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Can Non-Monetary Sanctions Improve Road Safety? A Policy Impact Assessment of Thailand's Demerit Point System

Supapong Tunsuparp*

Faculty of Economics, Ramkhamhaeng University, Thailand

Abstract

Thailand's road accident rate ranks among the highest globally, causing significant harm to individuals and economic losses. In 2023, the government introduced a demerit point system—a policy with mixed international outcomes. This study evaluates its impact on daily accident rates in Bangkok, analyzing data for all vehicle types, private/public passenger vehicles, and motorcycles. Using interrupted time series analysis, the results show that while the demerit point system did not reverse the upward accident trend, it effectively moderated the rate of increase. Behavioral economic concepts such as present bias, status quo bias, and loss aversion offer additional explanations for the observed behavioral patterns. Statistically significant variables affecting accident frequency include weather conditions and temporal factors such as weekends and festival holidays. These findings suggest that enhancing the system's effectiveness could involve strategic measures such as increased point deductions during high-risk periods like festivals, along with communication campaigns that emphasize loss-framed messages to discourage risky driving behavior.

Keywords: road accidents; demerit point system; risky driving behavior
JEL Classification: R14; H23; D91; C22

*Corresponding Author, Address: Faculty of Economics, Ramkhamhaeng University, Room 512, ECB2 building, Hua Mak, Bangkapi, Bangkok, Thailand, 10240. Email: supapong.t@rumail.ru.ac.th

1. Introduction

Road safety in Thailand is a critical public health concern and a major contributor to mortality. According to World Health Organization data from 2018, Thailand ranked ninth globally in road accident rates. Between 2012 and 2022, road accidents led to an average of 17,914 fatalities annually, while from 2017 to 2022, the country recorded an average of 228,740 serious injuries per year (Thailand Development Research Institute [TDRI], n.d.-b). These figures not only highlight the human toll but also point to substantial economic losses due to reductions in the labor force. A comprehensive TDRI assessment for 2015–2019 estimated annual economic damages between 260 and 430 billion baht, averaging 3.5% of the country's Gross Domestic Product (GDP) (Thongphat et al., 2024).

Thailand also has the highest motorcycle ownership rate in Asia (Poushter, 2015), likely due to economic constraints and traffic conditions favoring motorcycle use. As a result, motorcycles are involved in 80% of road traffic accidents and account for 84% of road traffic fatalities (Kanitpong et al., 2024).

To reduce these fatalities, the Thai government set a 2027 target to lower the road mortality rate from 26.86 (in 2023) to 12 deaths per 100,000 population (TDRI, n.d.-a). Measures to achieve this include public awareness campaigns and legislative interventions. A key legislative initiative is the implementation of a driver demerit point system—an approach widely adopted in various countries to monitor and penalize traffic infractions.

On January 9, 2023, the Royal Thai Police implemented the demerit point system as a non-monetary measure to promote safer driving behavior. Under the system, each driver begins with 12 points, which are deducted by 1–4 points depending on the severity of the violation—from minor offenses such as not wearing a helmet (1 point) to serious ones like driving under the influence of alcohol (4 points). Drivers who lose all 12 points receive a 90-day license suspension. Driving during this suspension is punishable by up to 3 months in prison and/or a fine of up to 10,000 baht. Points are reinstated one year after each violation (Government Contact Center, 2023; Royal Thai Government Gazette, 2022).

This study proposes a theoretical framework for understanding behavioral responses to the demerit point system, integrating traditional and behavioral economic perspectives. From the standard economic view, the system acts as a deterrent by raising the expected cost of violations. From a behavioral economics perspective, the system invokes concepts such as loss aversion (as point deductions are perceived as losses), status quo bias (where drivers aim to retain full points), and present bias (explaining the failure to modify long-term behavior without immediate feedback). Combining these approaches enhances the understanding of how such policies influence driver behavior.

Although the system has been implemented in countries such as Australia, Belgium, Italy, Ireland, Canada, France, the UK, and the US (Mehmood, 2010), its adoption in Thailand is recent, and empirical studies evaluating its impact are scarce. This study therefore examines the effect of Thailand's demerit point policy on daily road accident frequency in Bangkok.

The remainder of the paper is structured as follows: Section 2 reviews relevant behavioral and economic theories and related empirical studies. Section 3 details the methodology and variables used. Section 4 presents the empirical findings based on interrupted time series analysis. Section 5 discusses the findings in light of theoretical frameworks and study limitations. Section 6 concludes with policy recommendations and directions for future research.

