Italy. A sharp reduction (-68%) in seat belt offenses (and thus a strong compliance) is observed whereas other traffic offenses have been only marginally affected or even unaffected by PRDL. Moreover, while road accidents sharply decreased (-10%), a strong 'compensating effect' occurred, with reference to occupant and non - occupant injuries (Cohen and Evinav (2003)). In particular, a 1% reduction in seat belt offenses is generally associated on the one side with a reduction (-0.13%) in occupant fatalities and injuries, and on the other with an increase (+0.18%) in non - occupant ones.

In addition, after the introduction of the PRDL regime, the reduction in seat belt offenses generated slight, but nonetheless statistically significant, impacts on dangerous speeding and on drunk driving offenses.

We thus conclude that the PRDL regime generated selective compliance with seat belt laws and reduced the total motor vehicle death rate. However, the induced selective compliance with seat belt laws encouraged, in turn, significant offsetting behaviors.

Given the widespread adoption of PRDL, this is an urgent message to be delivered to policy makers. Should we just accept the observed offsetting behaviors as the unavoidable cost of avoiding accidents? We believe we should not, as some policy options could be easily implemented to overcome the unintended consequences of PRDL regime.

The paper proceeds as follows. In Section 2, we graphically show our intuition on a possible perverse relationship between deterrent effects and offsetting behaviors under a PRDL regime. In Section 3, we briefly describe the design of the point - record driving license mechanism in Italy, reporting some recent data about road safety in that country. In Section 4, we present the data and the methodology adopted in our empirical analysis. Section 5 outlines our findings and discusses the main results. Section 6 concludes, outlining how some adjustments are needed on traffic enforcement design to prevent the observed unintended consequences.

2. Point - record mechanism and offsetting behaviors: a graphical representation

In this Section we provide a simple graphical illustration of the possible perverse relationship between deterrent effects and offsetting behaviors under a point record mechanism regime. To this end, we outline separately the 'substitution effect' under a PRDL and the emergence of offsetting behaviors under selective compliance towards personal safety policy. Then we compare the two, under an integrated framework.

Point-record driver's license and the 'substitution effect'

A point - record driving license is a mechanism that imposes, besides fines, higher nonmonetary sanctions (penalty points) for repeat offenders, by tracking drivers' offense history through the progressive assignment of penalty points. Specifically, a PRDL can be thought as a mechanism through which authorities put on a given infraction a weight increasing with the number of previously detected infractions. Actually, under the assumption that individuals maximize the sum of their payoffs over different periods, drivers know that if caught committing an offense, they will incur an immediate sanction and that, because of their record, any sanction they face for a subsequent offense will be greater than it otherwise would have been (Polinsky and Rubinfeld (1991); Polinsky and Shavell (1998)). It is actually a mechanism which couples a system of *warnings* (Nyborg and Telle (2004)) with one of *specific enforcement* against repeat offenders (Bourgeon and Picard (2007); Basili and Nicita (2007)). A vast empirical literature has measured the deterrent effect of point - record mechanisms on traffic offenses and road accidents (Haque (1990); Zaal (1994); Vaa (2000); Zambon et al. (2008); Poli de Figueiredo et al. (2001); Hussain et al. (2006); Chipman and Morgan (1975); Chen et al. (1995); Diamantopoulou et al. (1997); Benedettini and Nicita (2009a) and (2009b)). Much less developed, so far, is the economic analysis of the PRDL as a hybrid sanctioning system against repeat offenders (Basili and Nicita (2005); Bourgeon and Picard (2007)).

We can graphically represent a PRDL through a curve of marginal rate of transformation (MRT), *Ss*, between the probability of the driver's license suspension and her driving intensity (which includes many different features such as speeding, dangerous and hazardous speeding, drunk driving, driving fast in adverse weather conditions, tailgating and so on), which, as in Figure 1, is assumed to be linear. The constraint faced by drivers is determined by expected enforcement and current endowment of income and penalty points. Drivers choose their driving intensity according to the budget constraint they face each time, in terms of both fines and penalty points associated with that level of driving intensity. Assuming that drivers know the enforcement probability (Polinsky and Shavell (1998)), they can calculate the risk of losing their license as the consequence of accumulating penalty points up to a critical threshold, because of the marginal impact of the offense they are evaluating whether to engage in, and/or the risk of selecting a very high level of driving intensity. When the license is suspended, the agent, being prevented from driving, is incapacitated for a while.

We want first to graphically outline the impact of selective compliance with some laws (say, seat belt laws) on the dynamics of other offenses.

Let us assume the driver to be initially at point *E*, in Figure 1, which provides the driver with utility V°. We are interested in understanding the impact on driving intensity of an *increase* in the stock of penalty points to drivers, due for instance to drivers' selective compliance with seat belt laws.

The intuition here is that penalty points are 'inputs' spent for 'consuming' the normal good given by driving intensity. Thus, an increase in the stock of total penalty points available to consume driving intensity has the effect of shifting the MRT curve to the right (*S's'*). The driver may now decide either to maintain the same level of driving intensity, while decreasing the probability of having the license suspended (as a higher number of points are available for 'consumption' before reaching the critical threshold which imposes license suspension), moving then from *E* to *R*; or she may decide to maintain the same risk of having her driver's license suspended, while increasing driving intensity, from *E* to *Z*. Any point between *R* and *Z* represents the dimension of the 'substitution effect' between penalty points and traffic offenses, generated by an increase of the stock of available points, which induces higher driving intensity.

Thus, departing from *E*, the larger is the new number of penalty points to be 'spent' in order to 'consume' driving intensity, the greater is this 'substitution effect'.

To fully understand the meaning of this 'substitution effect', and why it occurs under a PRDL, consider that a penalty points system generally covers several traffic offenses, attaching a monetary fine and some penalty points to each offense. For instance in Italy, speeding may be sanctioned by both a fine ranging from €155.00 to

€624.00 and by 5 penalty points (if the speed limit has been broken by between 10 and 40 km/h[1]); while driving without seat belts is sanctioned by a monetary fine ranging from €74.00 to €299.00, and by 5 penalty points. Thus, speeding and seat belt infractions receive a different fine but the same penalty in terms of points charged.

If we reasonably assume that some offenses are positively related to driving intensity, e.g. speeding or dangerous driving, we may reasonably state as well that a rational driver might be induced to comply with the law only selectively: for instance, in Italy, by complying with mandatory seat belt use, the driver may re - direct 5 penalty points to other offenses which, by increasing driving intensity, might increase the driver's utility (e.g., in order to reach a given destination earlier than he otherwise would have done (Tarko (2009), a driver may decide to 'invest' in speeding, the points saved by complying with mandatory seat belt use). A similar argument holds for monetary sanctions. Thus a first consequence of a point - record mechanism is that of inducing selective compliance in order to generate a substitution effect like the one depicted in Figure 1, from *Ss* to *S's'*.

Consequently, a first hypothesis to be tested in our empirical analysis is the following: *is the introduction of a point - record mechanism associated with selective compliance?*

Offsetting behaviors induced by safety protection

In his ground - breaking article, Sam Peltzman (1975) illustrated his intuition on the emergence of offsetting behaviors due to safety protection through a nice graphical example. Under this framework, drivers are self - interested individuals maximizing their own utility from driving. In particular, a trade - off does emerge between 'driving intensity' and road safety, measured as the probability of the driver avoiding injury.

Following Winston et al. (2006), we depict in Figure 2 the curve *Dd*, which represents the marginal rate of transformation (MRT) between safety (D) and driving intensity (d). This relation is assumed to be linear for the sake of simplicity.

Let us assume, as in Figure 2, that the MRT is given by *Dd* and that a driver initially chooses a point *E*, which maximizes his utility, as shown by the tangency of

[1] Actually, in Italy, speeding offenses related to the infringement of speed limits by between 10 and 40 km/h are the most frequently detected and penalized traffic law violations (as shown in the data kindly provided by the Italian Vehicle license office and by the Italian Institute of Statistics (2009)).

the utility curve $U°$ with the *Dd* curve. At point *E*, this then corresponds to the optimal levels of driving intensity and of expected damage injury.

Now, let us assume that a law is introduced which imposes mandatory use of seat belts upon drivers, or which, equivalently, toughens sanctions for seat belt offenses. The immediate effect of this legal provision is to affect the inclination of the MRT curve. Indeed for any given level of driving intensity, the probability of avoiding injury becomes greater, shifting the MRT curve from *Dd* to *D'd'*. Under the new MRT curve, the driver can decide either to maintain the same level of driving intensity while increasing safety (moving from *E* to *A*), or to maintain the same level of safety and increase driving intensity (moving from *E* to *C*). Of course, the driver can also choose any point between *A* and *C*. We define as *offsetting behavior* or *compensating effect* or *behavioral feedback*, as the literature has labeled it (Evans and Graham (1991)), any driver's shift from *A* towards *C* in the *D'd'* curve.

Many empirical works have investigated the existence of offsetting behaviors (e.g. Peltzman (1975); Blomquist (1988) and (1991); Crandall et al. (1986); Evans (1986) and (1987); Garbacz (1990) and (1991); Evans and Graham (1991); Traynor (1993); Levitt and Porter (2001); Singh and Thayer (2001); Sen (2001); Cohen and Einav, (2003); Sen and Mizzen (2007)). The typical analysis performed in these articles is devoted at empirically measuring "whether risk taking behavior is constant before and after installation of technological innovations" (Evans and Graham (1991)) such as drivers' seat belts, airbags, anti - lock brakes and so on.

Many scholars tested whether drivers who wear seat belts drive more recklessly than if they were unbelted. Given that the introduction of mandatory use of seat belts is generally associated with a reduction in overall traffic fatalities, scholars have long debated how to disentangle the adverse behavioral feedbacks and the general observed trend in road accidents. One way of performing this analysis has been that of comparing (the reduction of) car occupants' injuries and (the increase of) non-occupants' injuries in road accidents (see e.g. Cohen and Einav (2003); Sen and Mizzen (2007)).

However, the relationship between seat belt use and traffic fatalities is far from being conclusively ascertained. Indeed, while some studies document an increase in traffic fatalities as a consequence of an increase in seat belt use, some others reach completely different conclusions. For example, Cohen and Evinav (2003) found that an increase in seat belt use determines a reduction in traffic fatalities in general, thus finding no evidence of compensating behavior. Similarly, Houston et al. (1995), Sen

(2001), and Young and Likens (2000) found that traffic fatalities in general benefit from the enactment of seat belt laws. Conversely, evidence of offsetting behavior has been found by Garbacz (1990), and Sen and Mizzen (2007), who show a positive relationship between seat belt use and non-occupant death rates, as well as by Calkins and Zlatoper (2001) and Risa (1994) who show evidence of a positive relationship between occupant and non-occupant fatalities and seat belt use. Some investigations, such as Garbacz (1992) and Derrig et al. (2002), even find no kind of relationship at all between seat belt use and traffic fatalities.

While the empirical literature on offsetting or compensating behavior has generally focused on testing the hypothesis above, little of it explicitly addresses the relationship between enforcement design and the extent of offsetting behavior (Campbell (1988); Dee (1998)). In this paper we argue that one main consequence of neglecting the role of enforcement design in assessing the existence of offsetting behavior, is precisely the difficulty in disentangling such compensating effects from general trends in compliance with the law and in traffic fatalities.

The case of offsetting behaviors induced by PRDL 'substitution effects'

In order to graphically illustrate the relationship between selective compliance and offsetting behavior, let us refer now to Figure 3. We have represented there the relationships between driving intensity (on the lower horizontal axis), the probability of avoiding injuries (on the vertical axis on the left), the probability of having the driving license suspended (on the vertical axis on the right), and the probability of generating third - party damages through driving intensity (on the upper horizontal axis).

