



# Deterrent effects of demerit points and license sanctions on drivers' traffic law violations using a proportional hazard model

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## ABSTRACT

Current traffic law enforcement places an emphasis on reducing accident risk from human factors such as drunk driving and speeding. Among the various strategies implemented, demerit points and license sanction systems have been widely used as punitive and educational measures. Limitations, however, exist in previous studies in terms of estimating the interaction effects of demerit points and license sanctions. To overcome such limitations, this work focused on identifying the interaction effects of demerit points and license sanctions on driver traffic violation behavior. The interaction deterrent effects were assessed by using a Cox's proportional hazard model to provide a more accurate and unbiased estimation. For this purpose, five years of driver conviction data was obtained from the Korea National Police Agency (KNPA). This data included personal characteristics, demerit point accumulation and license sanction status. The analysis showed that accumulated demerit points had specific deterrent effects. Additionally, license revocation showed consistent and significant deterrent effects, greater than those for suspension. Male drivers under their 30s holding a motorcycle license were identified as the most violation-prone driver group, suggesting that stricter testing for the acquisition of a motorcycle driver's license is needed.

## 1. Introduction

Driver error is a significant contributing factor in most vehicle crashes (McFarland and Moore, 1957; Haddon, 1980; Guerrero, 2003; AASHTO, 2010). As such, the majority of preventive strategies and interventions focus primarily on drivers' behavior. Among the strategies implemented, point systems (PS) are widely used as a punitive and educational measure (ETSC, 2006). A PS can be divided into penalty points system (PPS) or demerit points system (DPS). In PPS, violators lose points and receive a license sanction when all points run out. In DPS, the system regulates a driver's behavior by imposing penalty points on drivers who violate specific traffic regulations. The points are levied in addition to fines, and drivers' licenses can be suspended or revoked if the accumulated points reach a specified level, or if drivers commit severe offenses. Currently, many countries have adopted such administrative sanctions as their primary measure for traffic law penalties. In South Korea, administrative sanctions include fines, demerit points, and license suspension or revocation, covering about 98% of all traffic law penalties (Korean National Police Agency, 2015).

The benefits of a demerit point and license sanction system are as follows (Basili and Nicita, 2005; Roca and Torrosa, 2008; SVOV, 2012).

First, the system acts as a preventive method to reduce traffic law offenses because potential infringers may drive more carefully to avoid receiving additional points. Second, the system selects out risky and habitual offenders and removes these drivers from the roads before they cause additional violations. Therefore, the system is effective only if the accumulated demerit points can be a predictive factor of future violations and when recidivism can be tracked over time. Third, the system also plays a role as an educational measure because points can be reduced if drivers enroll in driver education courses. The courses aim to provide a sufficient level of educational elements to effectively change driver behavior.

In South Korea, the number of people holding a driver's license is about 30.3 million, which accounts for almost 60% of the population in 2015. The KNPA is in charge of license acquisitions and sanctions. There are six license types in South Korea: Class 1-large, Class 1-special, Class 1-regular, Class 2-regular, Class 2-small, and Class 2-moped (Table 1). The level of requirements differs by license type: i.e., minimum age, prior driving experiences, type of test.

Drivers can receive demerit points in two ways. First, if drivers violate a traffic law, they may be given from 10 to 100 points for a single violation. Second, drivers causing at-fault crashes receive

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**Table 1**  
License Types in South Korea.

Type	Description	Requirements			
		Age	Written test	Off-street test	On-street test
Class 1	Large <sup>a</sup> Truck (≥12 t) Bus (≥15 seats)	19	✓	✓	–
	Special <sup>a</sup> Trailer, tow truck	19	✓	✓	–
	Regular Passenger car (manual) Truck (<12 t) Bus (<15 seats)	18	✓	✓	✓
Class 2	Regular Passenger car (automatic)	18	✓	✓	✓
	Small Motorcycle (>125 cc)	18	✓	✓	–
	Moped Motorcycle (≤125 cc)	16	✓	✓	–

<sup>a</sup> Required to hold regular licenses at least one year.

demerit points depending on the number of victims and the severity of the crash. According to the license sanction types, the demerit points remain on the driver’s license for different periods. For license suspension, the demerit points remain for one year. If the accumulated points reach more than 40 points, the driver’s license is suspended for some period of time. The suspension period increases by one day for each point. For license revocation, the demerit points are accumulated from one to three years. Infringers lose their driving privileges if the demerit points reach 121 points within one year, 201 within two years, or 271 within three years. The disqualification periods differ according to the cause of revocation. Drivers who have received a revocation and wish to drive again must re-apply for a driver’s license and undergo the same procedure as a first-time acquisition.