2. Literature Review

The implementation of a demerit point policy aligns with deterrence theory, as articulated by Becker (1968), which posits that individuals respond to changes in the expected costs of unlawful behavior. Under this theoretical framework, rational drivers are expected to adjust their behavior when policies increase the penalties associated with traffic violations. This system has been adopted by numerous developed countries to reduce risky driving behaviors, with substantial empirical evidence supporting its effectiveness. For instance, Abay (2018) provides evidence that traffic offenders respond to sanctions, and a recent meta-review by Alonso et al (2025) confirms the beneficial impact of demerit point systems on road safety. Their findings indicate that such systems reduce negative traffic-related outcomes by 21%, fatalities by 10%, and non-fatal injuries by 9%.

Expected utility theory (von Neumann & Morgenstern, 1944) further explains how individuals make decisions under uncertainty by maximizing the expected value of a utility function. In the road safety context, drivers weigh the expected utility of complying with traffic laws against the utility of violating them, considering the probability of being penalized and the disutility of sanctions. The demerit point system functions as a cumulative punishment mechanism—heightening the risk of license suspension—and can significantly reduce the expected utility of repeated infractions, thus deterring risky behavior (Alonso et al., 2025).

However, Castillo-Manzano and Castro-Nuño (2012) found that the positive effects of demerit point systems diminish after 18 months. This aligns with Basili and Nicita (2005), who demonstrate that the effectiveness of such systems depends on the distribution of preferences among potential infringers. For some demographic groups, the system may fail to prevent risky behaviors, and changes in behavior often occur only after accumulating enough penalties to reach a critical threshold.

Beyond standard economic models, behavioral economics offers alternative explanations for behavioral changes resulting from demerit point policies. Three key concepts are relevant:

Prospect Theory and Loss Aversion: Kahneman and Tversky (1979) propose that individuals evaluate outcomes relative to reference points, with losses having a greater psychological impact than equivalent gains. In this context, the demerit point system uses loss framing—drivers start with 12 points, and each infraction represents a loss. As point totals diminish, the perceived risk of losing driving privileges grows, enhancing motivation to avoid further violations. While traditional expected utility theory suggests that risky behavior may persist if the expected loss is small relative to the benefit (e.g., saving time), prospect theory explains why some drivers may alter their behavior even under low detection probability.

Status Quo Bias and Reference Points: Samuelson and Zeckhauser (1988) describe status quo bias as the tendency to maintain the current state. Drivers perceive their full 12-point license as the reference point; point deductions represent a departure from this norm, imposing a psychological cost. This bias encourages drivers to retain their current point status. Kahneman et al. (1991) similarly argue that individuals tend to remain in the status quo due to the disproportionate weight placed on losses.

Present Bias or Hyperbolic Discounting: Ainslie (1975) and Laibson (1997) show that people often prioritize immediate rewards over future consequences. Applied to road behavior, this bias explains why some drivers fail to consistently adjust their behavior: the immediate convenience of risky driving (e.g., speeding or not wearing a helmet) is prioritized over the delayed consequence of point loss.

Regarding methodology, Interrupted Time Series (ITS) analysis is widely used to evaluate the effects of policy interventions, including those targeting road safety. ITS assesses changes in the level and slope of outcome data—such as accident or fatality rates—before and after a policy is introduced. For example, Ye et al. (2018) applied ITS with Newey-West standard errors to evaluate road safety legislation and found declining trends in traffic fatalities. Similarly, Delavary et al. (2024) used ITS to examine the impact of Automated Speed Enforcement (ASE) in Rwanda and found significant reductions in deaths and serious injuries.

When examining factors influencing road accidents, prior studies frequently focus on individual-level variables such as demographic characteristics, vehicle type, and environmental conditions. This study emphasizes environmental determinants of daily accident frequency.

Weather conditions: Rainfall and visibility are significant predictors. Akallouch et al. (2023) found that rainfall increases accident severity. Hafeez et al. (2023) also reported a strong link between weather and pedestrian fatalities. In contrast, Wang et al. (2024) noted that decreased visibility can lower accident severity due to more cautious driving.

Temporal factors: Day of the week and long holiday periods (e.g., Songkran and New Year) are consistently linked to accident rates. Akallouch et al. (2023) found day-of-week effects on accident severity, supporting the hypothesis that holidays increase risk due to higher travel volumes.