Let us assume that, initially, the driver is at point *E*. Let us assume that, as a consequence of the introduction of a point - record driving mechanism, drivers are assumed to decide to selectively comply with seat belt use, in order to obtain 'more penalty points' to be spent on driving intensity. Under this assumption, a 'substitution effect' occurs, as with the one outlined in Figure 1, which induces a switch from *Ss* to *S's'*. Other things being equal, the driver will then move from *E* towards *L*, where driving intensity is accrued while the probability of losing the driving license is decreased (as a consequence of relaxing the penalty points constraint), and the probability of avoiding injury is decreased as an effect of driving intensity increase.

However, a point like *L* could not be an 'equilibrium' point. Selective compliance on seat belt use, indeed, generates a shift in *Dd* towards *D'd'*, because now, as shown in Figure 1, the probability of avoiding injury becomes greater. The new equilibrium point will thus be at or near *K*. Comparing *E* with *K*, it turns out that the new equilibrium point is characterized by a higher probability of avoiding injury, a higher probability of generating third party injury, and a higher driving intensity. The probability of having the license suspended in *K* is almost the same as in *E*.

It is important to note that Figure 3 allows us to distinguish three effects:

1. the *compensating effect*, from *E* to *W* (measuring the increase in driving intensity and in the probability of generating harm to a third party, due to a shift from *Dd* to *D'd'*, along *Ss*);
2. the *substitution effect*, from *E* to *L* (measuring the increase in driving intensity and in the probability of generating harm to a third party due to a shift from *Ss* to *S's'*, along *Dd*);
3. the *combined effect*, from *E* to *K* (measuring the increase in driving intensity and in the probability of generating harm to a third party due to both substitution and compensating effects).

As we can easily see, an enforcement system such as the point - record mechanism acts as a constraint on the extent of the 'compensating effect' (which potentially may expand to point *C*). However, when a point - record mechanism generates selective compliance, it might nonetheless induce a behavioral feedback leading to point *K*, thus offsetting the expected benefits from compliance.

In this paper we argue that the enforcement design which characterizes the point - record driver's license typically disregards two potential sources of adverse outcomes: (a) the 'substitution effect', which leads to selective compliance; and (b) the 'compensating effect' induced by strategic selective compliance.

We thus focus our empirical analysis on the introduction of the point -record driver's license in Italy in 2003, and investigate the following hypotheses:

Does the point - record mechanism induce selective compliance, i.e. a 'substitution effect' among traffic offenses?;

Does the substitution effect, if any, generate offsetting behavior?

3. Point – record driving license and road safety in Italy

The Italian PRDL came into force in July 2003, following Decree Law No. 153/2003[2], with the aim of tackling the question of road safety in Italy. Currently, according to the European Commission, Italy displays the second highest level of annual road fatalities among the 27 countries of the European Union, being second only to Poland, and above the most advanced European states, like Germany, France, and the UK (Directorate for Energy and Transport (2009)). Looking at Figs. 4 - 6 it clearly emerges that, although traffic fatalities are decreasing over time in the whole European Union[3], Italy shows a yearly number of driver, passenger, and pedestrian fatalities well above that of other European countries.

Certainly, the scarce use of seat belts contributes to the dramatic primacy of traffic fatalities in Italy which, it is important to recall, are responsible for a loss of 2% in terms of GDP and for 2% of the total number of deaths (Italian Institute of Statistics (2009)). Indeed, looking at Fig. 7 it also appears that Italy displays the worst performances among European countries[4] with reference to seat belt use for front and rear passengers.

As mentioned earlier in the article, on July 1st, 2003 a PRDL was introduced in Italy with the aim of reverting the dramatic primacy with reference to road safety. In contrast to other countries where the PRDL assumes the characteristics of a totting - up system, i.e. drivers are allowed to accumulate penalty points for a range of harmful acts up to a given threshold that when breached triggers license suspension, in Italy the PRDL is characterized by assigning to each driver an initial credit of 20 points. Once a given offense is committed, the driver loses a number of points which varies according to the seriousness of the offense committed. When the initial endowment of points is exhausted, the driver's license is not automatically suspended; drivers are merely required to attend a driving course and to pass a written and practical test within 30 days of the zeroing of their point endowment. The suspension occurs if, and only if, within the 30 days they fail to attend the driving course or do not pass the tests. During the time between the complete exhaustion of points and the driving tests, drivers are allowed to drive. Moreover, when several infringements are detected

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[2] Decree law no. 153/2003, "Modifiche ed integrazioni al codice della strada", published on the Italian Official Bulletin n. 149. Available at: www.parlamento.it/parlam/leggi/decreti/03151d.htm (in Italian).

[3] Figures refer to a sub – sample of countries of the EU – 27 for which data are available.

[4] See supra note 3.

at once, no more than 15 points may be deducted, even though the total number of detected infractions could otherwise be enough to lead to the suspension of the driver's license. Nonetheless, the Italian Traffic Code also provides redemptive mechanisms such as the crediting of points every two years for drivers who have kept a clean record. Specifically, if for two consecutive years a driver does not commit infractions entailing the deduction of points, the initial credit of 20 points is restored. When he does not commit infractions for two consecutive years and moreover he has maintained at least 20 points, he receives a further credit of two points. For a detailed analysis of the effectiveness of the Italian PRDL as an incentive - compatible mechanism, we refer to Benedettini and Nicita (2009a, 2009b) in which is accurately investigated the impact of PRDL on speeding offenses, disentangling the 'announcement effect' and the 'incapacitation effect'.

The introduction of the PRDL, in Italy, has exerted, *ceteris paribus*, a heterogeneous effect on traffic offenses (see Fig. 8) as well as a vanishing one for some of them (Benedettini and Nicita, 2009a, 2009b). Actually, seat belt offenses are those which benefited the most by the introduction of the new sanction system displaying a clear break in July 2003 as well as an indefinitely non-increasing trend over time. Conversely, offenses like speeding, dangerous speeding, drug driving and drunk driving appear to have been positively affected only in a short - term window, around the time of the enactment of the new law. Indeed, they all display a clear indefinitely increasing trend over time beginning a few months after July 2003.

In the next Section, based on our previous investigations (Benedettini and Nicita, 2009a, 2009b) we provide further statistical evidence both of drivers' alternative responses to traffic offenses, and of the trend in road accidents, after the introduction of the PRDL in Italy.

4. Data and methodology

4.1 Description of the data

Our research is devoted at: (i) investigating whether, and to what extent, the introduction of a PRDL determined a reduction of road accidents and traffic offenses, through the deterrence of socially undesirable driving behaviors; and (ii) analyzing the relationship between deterrent and compensating effects by investigating the link between seat bealt offenses and traffic fatalities in the light of the mentioned changes in sanction policies.

Data on traffic offenses have been collected from the dataset of the Italian National Police, which provides evidence on the daily number of recorded tickets. In particular we focus on the following traffic law violations: (i) *speeding*[5]; (ii) *driving at a dangerous speed*[6]*;* (iii) *driving without seat belts*[7]*;* (iv) *driving under the influence of alcohol*[8]; and (v) *driving under the influence of drugs*[9].

These data are available with regard to the whole Italian road network, i.e. highways, state, regional, provincial, and municipal roads, from March 1st, 2001. Specifically, our analysis has been performed by employing monthly observations of the number of recorded tickets relative to the offenses mentioned in points (i) to (v).

To investigate the effects of the coming into force of a PRDL on road accidents, and then to test the *Peltzman hypothesis*, we used data on the monthly number of, respectively, road accidents and occupant and non – occupant fatalities and injuries. These data, provided by the Italian Institute of Statistics (2009), refer to the whole Italian road network and cover the period January 1st, 2001 – December 31st, 2008[10]. The monthly number of vehicle occupants involved in accidents refers to drivers and passengers who have suffered injuries or died as the result of an accident. Evidence on non – occupants relates to the monthly number of pedestrians who died or were injured in a crash.

[5] Art. 142 of the Italian traffic code, (ITC henceforth).
[6] Art. 141 of the ITC.
[7] Art. 172 of the ITC.
[8] Art. 186 of the ITC.
[9] Art. 186 of the ITC.
[10] At the time of writing, the Italian Institute of Statistics has yet to publish data on accidents occurring in 2009.

In studying whether the introduction of a PRDL to curb traffic infractions determined a reduction of offenses, we also took into account several factors, other than the change in the sanction policy itself, which may account in explaining the dynamics of traffic offenses. First of all, we considered the number of deployed cameras ($Cameras_t$) and police patrol cars ($Police_t$)[11]. Data on the implemented level of controls have been provided by the *Direzione della Polizia Stradale* (Traffic Police Directorate) and refer to the period January 1st, 2001 – September 30th, 2008.

In our specifications, we also controlled for the potential volume of vehicles on roads by using data on the monthly number of circulating vehicles ($Veic_t$), as they appear from the register of the *Automobile Club d'Italia*[12].

In addition, our regressions include a variable capturing weather conditions, as measured by the average monthly level of precipitations occurred in Italy ($Prec_t$). These data have been obtained by averaging the daily amount of precipitation registered by each of the 187 meteorological stations located across the whole Italian territory. In fact, weather conditions may be related to the number of recorded tickets and road accidents in several ways. Specifically, they may influence the frequency of accidents as well as drivers' perceived risk of accidents thus potentially affecting their willingness to infringe traffic laws and, *ceteris paribus*, the number of registered traffic infractions.

In addressing empirically the effects of the introduction of the PRDL on the dynamics of the total amount of accidents and traffic offenses as well as in investigating the influence of seat belt use on occupant and non – occupant fatalities and injuries, we added in our regressions a further set of controls besides those just mentioned. We refer, first, to the monthly unemployment rate ($Unempl_t$), which has been used to capture the effect of economic conditions on traffic fatalities. Data on the monthly rate of unemployment come from the International Labour Organization database on labor statistics, LABORSTA. Actually, macro - economic conditions may affect the dynamics of accidents through different channels as well as in opposite directions. For example, an increase in the rate of unemployment may be associated with a reduction in traffic fatalities (Stuckler (2009)) and offenses, because of e.g. a

[11] This was finalized at controlling for the implemented level of enforcement and thus for any change occurred in the enforcers' ability into detecting traffic offenses. Actually, it is important to remind that the collected observations on traffic tickets result as they have been detected and recorded by the Italian National Police.

[12] Available at: http://www.aci.it/index.php?id=54 . The monthly number of circulating vehicles has been computed by considering the total amount of circulating vehicles, as they resultedrecorded at December 31st 2000, and by adding then, for every month, the number of newly registered vehicles minus the number of vehicles that have been removed from the register.

reduction in people's opportunity costs (Cohen and Evinav (2003)), as well as in traveling (Ruhm (2000)). Conversely, a decrease in the unemployment rate, being associated with an improvement in well – being, may lead to the purchasing of safer vehicles and thus to a reduction of accidents (Sen and Mizzen (2007)). Or conversely, an increase in the unemployment rate may determine an increase in traffic fatalities and offenses because of an increase in alcohol consumption (see e.g. Carpenter and Dobkin (2009), Arranz and Gil (2009), Sen and Mizzen (2007)).

In addition, we employed the monthly variations in alcohol price ($AlcPrice_t$) to control for the effect of alcohol consumption[13] on road accidents. Data on the variations in alcohol price have been collected from the dataset used by the Italian Institute of Statistics to compute the yearly National Consumer Price Index[14].