The literature review in the next section indicates that the following two issues need further investigation: 1) whether or not demerit points and license sanctions have a sufficient specific deterrent effect; and 2) which driver group is least deterred and has the greatest tendency to offend. Thus, the purpose of this study is to estimate the deterrent effect of demerit points, license sanctions and their interaction on the compliance duration of traffic law infringers. The following steps were taken to achieve this objective. First, specific deterrent effects of a DPS were identified. Accordingly, demerit points are categorized into two types: demerit points before a suspension and demerit points before a revocation. Second, estimates were generated for specific deterrent effects of license sanctions. This includes drivers’ license suspension and revocation. Third, the deterrent effects of suspension and revocation were compared, which is required in order to optimize a traffic law penalty system. Finally, the most violation-prone driver group was identified.

## 2. Literature review

Extensive studies have explored the effects of administrative sanctions on driver behavior. Previous studies can be broadly grouped into two types depending on the type of data used. The first type estimates safety improvement effects due to the application of the PS and license sanctions. These studies typically used aggregate data, such as the number of traffic violations to estimate effects. The deterrent effects of PS on traffic violation behavior have been examined, especially via before-and-after studies in both PPS and DPS (Liberatti et al., 2001; Zambon et al., 2008; Benedettini and Nicita, 2009; Mehmood, 2010; Simpson et al., 2012; Abay, 2017). Such research analyzed deterrent effects on traffic infringement with research ranging from seat belt use to speeding. Alternatively, some literature has covered the possible perverse effects of adoption of PS, such as where selective compliance

of infringers was observed due to a Peltzman effect (Benedettini and Nicita, 2012; De Paola et al., 2013). The Peltzman effect in traffic regulation refers to having one traffic safety policy that can affect agents’ reaction in other unexpected aspects, which lead to possible perverse results (Peltzman, 1975). For example, while an adoption of a PS reduced occupant fatalities and injuries, non-occupant fatalities increased at the same time (Benedettini and Nicita, 2012). It is difficult to conclude whether the effects of the DPS have been proven empirically, because studies have typically dealt with particular sets of major traffic violations. Accordingly, to determine the overall effects of DPS, Castillo-Manzano and Castro-Nuño (2012) conducted a meta-analysis using the results of previous studies. According to their analysis, the application of DPS can reduce traffic violations by about 30%; however, the duration of the effects was limited to less than 18 months. Although previous studies on the application of DPS showed deterrent effects of DPS implementation from both general and specific aspects, these studies were unable to reveal the specific effect mechanism. Therefore, other researchers have tried to identify the specific deterrent effect by using individual driver data. Also, Dionne et al. (2013) reviewed modeling frameworks of the trade-off relationship among road safety insurance, regulation and incentives. The results showed that although traffic accidents decreased, there was residual moral hazard and asymmetric learning. This implied the necessity of improving the incentive system.

The second type of method is to identify the effects of demerit points and license sanctions on individual driver traffic violation behavior. Disaggregate data such as the violation histories of individual drivers were often used for these studies. The deterrent effect mechanism of demerit points was studied in both theoretical and empirical ways. Haque (1990) analyzed the effects of the number of traffic violation convictions and correction programs on compliance duration. The results showed that the DPS caused compliance duration to increase from the second to the third offense. Bourgeon and Picard (2007) developed the incentive mechanism of DPS by using a binary effort variable. They were able to prove their model theoretically, and suggested ways to optimize effective mechanisms. Later, Dionne et al. (2011) extended the model of Bourgeon and Picard by applying a continuous effort level function. Furthermore, they analyzed empirical data to evaluate the effects of demerit points on compliance duration. As points accumulated, they found that drivers’ violation hazard level decreased to avoid license sanctions. This phenomenon was described as moral hazard. Basili et al. (2015) explained the rationale of drivers’ reaction to demerit points. They divided drivers into three types: deterred, partially deterred and non-deterred. Empirical analysis included accumulated demerit points, accumulated number of prior convictions, and other personal characteristics as independent variables. Although the deterrent effects of demerit points were identified, the probability of infraction increased as the number of past infractions accumulated, which indicated the existence of recidivism.

Unlike studies estimating the deterrent effects of DPS, evaluation studies of license suspension and revocation focused mainly on DUI (driving under the influence of alcohol). Hagen (1977) conducted a comparison study that focused on whether or not drivers had received a license sanction. The results showed that drivers with a license sanction record were significantly less convicted for DUIs. Mann et al. (1991) estimated the effects of fines, license suspension and criminal punishment with regards to the frequency of crashes and violations. They reported that license suspensions were consistently related to traffic safety benefits. DeYoung (1997) conducted a quasi-experimental study comparing the effects of sanctions on DUI infringers, and concluded that license sanctions along with alcohol treatment were the most effective sanction for preventing DUI recidivism. Recently, Choi et al. (2016) estimated the effects of license suspension and revocation on compliance duration based on survival analysis. The analysis showed that license sanctions significantly increase compliance duration.

Meanwhile, a few research studies have examined all types of traffic

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