Data on the monthly level of resident population (Pop_t) and on the monthly number of resident males aged between 25 – 29 ($PopM2529_t$) are also included in regressions. Pop_t is a proxy for the overall potential volume of road users. $PopM2529_t$ accounts for the presence of those individuals who have been revealed to show a higher probability of being involved in accidents (Italian Institute of Statistics (2009)). Data on population come from the Italian Institute of Statistics Monthly Demographic Balance dataset[15] and are available only from January 2002 onward[16].

Finally we tested the robustness of our results by adding also the variable $GasPrice_t$ as proxy for traffic intensity. This variable captures monthly variations in gasoline price. Although gasoline demand may be considered substantially inelastic (Brons et al. (2008)), gasoline price is usually employed in the literature on road safety as an exogenous proxy for traffic intensity. As with the price of alcohol price, data on changes in gasoline prices have been collected from the National Consumer Price Index dataset of the Italian Institute of Statistics[17].

Our balanced dataset covers the period March 2001 – Septemeber 2008. In Table 1 we report the main descriptive statistics concerning the variables employed in our regressions.

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[13] We assume that alcohol demand is not inelastic, Fogarty (2009).

[14] Available at: http://www.istat.it/salastampa/comunicati/in_calendario/precon/20100223_00/ . The reference year for variations in alcohol price is 1995.

[15] Available at: http://demo.istat.it/index_e.html .

[16] Monthly data on population for the year 2002 were kindly provided by Angela Silvestrini of the Italian Institute of Statistics. In fact, monthly data on population are publicly available only from January 2003 on. Data for the year 2001 are available only on a yearly basis. This is because after the October 2001 census, resident population in 2001 was recalculated to avoid problems of census representativeness. However, the computation was performed only on a yearly basis.

[17] See supra note 14.

4.2 Methodology and empirical specification

The effects of the PRDL on traffic offenses and accidents

The effects on offenses and road accidents of the introduction of the PRDL have been outlined in previous empirical research (Benedettini and Nicita (2009a, 2009b)) through non parametrical estimates. Here we extend previous analysis by estimating a Sharp Regression Discontinuity Analysis (Angrist and Pischke (2009)), while enriching the number of control variables. In particular the following specifications are drawn:

$$(1) \quad Off_t = \alpha + \gamma PRDL_t + \beta \Theta_t + t + \varepsilon_t$$

$$(2) \quad Acc_t = \delta + \theta PRDL_t + \psi \Theta_t + t + u_t$$

where Off_t and Acc_t represent, respectively, the amount of recorded tickets and occurring road accidents during month *t; $PRDL_t$* is a dummy variable which takes the value 1 for the months from the cutoff date July 1st, 2003 onward (i.e. from the entry into force of the PRDL onward), and 0 otherwise, and represents our treatment status; Θ_t is a set of controls including the variables $Cameras_t$, $Police_t$, $Veic_t$, $Prec_t$, $Unempl_t$, $GasPrice_t$ and $AlcPrice_t$, and the lagged dependent variable (up to three lags, arbitrarily chosen[18]) to account for autocorrelation; *t* is a variable accounting for the time trend.

Equation (1) has been estimated for all the five traffic offenses in respect of which we want to evaluate the impact of the introduction of the PRDL, i.e. speeding ($Speed_t$), seat belt offenses ($Seat_t$), dangerous driving ($Dang_t$), drug ($Drug_t$), and drunk driving offenses (Alc_t),.

The baseline regressions involve two years before and after the introduction of the PRDL and therefore refer to the period July 2001 – June 2005. We then tested the robustness of our results by: (i) considering different time windows around the entry into force of the new law, i.e. 12 months and 18 months before and after; (ii) adding, in

[18] The decision to consider a number of lags up to three is the outcome of a trade – off between the willingness to control for autocorrelation and the necessity to ensure 'enough' degree of freedom, given the size of our sample, in order to guarantee efficient estimates as far as possible.

the specifications concerning road accidents, further controls, i.e. Pop_t, and $PopM2529_t$. In all specifications standard errors are corrected for heteroskedasticity.

To ensure that our time series are definitely free from seasonal effects (e.g. the dynamics of traffic tickets and road accidents may be driven by changes in traffic intensity because of holiday periods), we transformed both our dependent and independent variables by means of the moving average technique. Similar remarks apply for those controls like the unemployment rate, alcohol price, or precipitations, which, for differing reasons, are likely to be affected by seasonality. Given that our data refer to monthly observations, the time window employed for the moving average transformation is equal to twelve months.

The figures obtained thereafter were then transformed into logarithmic values in order to interpret the coefficient of our regressions as elasticities and to approximate as much as possible a normal distribution of the data.

Seat belt use and traffic fatalities

The second goal of our analysis is to estimate the relationship between seat belt use and traffic fatalities in order to capture the eventual occurrence of offsetting behaviors due to the introduction of a PRDL. To our knowledge this is the first paper dealing with this issue.

Actually, accordingly to a preliminary analysis (see Fig. 8) we observe that among the several types of traffic law violations we considered, seat belt offenses in Italy strongly benefited from the introduction of a PRDL. Specifically, not only seat bealt offenses' time series experiences a clear downward jump after the coming into force of the PRDL, but it represents also the only time series which shows, different than that of the other infractions, an indefinitely decreasing trend over time. Consequently, we want to investigate whether an increase in the use of seat belts benefited road safety as well, by reducing the number of individuals suffering from road accidents, or rather promoted offsetting behaviors producing puzzling results on road safety.

To this end we investigated:

1. the relationship between seat belt offenses (as a proxy of seat belt use) and occupant and non – occupant fatalities during the overall observation period March

2001 – December 2008, as a measure of the occurrence of *offsetting behaviors* or *compensating effects* due to an increase in the usage of personal safety devices ;

2. the impact, if any, of PRDL regime on the relationship between seat belt offenses and traffic fatalities;

3. the channels through which the mentioned impact of PRDL, if any, prevented or exacerbated the occurrence of *offsetting behaviors*.

In order to test the Peltzman hypothesis for Italy we estimated the following two Log – Log models, by means first of an OLS and then of a 2SLS estimator, as in Cohen and Evinav (2003),and Sen and Mizzen (2007)):

$$(3)\ Log\,(Occ_t) = \alpha + \gamma Log(Seat_t) + \beta Log(\Theta_t) + t + \varepsilon_t$$

$$(4)\ Log\,(Non - Occ_t) = \delta + \theta\, Log(Seat_t) + \psi\, Log(\Theta_t) + t + u_t$$

where Occ_t and $Non - Occ_t$ are, respectively, the monthly number of occupants and pedestrians injured or killed as the result of an accident during month *t*; and Θ_t is a set of controls including $Police_t$, $Cameras_t$, $Unempl_t$, $Veic_t$, $Prec_t$, $GasPrice_t$, $AlcPrice_t$ in the baseline regressions, and also the variables Pop_t, and $PopM2529_t$, when testing for the robustness of our original results. The robustness of the baseline specifications, originally estimated for the whole period March 2001 – September 2008, has been then tested by using alternative time windows around the entry into force of the PRDL (i.e. two years, 18 months, and 12 months before and after).

The 2SLS estimator has been used to take into account the outlined influence of the introduction of the PRDL in increasing seat belt use and thus to take into account the potential endogeneity between the dependent variables and seat belt use (see e.g. Cohen and Evinav (2003), Sen and Mizzen (2007)). Specifically, we wanted to capture the idea that an increase in road fatalities may have caused the adoption of a law reform, like the PRDL, which, in turn, has caused an increase in seat belt use.

To this end, we regress, in the first stage of our 2SLS regressions, the endogenous variable $Log(Seat_t)$ on the set of regressors employed in the second stage plus the dummy variable $PRDL_t$ and a first order lagged dependent variable (see e.g. Sen and Mizzen (2007)).

In all the estimated specifications standard errors are corrected for heteroskedasticity, a time trend, the lagged dependent variable (up to three lags), and two dummies to account for seasonal peaks are included. Specifically, dummies refer to the months August and November where the dependent variable is $Non - Occ_t$ and to February and July where the dependent variable is Occ_t[19].

Once we had ascertained the relationship between seat belt offenses and traffic fatalities, we proceeded further in our analysis by investigating whether and to what extent the PRDL has had a role in shaping this relationship and, if any, in encouraging thus offsetting behaviors.

To this end we estimated:

1. the previous specifications for two different sub – samples covering, respectively, two years before and two years after the introduction of the PRDL;

2. the following Log - Log model by means of a 2SLS in order to understand which type of hazardous driving behavior, if any, has been incentivized by the coming into force of the PRDL:

$$(5) \quad Log\,(Off_t) = \delta + \theta\, Log(Seat_t)*PRDL_t + \psi\, Log(\Theta_t) + t + u_t$$

where: Off_t is the number of recorded infractions at time t for each of the four offenses with respect to which we are looking for the occurrence of compensatory behavior, i.e. speeding, dangerous speeding, drug and drunk driving; $Log(Seat_t)*PRDL_t$ is our key variable and is an interaction term which captures contextually the occurrence of two conditions: variation in seat belt use, as proxied by the number of seat belt offenses $Log(Seat_t)$; and being under the PRDL regime, captured as usual by the dummy variable $PRDL_t$. This variable has the aim of capturing the role of the PRDL in promoting offsetting behavior. Indeed, whether negative and statistically significant, the coefficient of this interaction term tells us that a 1% reduction in seat belt offenses determines an increase in traffic offenses related to hazardous driving behavior, which is greater than it would have occurred in the absence of a PRDL, our reference category, by a percentage equal to the value of the mentioned coefficient; Θ_t includes a set of controls like $Cameras_t$, $Police_t$, $Veic_t$, $Prec_t$, $AlcPrice_t$, $Unempl_t$ and $GasPrice_t$.

[19] The emergence of these peaks can be easily detected through a plot of the corresponding time series.

We then exploited a 2SLS estimator in order to take into account the potential endogeneity existing between different driving behaviors[20]. Specifically, the variable $Log(Seat_t)*PRDL_t$ has been instrumented by using all the variables included in the second stage of our 2SLS regressions, i.e. the regressors in the right hand of eq. (5) plus the dummy variable $PRDL_t$ to account for the documented effect of the PRDL on seat belt offenses.

[20] For example it may happen that one drives faster because he or she wears a seat belts, i.e. offsetting behavior, but it might be also the case that one wears the seat belt because he or she decides to drive faster;. Similarlythe same applies for the other risky potentially dangerous behaviors we examined.

5. Estimation results

In this section we report the results of our econometric analyses concerning the effect on traffic offenses and road accidents of the introduction of the PRDL in Italy on July 1st, 2003, and the relationship between seat belt offenses and traffic fatalities.

The effects of the PRDL on traffic offenses and accidents

In Table 2 we report the results of our regression analysis concerning the effect on several traffic offenses of the adoption of a PRDL. We illustrate first the results of our baseline regressions, and then the robustness checks consisting in the estimation of the original models using different time windows around the entry into force of the new law.

Our results confirms previous analyses[21] in this respect. The coming into force of the PRDL did not affect all offenses in the same way. Indeed, consistent with Fig. 8 the traffic law violation which benefited the most is seat belt offense. Actually, when shifting from a regime without PRDL to one with PRDL, we observe a decrease of about 68.88% in seat belt offenses.

Then, it follows that drunk driving and speeding offenses also benefited, though to a lesser extent, from the introduction of the PRDL, experiencing reductions of 21.41% and 20.68% respectively in the two years following its adoption.

Our robustness checks confirm the results of the baseline regressions and point out also the vanishing effect over time of the PRDL that occurred for some traffic offenses (Benedettini and Nicita 2009b).

Indeed, we observe that when moving from a 12 -month to a 18 - month and then 24 - month time window (Tabs. 3 and 2), the coefficient of the variable $PRDL_t$, capturing the treatment status, tends to decrease for all offenses with the exception of seat belt offenses. In addition, it emerges that for drug driving and dangerous speeding offenses the introduction of the PRDL exerted a deterrent effect only in the period immediately following the entry into force of the new law (i.e. when examining a 12-month time window). Indeed, it appears that when considering broader time windows, the coefficient of our treatment variable loses significance. Unlike all other offenses, i.e. speeding and drunk driving, it progressively decreased, while for seat belt offenses it

[21] Benedettini and Nicita (2009a, 2009b).

tends to rise, albeit with a different magnitude. Specifically, it appears that the reduction in seat belt offenses rises from 0.42 offenses to 0.52 points in passing from a 12-month to a two-year window.

Table 4 reports the results concerning the effect of the introduction of the PRDL on road accidents. Our estimates show that the adoption of the PRDL is associated with a reduction of about 0.10 points in accidents, corresponding to a decrease of 10.52%. This percentage tends to rise, until about 18.53%, when, testing for the robustness of our results, we added further controls in our regressions. These robustness checks also show that actions aimed at reducing alcohol consumption – e.g. an increase in alcohol price – enhance road safety. Indeed, it emerges that a alcohol price rise of 1% is associated with a reduction of about 11% in road accidents. Our regressions also confirm that males aged 25 – 29 are significantly exposed to accident risk. Indeed an increase of 1% in the number of males aged between 25 – 29 in the population corresponds, *ceteris paribus*, to an increase of about 14% in accidents.

We then tested the robustness of our results by using different time windows around the enactment of the PRDL (see Tab. 5). These robustness checks further confirms our results. In addition, when looking at the OLS estimates, it appears that the positive effect on accidents, as for offenses, is decreasing over time. Indeed, the coefficient of the variable $PRDL_t$ decreases when passing from a 12 - month to a 18 - month and then 24 - month time window. Moreover, the effect of alcohol price changes tends to lose significance, while that relating to the influence of the level of resident population and of the number of males aged between 25 – 29 tend, generally, to maintain their statistical significance.

In Figs. 9 – 11 we show the discontinuous trend in speeding, drunk driving, and seat belt offenses. In Fig. 12 we report the discontinuous trend associated with road accidents. Consistent with the results of our regressions, Figs. 9 – 11 also highlight the heterogeneous responses of traffic offenses to the adoption of the PRDL. In addition, these figures provide evidence of the fact that offenses like speeding and drug driving, although they benefited from the introduction of the PRDL, are characterized by an increasing trend over time (Benedettini and Nicita (2009a)).

An explanation of the occurrence of the increasing trend experienced by the mentioned offenses, despite the coming into force of the PRDL, as well as of the vanishing effect of the latter exerted on road accidents and speeding offenses, isprovided in Benedettini and Nicita (2009b). In this paper we further contribute by attempting to disentangle the reasons behind the strong deterrent effect that the coming into force of the PRDL exerted on seat belt offenses. We argue that the significant response of seat belt offenses is the outcome of what we define in Section 2 as the 'substitution effect': rational drivers may have re-directed the penalty points that would have been otherwise 'spent' in seat belt offenses, to other more rewarding traffic law violations. In addition, the simultaneous steep increase in fines for seat belt infractions, which occurred in Italy with introduction of PRDL, further exacerbates this substitution effect, through a Beckerian channel (Becker (1969)).

Seat belt use and traffic fatalities

Table 6 illustrates the baseline regressions concerning the relationship between seat belt use and traffic fatalities. Our OLS and 2SLS estimates show that seat belt use is positively related to the amount of occupant fatalities but negatively to that of non – occupant fatalities. Specifically, the positive and statistically significant coefficient of the variable $Log(Seat_t)$ tells us that an increase in seat belt offenses is related to an increase in occupant fatalities or, equivalently, that a reduction in seat belt infractions, and thus an increase *ceteris paribus* in seat belt use, is associated with a reduction in occupant fatalities. Conversely, when non – occupant fatalities are considered, we observe a negative relationship with seat belt use. Specifically, the negative and statistically significant coefficient of the variable $Log(Seat_t)$ indicates that an increase in seat belt use (i.e. a reduction in seat belt offenses), is associated with an increase in pedestrian fatalities. Correspondingly, it can be stated that a reduction in seat belt usage, and thus an increase in seat belt offenses, is associated with a reduction in non – occupant fatalities.

Specifically, we observe that an increase of 1% in seat belt use determines a reduction of 0.13% in occupant fatalities, but an increase of 0.18% in pedestrian injuries and deaths.

Regressions concerning the effect of the coming into force of the PRDL on traffic offenses have revealed that the new sanction policies exerted a strong deterrent effect with reference to seat belt offenses. By considering that, generally, a reduction in seat belt offenses is related with a reduction in occupant fatalities but with an increase in pedestrian fatalities and that following the introduction of the PRDL seat belt offenses experienced a drastic reduction, we may reasonably state that the adoption of a PRDL, by increasing seat belt use, encouraged offsetting behaviors. We will address the specific role of the PRDL in the next subsection. At this stage, it is sufficient to observe that an increase in sanctions for seat belt offenses, both monetary and non – monetary, is associated with compensatory behavior and that the influence of the new law has been taken into account in the IV regressions, where the dummy $PRDL_t$ assumes a negative and statistically significant coefficient in the first stage of the 2SLS estimates.

Moreover, it is important to observe, by considering a two - year time window around the entry into force of the new law, that the average number of occupant fatalities declined by an amount equal to 6%, and the average number of non – occupant fatalities increased by an amount equal to 5%, after July 1st, 2003.

Our results concerning the relationship between traffic fatalities and seat belts usage appear to be robust to the introduction of further controls in the specifications (Tabs. 7 and 8), and to the adoption of different time windows around the introduction of the PRDL (Tabs. 9 and 10). We focused, respectively, on a 24-month, 18-month and 12-month time window around the introduction of the PRDL.

The performed baseline estimates also reveal that macroeconomic conditions, as measured by the monthly unemployment rate $Unempl_t$, are negatively associated with occupant fatalities but show no relationship of any kind with non – occupant fatalities.

Also of interest is the role of different types of enforcement 'devices' on road fatalities. Actually, while occupant fatalities appear not to be sensitive to the number of cameras or police patrol cars deployed (an exception occurs when we perform our robustness checks by employing different time – horizons around the entry into force of the PRDL, Tab. 9), it emerges that non – occupant fatalities are positively related to the amount of police patrol cars on duty (Tabs. 6, 8, and 10), but negatively to the number of deployed cameras (Tabs. 8 and 10). The positive effect of cameras on traffic fatalities may be explained through the effect they exert on certain driving behaviors such as speeding or drunk driving. Actually, we have seen that increasing the number of cameras deployed, Tab. 2, leads to an increase in the number of speeding and alcohol related offenses detected. To put it differently, the ability of the enforcement authorities to detect these offenses increased. Therefore, if we assume that an increase in the probability of detection exerts a deterrent effect on certain types of driving behavior (Leung (1995), Shepherd (2001), Tay (2005)), we may well understand the negative relationship between the number of enforcement devices and traffic fatalities[22]. Another possible explanation has to do with the non – monetary sanctions related to speeding and drunk driving[23].

Moreover, our estimates point out that, generally, an increase in the number of circulating vehicles, as proxied by the variable $Veic_t$, is positively associated with the volume of both non – occupant and occupant fatalities. In addition, policies aimed at reducing alcohol consumption, through e.g. an increase in alcohol price, appear to benefit non – occupant fatalities, as pointed out by the negative and statistically significant coefficient of $AlcPrice_t$ (Tab. 8).

When we test the robustness of our results by adding further controls, we observe that an increase in the number of males aged between 25–29 in the population is positively associated with the number of occupant fatalities, thus supporting the view that, in Italy, the category of male drivers aged between 25–29 have a substantially higher risk of being involved in accidents (Italian Institute of Statistics (2009)).

Does the point - record mechanism induce offsetting behavior?

Finally, we measure to what extent the emergence of observed offsetting behaviors is attributable to the adoption of a PRDL regime, and thus to the increase in seat belt use induced by selective compliance (what we defined the 'substitution effect' in Section 2).

We investigated the occurrence of offsetting behavior, i.e. the relationship between seat belt offenses and occupant and non – occupant fatalities, in two different sub - periods: the first one covering the two years before the coming into force of the PRDL, and the second one covering the two years afterwards. Table 11 documents the corresponding results.

While we find no relationship between seat belt offenses (and thus *ceteris paribus* seat belt use) and occupant and non–occupant fatalities before the adoption of PRDL,

[22] Conversely, police patrol cars might be positively related with the number of pedestrian fatalities because of the type of control or warning they may exert on drivers. Actually, drivers have to be stopped by the Police to be charged with a fine, or generally the presence of Police patrols on roads makes drivers decrease the speed at which they are travelling. However, once the control has been performed or the Police patrol disappears from drivers' route, a discontinuity in the driving speed occurs, i.e. it increases. It is this sudden increase in driving speed to which we ascribe the negative effect of Police patrols on pedestrian fatalities.

[23] Indeed, in Italy, drunk driving is always punished with license suspension and speeding offenses are directly punished with license suspension when the speed limit has been broken for a range beyond 40 Kkm/h. If we consider that breaking the speed limit for a range beyond 40 Km/h is among the ten most frequent offenses, in Italy, the negative coefficient of *Cameras(t)* may capture the beneficial effect of license suspension on traffic fatalities.

within the two years after the adoption of the PRDL a strong offsetting behavior is found.

Seat belt use turns out to reduce occupant fatalities while increasing non – occupant fatalities. More precisely, in the two years after the coming into force of the PRDL regime, a reduction of 1% in seat belt offenses is associated with an increase of 0.34% in non – occupant fatalities and with a decrease of 0.28% in occupant fatalities. These results strongly confirm our intuition of a direct effect of the PRDL on offsetting behavior and suggest that large part of the effect of seat belt use on traffic fatalities, during the overall period (Tab. 6), occurred after the introduction of the PRDL.

Finally, we investigated the hazardous driving behavior generated by seat belt use. To this end, our regressions in Table 12 highlight that compensating behavior has occurred with reference to two types of driving behavior: dangerous speeding and drunk driving.

Actually, the negative and statistically significant coefficient of the variable $Log(Seat_t)*PRDL_t$ tells us, first, that a decrease in seat belt offenses is positively associated with an increase in dangerous driving and drunk driving offenses; secondly, it shows that this increase in drunk driving and dangerous speeding is greater than it would have occurred in the absence of a PRDL, i.e. in the months before its introduction[24]. Specifically, this increase is equal to 0.02% for dangerous speeding and to 0.007% for drunk driving offenses.

[24] Being it an interaction term with the dummy $PRDL_t$ which captures the presence of the PRDL

6. Conclusions and Policy Options

In his ground-breaking article on offsetting behavior Peltzman (1975) argued that personal safety protection, such as mandatory seat belt usage, by encouraging careless driving, may indirectly generate adverse effects on road safety, leading to more road accidents. In this paper we have empirically investigated the role of the point-record driving license in encouraging this type of moral hazard. Actually, while a broad part of the empirical literature on the point–record mechanism has measured its deterrent effect on traffic offenses and road accidents, to the best of our knowledge it has neglected its impact on promoting offsetting behaviors.

Specifically, we tested the relationship between deterrent and compensating effects. Our behavioral assumption was that a point-record system may induce selective compliance ('substitution effect') on seat belt use and, in turn, this effect may encourage offsetting behavior, measured by occupant and non-occupant injuries.

Our empirical findings confirm our intuition. The reduction we observe in the rate of motor vehicle accidents, consequently to the introduction of a point–record driving license, did not occur for free in Italy. While the PRDL regime increased deterrence, as proxied by a reduction in traffic offenses, selective compliance only occurred for seat belt use. The relatively greater increase in seat belt use determined on the one side a reduction in occupant fatalities but on the other an increase in non-occupant fatalities as a result of drivers engaging in more hazardous driving behaviors.

We ascribe this compensating effect to what we have called the 'substitution effect' - i.e. rational drivers re-directed the penalty points that would have been otherwise 'spent' in seat belt offenses, to other more rewarding traffic law violations. Moreover, the increase in seat belt use generated additional dangerous speeding and drunk driving.

In particular, in order to maintain the deterrence effects of a point-record mechanism, while reducing the observed perverse linkage between the 'substitution effect' and offsetting behaviors, we suggest that the authorities: (i) refrain from assigning penalty points to offenses related to the use of personal safety devices such as the seat belt, relying only on monetary sanctions for these offenses and, if appropriate, raising fines for them; (ii) increase the penalty point tariffs for 'driving intensity' offenses such as speeding, drunk driving, and so on; (iii) reduce the amount of points initially assigned to drivers, in order to reduce drivers' incentives to strategically re-direct penalty points towards more rewarding offenses. Actually, looking at Fig. 3 it is possible to observe that if penalty points were not assigned for offenses related to the use of personal safety devices, no substitution effect would occur. This is equivalent to saying that the shift of the curve sS to s'S' would not take place, thus determining a lower level of driving intensity and of the probability of third-party injuries, while increasing the probability of license suspension and of avoiding driver injuries.

These measures, in our view, may partially re-align drivers' incentives to safer driving, preventing the observed distortions of the PRDL regime and thus minimizing the unintended 'costs of avoiding accidents'.

Given the widespread adoption of the point–record driving license, we believe this is an urgent message to be delivered to policy makers.

Figures

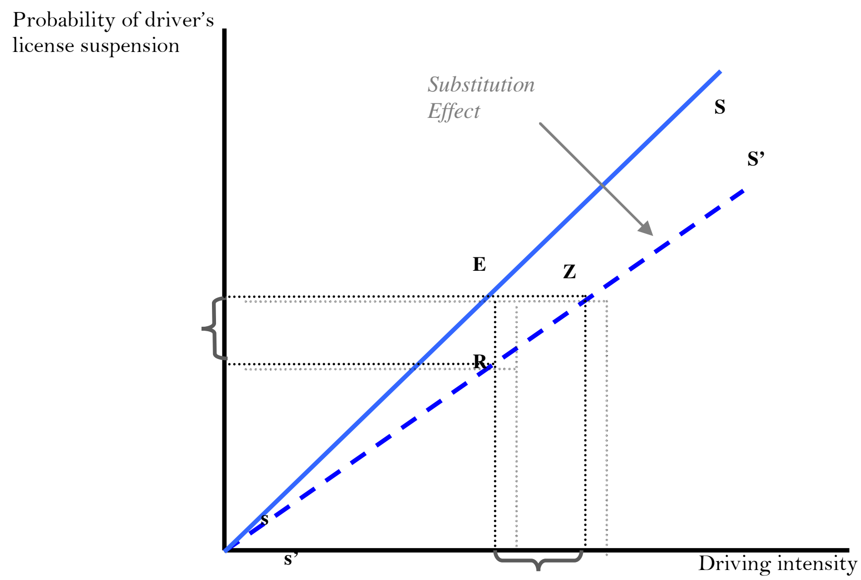

Fig. 1: Substitution effect under a point – record driving license.

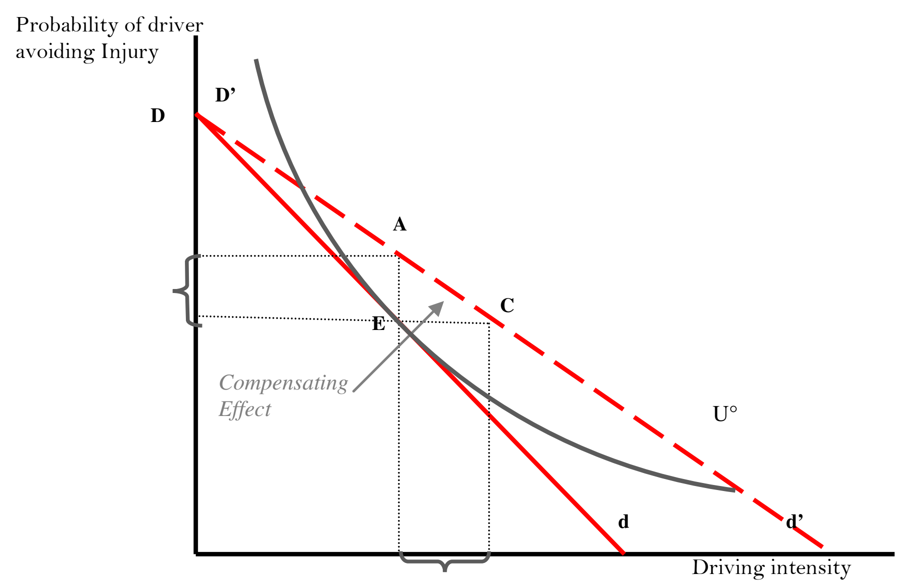

Fig. 2: Compensating effect under a point – record driving license.

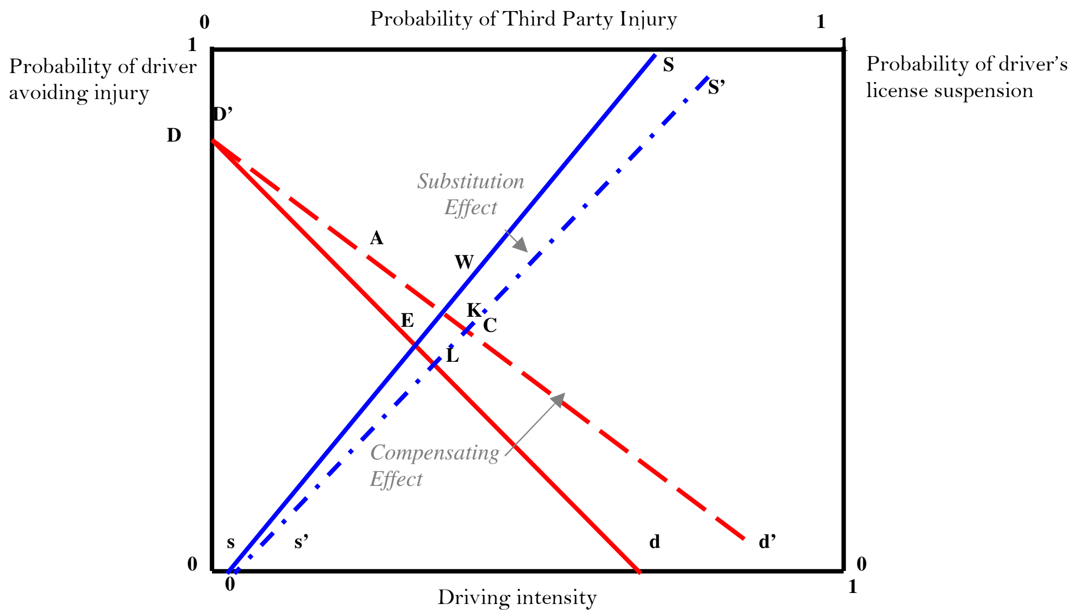

Fig. 3: Selective compliance and offsetting behavior under a point – record driving license.

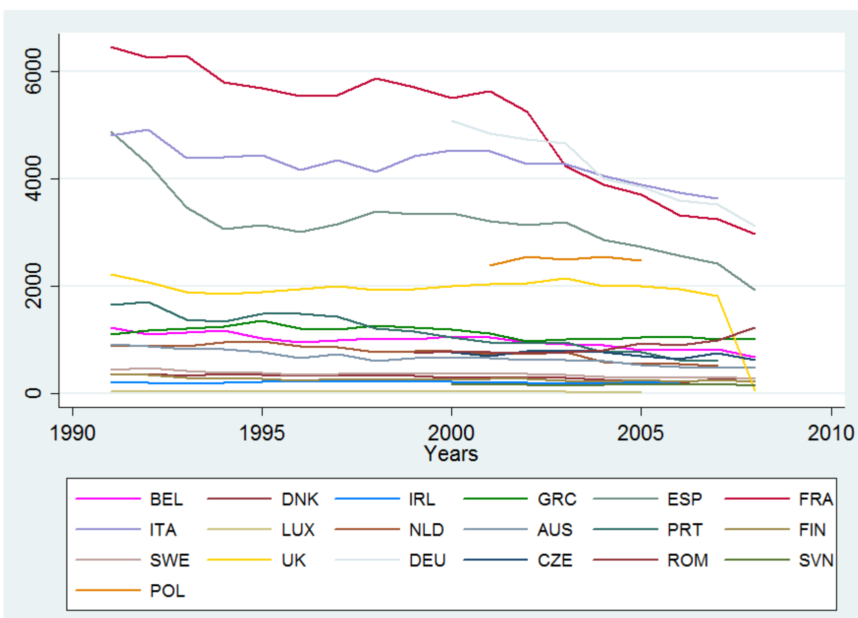

Fig. 4: Driver fatalities in Europen Union. Period: 1990 - 2008.

Source: European Road Safety Observatory (2008).

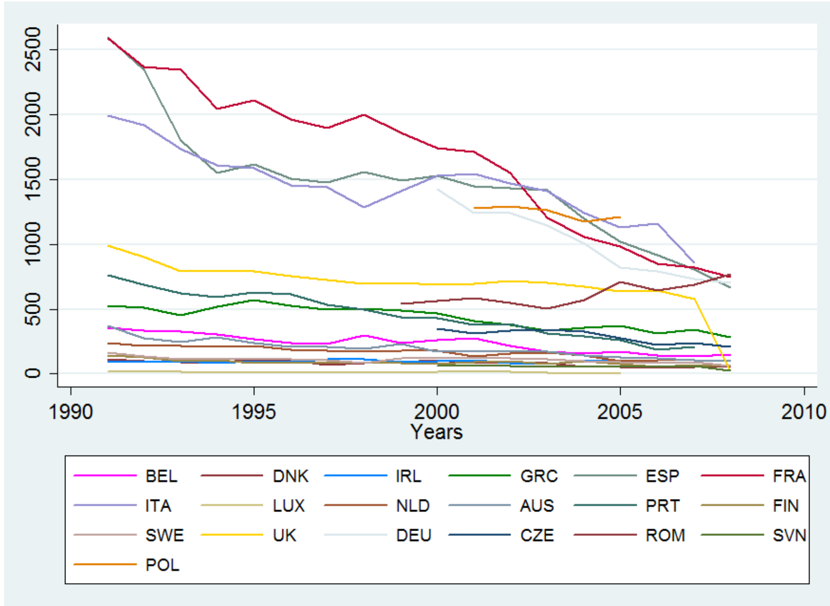

Fig. 5: Passenger fatalities in Europen Union. Period: 1990 - 2008.

Source: European Road Safety Observatory (2008).

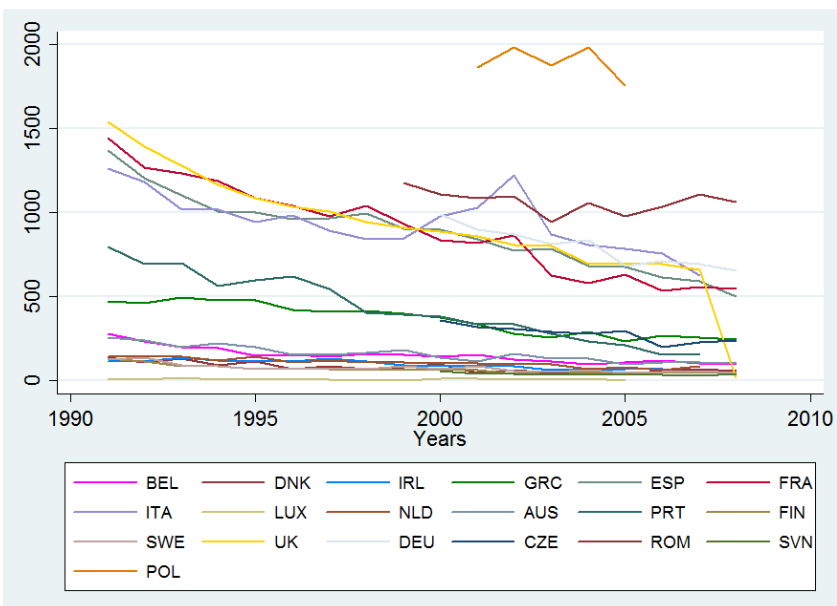

Fig. 6: Pedestrian fatalities in Europen Union. Period: 1990 - 2008.

Source: European Road Safety Observatory (2008).

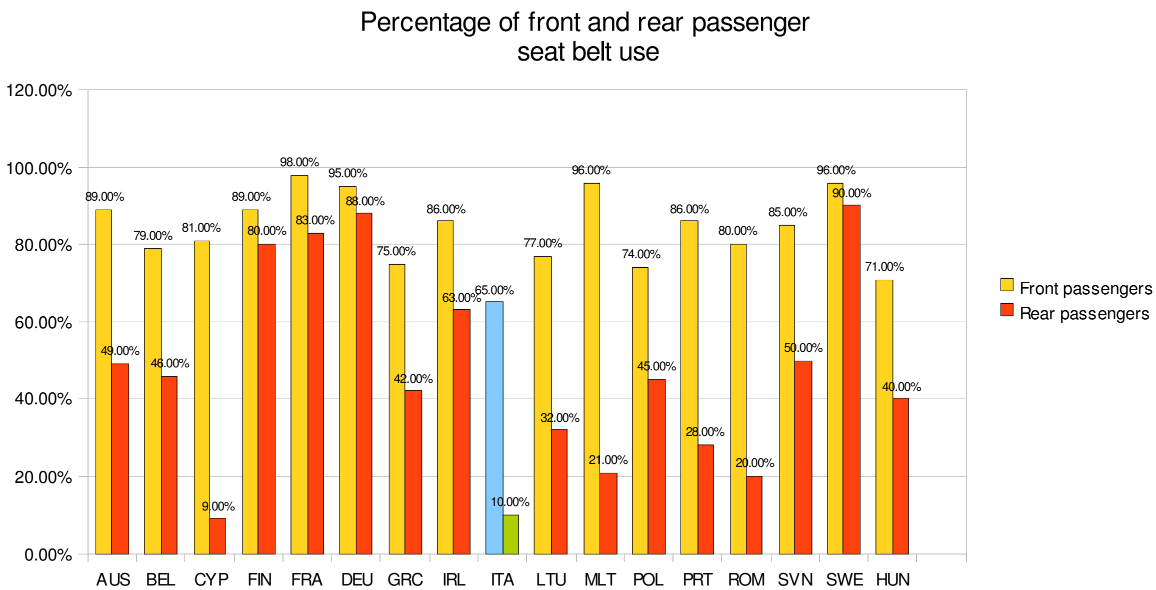

Fig. 7: Percentage of front and rear passenger seat belt use in European Union.

Source: World Health Organization (2009).

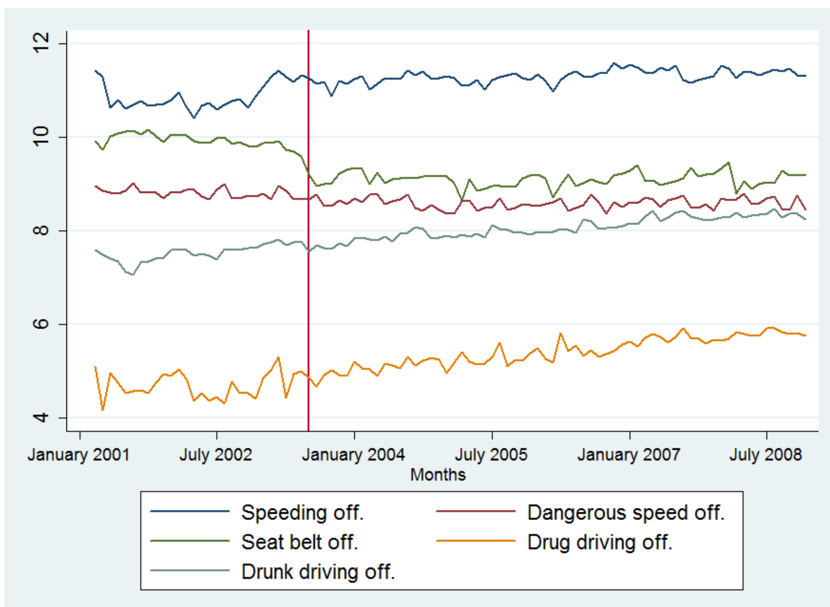

Fig. 8 Traffic offenses in Italy. Period: March 2001 - December 2008.

Source: Italian National Police dataset.

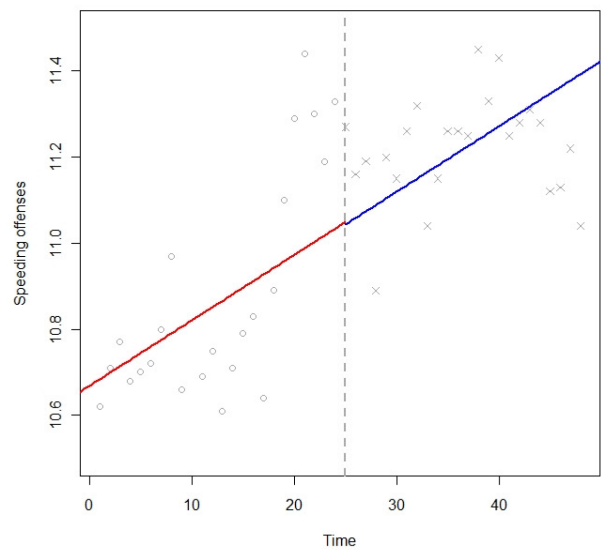

Fig. 9: Predicted values of speeding offenses (deseasonalized).
Period: July 2001 - June 2005.

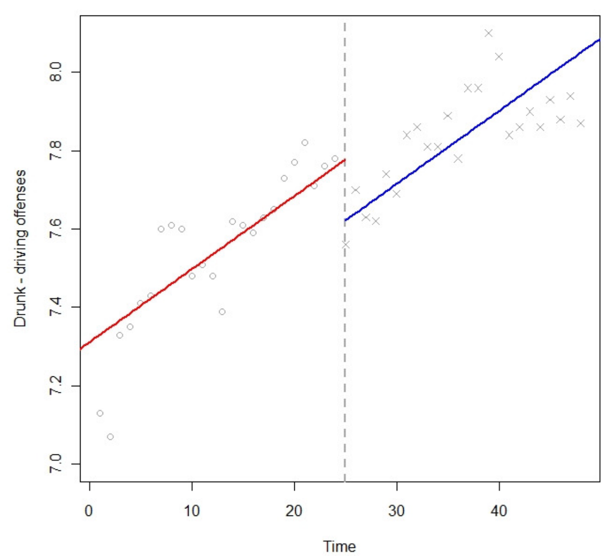

Fig. 10: Predicted values of drunk driving offenses (deseasonalized).
Period: July 2001 - June 2005.

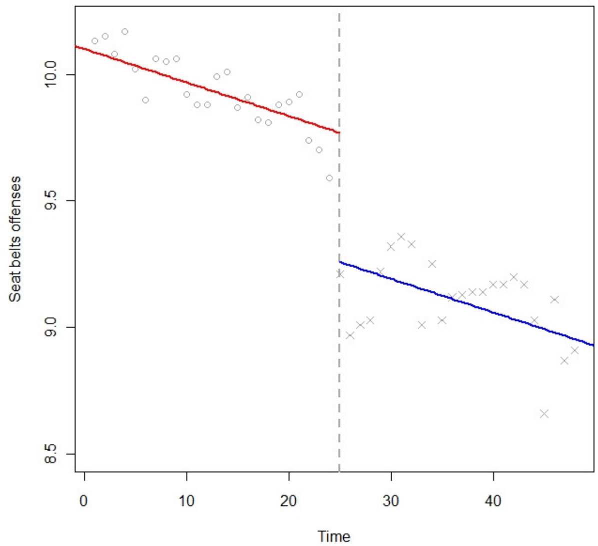

Fig. 11: Predicted values of seat belt offenses (deseasonalized).

Period: July 2001 - June 2005.

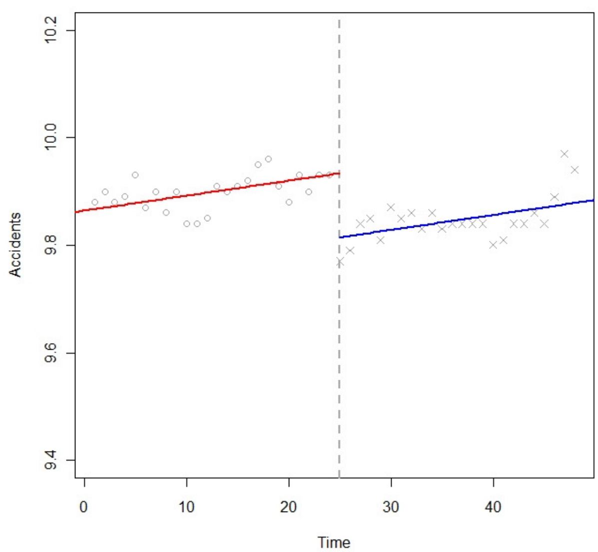

Fig. 12: Predicted values of accidents (deseasonalized).

Period: July 2001 - June 2005.

Tables

Table 1: Descriptive statistics

Period March 2001 – September 2008

Variable	Observations	Mean	Sd. Dev.	Max	Min
Speeding offenses	91	74349.82	19880.07	30678	109379
Seat belt offenses	91	12834.63	6033.17	5973	28103
Drunk driving offenses	91	2057.65	463.6	1404	3410
Drug driving offenses	91	146.23	54.23	55	304
Dangerous speed offenses	91	5858.78	785.69	4187	8053
Road accidents	91	19452.76	2104.88	15869	23734
Occupant fatalities and inuries	91	26273.33	2843.71	20889	32102
Non – occupant fatalities and inuries	91	1660.14	300.83	930	2415
Police patrols cars	91	338296.7	39273.79	258895	423675
Cameras	91	3209.59	637.5	1833	5161
Vehicles	91	45000000	2266468	40900000	48500000
New registered vehicles	91	259225.2	54393.02	125212	476037
Precipitations	91	24.7	14.1	3.62	71.13
Unemployment rate	91	6.95	1.21	5	9.6
Alcohol price	91	129.31	6.98	117.23	143.57
Gasoline price	91	135.82	17.99	112.8	184.05
Resident population[*]	81	58600000	880055.7	57000000	59900000
25 – 29 years old male population *	81	1927285	240088.1	1754189	2315530

Table 2: The effect of PRDL on traffic offenses

	Period: July 2001 – June 2005				
Dep. Var.:	**Log($Speed_t$)**	**Log($Seat_t$)**	**Log($Drug_t$)**	**Log(Alc_t)**	**Log($Dang_t$)**
$PRDL_t$	-0.188** (0.073)	-0.524*** (0.110)	0.167 (0.195)	-0.194*** (0 .058)	-0.110 (0.086)
Log($Cameras_t$)	0.920*** (0.246)	0.237 (0.186)	0.105 (0.291)	0.365* (0.199)	0.078 (0.181)
Log($Police_t$)	-0.272 (0.528)	0.385 (0.430)	0.673 (0.536)	0.443 (0.268)	-0.369 (0.367)
Log($Veic_t$)	-8.755 (11.031)	5.725 (8.981)	17.540 (15.577)	12.670 (9.293)	-4.261 (9.581)
Log($Prec_t$)	0.028 (0.051)	0.054 (0.033)	-0.140* (0.073)	0.039 (0.026)	-0.002 (0.034)
Log($Unempl_t$)	-0.641 (0.388)	-0.584 (0.435)	1.302* (0.680)	-0.080 (0.348)	-0.264 (0.386)
Log($AlcPrice_t$)	9.378 (5.466)	-1.085 (4.084)	-0.388 (6.983)	-1.647 (4.715)	4.189 (5.301)
Log($GasPrice_t$)	0.249 (0.827)	0.763 (0.721)	0.301 (1.309)	-1.370** (0.612)	-0.162 (0.877)
Obs.	48	48	48	48	48
R sq.	0.85	0.96	0.71	0.89	0.66

Notes: All specifications include a first order time trend and lagged dependent variable lags (up to 3 lags) to control for autocorrelation. Standard errors (reported in parentheses) are corrected for heteroskedasticity. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

[*] Data on Pop_t and $PopM2529_t$ are available since January 2002.

Table 3: The effect of PRDL on traffic offenses
Different time – windows around the enactment of the PRDL

	Period: July 2002 – June 2004				
Dep. Var.:	**Log($Speed_t$)**	**Log($Seat_t$)**	**Log($Drug_t$)**	**Log(Alc_t)**	**Log($Dang_t$)**
$PRDL_t$	-0.234** (0.116)	-0.422*** (0.158)	-0.475** (0.156)	-0.348*** (0.095)	-0.259** (0.115)
Log($Cameras_t$)	0.100** (0.406)	-0.272 (0.423)	-0.093 (0.258)	0.488 (0.268)	-0.010 (0.264)
Log($Police_t$)	-0.935 (1.087)	0.395 (0.823)	-0.103 (0.900)	-0.010 (0.426)	-1.208 (0.707)
Log($Veic_t$)	-22.423 (29.780)	-14.155 (1.439)	-10.859 (19.849)	7.782 (19.071)	-9.129 (16.697)
Log($Prec_t$)	-0.017 (0.053)	-0.013 (0.053)	-0.193* (0.095)	0.021 (0.037)	0.011 (0.074)
Log($Unempl_t$)	-0.288 (0.624)	-0.207 (0.801)	1.848*** (0.498)	-0.086 (0.353)	-1.299** (0.382)
Log($AlcPrice_t$)	18.786 (18.687)	12.756 (11.627)	18.790 (10.259)	-1.183 (11.950)	2.487 (8.873)
Log($GasPrice_t$)	0.876 (1.249)	1.310 (1.090)	-1.861 (1.144)	0.008 (0.911)	0.746 (0.990)
Obs.	24	24	24	24	24
R sq.	0.86	0.97	0.93	0.90	0.73
	Period: January 2002 – December 2004				
Dep. Var.:	**Log($Speed_t$)**	**Log($Seat_t$)**	**Log($Drug_t$)**	**Log(Alc_t)**	**Log($Dang_t$)**
$PRDL_t$	-0.267** (0.105)	-0.468*** (0.115)	0.178 (0.425)	-0.227*** (0.044)	-0.174 (0.111)
Log($Cameras_t$)	1.063*** (0.344)	-0.008 (0.270)	-0.178 (0.425)	0.440*** (0.123)	-0.150 (0.234)
Log($Police_t$)	-0.980 (0.752)	0.496 (0.520)	0.285 (0.801)	-0.066 (0.404)	-0.505 (0.746)
Log($Veic_t$)	-5.842 (13.200)	10.270 (8.078)	27.736 (18.155)	23.475*** (6.734)	-7.953 (11.798)
Log($Prec_t$)	0.034 (0.081)	-0.002 (0.029)	-0.141 (0.108)	0.028 (0.024)	-0.035 (0.049)
Log($Unempl_t$)	-0.454 (0.531)	-0.207 (0.435)	1.677** (0.711)	0.187 (0.287)	-0.570 (0.432)
Log($AlcPrice_t$)	9.078 (6.832)	-4.080 (4.985)	-1.675 (8.414)	-7.860** 3.403	6.783 (5.556)
Log($GasPrice_t$)	0.333 (1.152)	0.714 (0.647)	-0.237 (1.946)	-0.693 (0.609)	-0.081 (1.187)
Obs.	36	36	36	36	36
R sq.	0.85	0.97	0.91	0.91	0.65

Notes: All specifications include a first order time trend and lagged dependent variable lags (up to 3 lags) to control for autocorrelation. Standard errors (reported in parentheses) are corrected for heteroskedasticity. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

Table 4: The effect of PRDL on accidents

	Period: July 2001 – June 2005[25]		
Dep. Var.:	**Log(Acc_t)**	**Log(Acc_t)**	**Log(Acc_t)**
$PRDL_t$	-0.098*** (0.029)	-0.103*** (0.033)	-0.165*** (0.030)
$Log(Cameras_t)$	-0.053 (0.057)	-0.138* (0.078)	-0.028 (0.072)
$Log(Police_t)$	-0.036 (0.106)	0.068 (0.182)	-0.045 (0.173)
$Log(Veic_t)$	-1.046 (2.339)	-2.532 (2.598)	-2.166 (2.438)
$Log(Prec_t)$	-0.012 (0.012)	-0.023* (0.013)	-0.016 (0.011)
$Log(Unempl_t)$	0.156 (0.101)	0.256** (0.109)	0.123 (0.089)
$Log(AlcPrice_t)$	-0.153 (1.243)	0.292 (1.635)	-10.896** (4.100)
$Log(GasPrice_t)$	0.107 (0.140)	-0.003 (0.197)	0.216 (0 .232)
$Log(Pop_t)$		1.949 (1.930)	41.975*** (13.375)
$Log(PopM2529_t)$			1.500*** (0.500)
Obs.	48	42	42
R sq.	0.63	0.68	0.77

Notes: All specifications include a first order time trend and lagged dependent variable lags (up to 3 lags) to control for autocorrelation. Standard errors (reported in parentheses) are corrected for heteroskedasticity. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

[25] Data on Pop_t and $PopM2529_t$ are available since January 2002. Thus regressions including these controls refer to the period January 2002 – June 2005.

Table 5: The effect of PRDL on accidents – Robustness checks
Different time – windows around the enactment of the PRDL

	Period: January 2002 – December 2004		
	(I)	**(II)**	**(III)**
PRDL$_t$	-0.116*** (0.035)	-0.129*** (0.036)	-0.164*** (0.034)
Log(Cameras$_t$)	-0.045 (0.085)	0.001 (0.087)	0.020 (0.090)
Log(Police$_t$)	0.130 (0.161)	0.029 (0.168)	-0.050 (0.174)
Log(Veic$_t$)	-3.061 (2.861)	-5.805 (3.335)	-4.472 (3.172)
Log(Prec$_t$)	-0.015 (0.012)	-0.017 (0.013)	-0.015 (0.012)
Log(Unempl$_t$)	0.151 (0.135)	0.157 (0.125)	0.143 (0.109)
Log(AlcPrice$_t$)	1.868 (1.407)	0.816 (1.607)	-8.563* (4.681)
Log(GasPrice$_t$)	-0.060 (0.181)	0.023 (0.176)	0.156 (0.223)
Log(Pop$_t$)		5.103 (3.288)	36.252** (14.637)
Log(PopM2529$_t$)			1.175** (0.523)
Obs.	36	36	36
R sq.	0.73	0.76	0.80
	Period: July 2002 – June 2004		
Dep. Var.:	**Log(Acc$_t$)**	**Log(Acc$_t$)**	**Log(Acc$_t$)**
PRDL$_t$	-0.123*** (0.019)	-0.129*** (0.023)	-0.139*** (0.027)
Log(Cameras$_t$)	-0.180* (0.095)	-0.122 (0.116)	-0.129 (0.121)
Log(Police$_t$)	0.101 (0.149)	0.041 (0.180)	-0.044 (0.217)
Log(Veic$_t$)	-1.938 (3.912)	-3.835 (5.324)	-4.077 (5.562)
Log(Prec$_t$)	0.079 (0.015)	0.001 (0.017)	-0.002 (0.018)
Log(Unempl$_t$)	0.256* (0.137)	0.244 (0.147)	0.274 (0.155)
Log(AlcPrice$_t$)	0.936 (1.960)	0.493 (1.940)	-5.802 (5.598)
Log(GasPrice$_t$)	-0.003 (0.202)	0.069 (0.236)	0.147 (0.255)
Log(Pop$_t$)		3.259 (4.002)	27.957 (21.477)
Log(PopM2529$_t$)			0.893 (0.751)
Obs.	24	24	24
R sq.	0.91	0.92	0.92

Notes: All specifications include a first order time trend and lagged dependent variable lags (up to 3 lags) to control for autocorrelation. Standard errors (reported in parentheses) are corrected for heteroskedasticity. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

Table 6: Seat bealt use effect on occupant and non – occupant fatalities and injuries

	Period: March 2001 – September 2008			
Dep. Var.:	**Log (Occupant fatalities and injuries)**		**Log (Non - occupant fatalities and inj.)**	
	OLS	**IV**	**OLS**	**IV**
Log(Seat$_t$)	0.130*** (0.038)	0.128*** (0.036)	-0.179*** (0.048)	-0.180*** (0.046)
Log(Police$_t$)	0.073 (0.228)	0.078 (0.215)	0.377* (0.210)	0.371* (0.196)
Log(Cam$_t$)	-0.046 (0.050)	-0.043 (0.047)	-0.075 (0.077)	-0.073 (0.072)
Log(Unempl$_t$)	-0.179* (0.096)	-0.180** (0.090)	0.086 (0.150)	0.084 (0.140)
Log(Veic$_t$)	5.337** (2.064)	5.058** (2.068)	-1.035 (3.686)	-1.162 (3.601)
Log(Prec$_t$)	-0.001 (0.017)	-0.0003 (0.016)	0.017 (0.017)	0.017 (0.016)
Log(FuelPrice$_t$)	0.333 (0.226)	0.349 (0.218)	0.159 (0.223)	0.163 (0 .222)
Log(AlcPrice$_t$)	3.073 (2.403)	2.483 (2.348)	-12.180*** (2.434)	-12.267*** (2.396)
Obs.	91	91	91	91
R sq.	0.54	0.54	0.73	0.73

Notes: All specifications include a first order time trend and two dummy variables accounting for the peaks displayed by the relative time series in February and July (Occupant fatalities), and in November and August (Non – Occ. fatalities) . Standard errors (reported in parentheses) are corrected for heteroskedasticity. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

Table 7: Occupant fatalities and injuries – Robustness checks

	Period: January 2002 – September 2008			
Dep. Var.:	**Log (Occupant fat. and inj.)**		**Log (Occupant fat. and inj.)**	
	OLS	**IV**	**OLS**	**IV**
Log(Seat$_t$)	0.132*** (0.0492)	0.132*** (0.045)	0.145*** (0.052)	0.142*** (0.047)
Log(Police$_t$)	0.089 (0.288)	0.088 (0.263)	0.131 (0.269)	0.132 (0.246)
Log(Cam$_t$)	-0.043 (0.057)	-0.042 (0.052)	-0.051 (0.058)	-0.050 (0.052)
Log(Unempl$_t$)	-0.176 * (2.531)	-0.176* (0.097)	-0.259** (0.124)	-0.252** (0.113)
Log(Veic$_t$)	6.206** (0.019)	6.179*** (2.319)	7.309*** (2.657)	7.204*** (2.412)
Log(Prec$_t$)	-0.0004 (0.019)	-0.0004 (0.018)	-0.004 (0.020)	-0.004 (0.018)
Log(FuelPrice$_t$)	0.217 (0.263)	0.217 (0.241)	0.274 (0.243)	0.269 (0.222)
Log(AlcPrice$_t$)	4.026 (3.024)	4.005 (2.77)	3.255 (2.874)	3.312 (2.610)
Log(Pop$_t$)	-1.737 (2.926)	-1.699 (2.680)	5.580 (5.307)	4.721 (4.821)
Log(PopM2529$_t$)			0.471 (5.307)	0.430* (0.259)
Obs.	81	81	81	81
R sq.	0.52	0.52	0.54	0.54

Notes: All specifications include a first order time trend and two dummy variables accounting for the peaks displayed by the relative time series in February and July. Standard errors (reported in parentheses) are corrected for heteroskedasticity. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

Table 8: Non - occupant fatalities and injuries – Robustness checks

	Period: January 2002 – September 2008			
Dep. Var.:	**Log (Non - occupant fat. and inj.)**		**Log (Non - occupant fat. and inj.)**	
	OLS	**IV**	**OLS**	**IV**
Log($Seat_t$)	-0.246*** (0.0569)	-0.245*** (0 .052)	-0.243*** (0 .055)	-0.245*** (0.050)
Log($Police_t$)	0.704** (0.278)	0.703** (0.255)	0.705** (0.278)	0.706** (0.254)
Log(Cam_t)	-0.086 (0.080)	-0.086 (0.073)	-0.085 (0.080)	-0.085 (0.073)
Log($Unempl_t$)	-0.007 (0.149)	-0.001 (0.136)	-0.023 (0.154)	-0.022 (0.140)
Log($Veic_t$)	-1.846 (3.850)	-1.824 (3.529)	-1.745 (3.899)	-1.823 (3.541)
Log($Prec_t$)	0.030 (0.018)	0.030* (0.017)	0.030 (0.018)	0.030* (0.017)
Log($FuelPrice_t$)	0.110 (0.278)	0.109 (0.255)	0.120 (0.272)	0.120 (0.248)
Log($AlcPrice_t$)	- 9.904*** (2.985)	-9.990*** (2.734)	-10.174*** (3.020)	-10.169*** (2.754)
Log(Pop_t)	-5.468 (3.879)	-5.434 (3.553)	-3.938 (5.491)	-4.263 (5.021)
Log($PopM2529_t$)			0.095 (0.308)	0.080 (0.281)
Obs.	81	81	81	81
Rsq.	0.75	0.75	0.75	0.75

Notes: All specifications include a first order time trend and two dummy variables accounting for the peaks displayed by the relative time series in November and August. Standard errors (reported in parentheses) are corrected for heteroskedasticity. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

Table 9: Robustness checks – Occupant fatalities and injuries
Different time – windows around the enactment of the PRDL

***Period*:**	**July 2002 – June 2004**		**January 2002 – December 2004**		**July 2001 – June 2005**	
Dep. Var.:	**Log (Occupant fat. and inj.)**		**Log (Occupant fat. and inj.)**		**Log (Occupant fat. and inj.)**	
	OLS	**IV**	**OLS**	**IV**	**OLS**	**IV**
Log(Seat$_t$)	0.209* (0.121)	0.217*** (0.084)	0.264 *** (0.092)	0.259 *** (0.076)	0.374*** (0.090)	0.372*** (0.078)
Log(Police$_t$)	-0.029 (0.376)	-0.064 (0.267)	-0.185 (0 .358)	-0.165 (0.293)	-0.731** (0.329)	-0.722*** (0.286)
Log(Cam$_t$)	-0.402** (0.078)	-0.397*** (0.0534)	-0.312*** (0.047)	-0.313*** (0.039)	-0.229*** (0.055)	-0.230** (0.048)
Log(Unempl$_t$)	-0.036 (0.198)	-0.029 (0.139)	0.060 (0.131)	0.059 (0.108)	0.190 (.1464123)	0.191 (0.127)
Log(Veic$_t$)	-5.499 (6.205)	-5.905 (4.392)	-5.006 (3.320)	-4.513 (2.685)	-5.139 (4.349)	-4.884 (3.768)
Log(Prec$_t$)	0.011 (0.018)	0.011 (0.013)	0.005 (0.012)	0.005 (0.010)	-0.08 (0.016)	-0.008 (0.013)
Log(FuelPrice$_t$)	1.692** (0.761)	1.625*** (0.545)	1.066** (0.483)	1.065*** (0.394)	0.331 (0.500)	0.334 (0.433)
Log(AlcPrice$_t$)	73.984*** (16.475)	71.981*** (11.776)	49.714*** (9.180)	50.088*** (7.507)	9.741 (6.992)	9.917 (6.065)
Obs.	24	24	36	36	48	48
Rsq.	0.91	0.91	0.87	0.87	0.71	0.71

Notes: All specifications include a first order time trend include and two dummy variables accounting for the peaks displayed by the relative time series in February and July. Standard errors (reported in parentheses) are corrected for heteroskedasticity. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

Table 10: Robustness checks – Non - occupant fatalities and injuries
Different time - windows around the coming into force of the PRDL

***Period*:**	**July 2002 – June 2004**		**Jan. 2002 – Dec. 2004**		**July 2001 – June 2005**	
Dep. Var.:	**Log (Non – occ. fat. and inj.)**		**Log (Non – occ. fat. and inj.)**		**Log (Non – occ. fat. and inj.)**	
	OLS	**IV**	**OLS**	**IV**	**OLS**	**IV**
Log(Seat$_t$)	-0.415*** (.171)	-0.441*** (0.115)	-0.184 0.148	-0.186 (0 .121)	-0.241* (0.121)	-0.241** (0.105)
Log(Police$_t$)	1.261* (0.653)	1.294 *** (0.457)	0.973 * (0.524)	0.982** (0.426)	0.735* (0.368)	0.729** (0.319)
Log(Cam$_t$)	-0.895*** (0.226)	-0.951*** (0.176)	-0.485*** (0.127)	-0.488*** (0.104)	-0.336** (0.132)	-0.333*** (0.114)
Log(Unempl$_t$)	0.746 (0.431)	0.736** (0.319)	0.685*** (0.228)	0.692*** (0.186)	0.734*** (0.203)	0.728*** (0.176)
Log(Veic$_t$)	-5.804 (10.754)	-10.894 (8.138)	8.713 (5.556)	8.989** (4.522)	10.926** (5.344)	10.684** (4.639)
Log(Prec$_t$)	-0.034 (0.045)	-.0309 (0.035)	-0.0169 (0.0239)	-0.017* (0.020)	0.001 (0.021)	0.001 (0.018)
Log(FuelPrice$_t$)	1.351 (1.196)	1.760** (0.888)	-0.990 (0.972)	-0.975 (0.794)	0.211 (0.708)	0.205 (0.613)
Log(AlcPrice$_t$)	31.039 (30.681)	43.235* (23.230)	-20.590 (13.822)	-20.009 (11.325)	-3.902 (7.540)	-4.142 (6.521)
Obs.	24	24	36	36	48	48
Rsq.	0.89	0.89	0.82	0.83	0.80	0.80

Notes: All specifications include a first order time trend two dummy variables accounting for the peaks displayed by the relative time series in August and November. Standard errors (reported in parentheses) are corrected for heteroskedasticity. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

Table 11: Seat belt offenses and traffic fatalities before and after the introduction of the PRDL

***Period*:**	**Jul 2001 – Jun 2003**	**Jul 2003 – Jun 2005**	**Jul 2001 – Jun 2003**	**Jul 2003 – Jun 2005**
Dep. Var.:	**Log(Occ. fatalities and injuries)**		**Log(Non - occ. fatalities and injuries)**	
$Log(Seat_t)$	0.031 (0.174)	0.279* (0.144)	-0.666 (0.416)	-0.336* (0.188)
$Log(Police_t)$	0.163 (0.301)	-0.318 (0.721)	0.734 (0.843)	1.489** (0.521)
$Log(Cam_t)$	-0.094 (0.077)	-0.351* (0.171)	0.068 (0.3409)	-0.679*** (0.218)
$Log(Unempl_t)$	0.005 (0 .202)	0.408 (0.281)	0.573 (0.809)	0.416 (0.283)
$Log(Veic_t)$	4.781 (4.514)	-10.646 (11.053)	42.023* (20.881)	17.187*** (5.555)
$Log(Prec_t)$	0.000 (0.012)	-0.057 (0.056)	-0.0256 (0.056)	0.038 (0.044)
$Log(FuelPrice_t)$	0.394 (0.281)	3.923 (2.142)	-0.287 (1.021)	1.672 (1.846)
$Log(AlcPrice_t)$	46.213*** (8.001)	12.255 (14.100)	-43.880 (44.059)	-3.992 (9.003)
Obs.	24	24	24	24
Rsq.	0.94	0.74	0.80	0.90

Notes: All specifications include a first order time trend and two dummy variables accounting for the peaks displayed by the relative time series in February and July (Occupant fatalities), and in November and August (Non – Occ. fatalities) . Standard errors (reported in parentheses) are corrected for heteroskedasticity. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

Table 12: PRDL and offsetting behaviors

Period: March 2001 – September 2008				
	Log(Speed$_t$)	**Log(Dang$_t$)**	**Log(Alc$_t$)**	**Log(Drug$_t$)**
$Log(Seat_t)*PRDL_t$	0.002 (0.007)	-0.021*** (0.006)	-0.007** (0.004)	0.014 (0.010)
$Log(Police_t)$	-0.259 (0.294)	-0.199 (0.191)	-0.009 (0.198)	-0.283 (0.357)
$Log(Cameras_t)$	0.750*** (0.112)	0.012 (0.094)	0.021 (0.090)	0.100 (0.156)
$Log(Veic_t)$	0.035 (0.027)	0.0131258 (0.021)	0.2.66 (1.995)	-0.082*** (0.031)
$Log(Prec_t)$	-1.195 (1.421)	0.327 (2.310)	0.011 (0.020)	6.589*** (2.397)
$Log(GasPrice_t)$	0.225 (0.463)	-0.102 (0.265)	-0.425* (0.236)	0.771 (0.524)
$Log(Unempl_t)$	0.105 (0.161)	0.250 (0.152)	0.116 (0.149)	0.640*** (0.206)
$Log(AlcPrice_t)$	7.083*** (1.368)	2.283 (1.607)	2.021 (1.302)	-0.102 (2.227)
Obs.	91	91	91	91
R sq.	0.74	0.52	0.91	0.84

Notes: All specifications include a first order time trend and lagged dependent variable lags (up to 3 lags) to control for autocorrelation. Standard errors (reported in parentheses) are corrected for heteroskedasticity. The symbols ***, **, * indicate that coefficients are statistically significant, respectively, at the 1, 5, and 10 percent level.

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