Traffic conditions: The relationship between traffic congestion and accidents is nuanced. While congestion can lead to more frequent minor collisions, free-flowing traffic may result in more severe high-speed accidents. Hafeez et al. (2023) found that congestion affects pedestrian fatalities, while Wang et al. (2024) observed that traffic slows during holidays in China, reducing fatalities and injuries.

Despite growing interest, research on the determinants of road accidents in Thailand—especially using official data—is limited. Given the introduction of the demerit point policy in 2023, this study provides valuable insights into its early impact and contributes to a deeper understanding of accident determinants in the Thai context.

3. Methodology

This study examines the impact of the demerit point policy on the incidence of road traffic accidents in Bangkok. The analysis draws on data regarding injuries, fatalities, and weather conditions from the Office of the Permanent Secretary, along with traffic congestion index data provided by the Thai Intelligent Traffic Information Center Foundation. The focus is limited to Bangkok, which consistently records the highest number of accidents in Thailand. In many years, Bangkok and its metropolitan region account for more accidents than the rest of the country combined. The study covers the period from January 1, 2022, to December 31, 2023.

Given prior literature suggesting that accident rates vary by day of the week, the analysis incorporates control variables for weekdays (Monday to Sunday) and includes dummy variables for major holiday periods, specifically the New Year and Songkran festivals.

The study employs Interrupted Time Series (ITS) analysis—a robust quasi-experimental method commonly used to assess policy impacts at a defined point in time (Bernal et al., 2017; Linden, 2015). ITS leverages the temporal discontinuity introduced by the January 2023 implementation of the demerit point policy to estimate its effect. This method is particularly suitable when randomization is not feasible and provides a reliable means of evaluating changes in accident rates before and after the policy intervention.

$$Acc_t = \alpha + \beta_1 Time_t + \beta_2 Post_t + \beta_3 (Time_t \; x \; Post_t) + \boldsymbol{\gamma} \boldsymbol{X}_t' + \varepsilon_i$$

Where:

- Acc_t represents the number of road traffic accidents per day at time t,
- $Time_t$ denotes the time trend (in days),
- $Post_t$ is a dummy variable indicating the policy period (0 = pre-policy, 1 = post-policy),
- $Time_t \; x \; Post_t$ captures the change in trend associated with the demerit point policy intervention,
- $\boldsymbol{X_t}$ is a vector of control variables including weather conditions, day of the week, long holidays, and traffic congestion index,
- ε_i is the error term.

The analysis employs the Prais–Winsten estimation method, which adjusts for serial correlation under an AR(1) process. To enhance robustness, heteroskedasticity-consistent standard errors are used to account for potential model misspecification and variance inconsistency.

To assess the policy's effects across different vehicle categories, the study specifies three separate models. The first model uses the total number of daily road accidents in Bangkok as the dependent variable, encompassing incidents involving all vehicle types—private vehicles (e.g., cars, pickup trucks), public transport (e.g., buses, taxis, vans), and motorcycles. The second model narrows the focus to accidents involving only private and public passenger vehicles. The third model examines accidents involving motorcycles exclusively. This disaggregated approach allows for a more nuanced evaluation of the demerit point policy's effectiveness, enabling comparisons between its impact on automobile drivers and motorcycle riders.

4. Empirical Results

4.1 Descriptive Statistics

Table 1 shows that during 2022–2023, the average number of daily road accidents involving all vehicle types (nac) in Bangkok was 6.025 incidents per day, with a maximum of 23 incidents on the most severe day, and zero accidents recorded on some days. When disaggregated by vehicle type, daily accidents involving only private and public passenger vehicles (ncar) averaged 2.299 incidents, while those involving motorcycles (nmot) averaged 0.655 incidents per day. A year-on-year comparison reveals that the average number of daily accidents across all three categories increased in 2023 compared to 2022.

Regarding weather conditions (wea), this binary variable is coded as 0 for clear weather and 1 for other conditions, such as rainfall. The data indicate that most days experienced clear weather. For the traffic congestion index (traf), the mean value is 3.77 out of 10, indicating a relatively high level of congestion on Bangkok's major roads.

The variable day represents the day of the week. Since the dataset spans two full calendar years, weekday observations are evenly distributed. The public holiday variable (dday) is a dummy variable coded as 1 on major national holidays, specifically New Year and Songkran festivals, and 0 otherwise.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
nac2022	365	4.741	2.622	0.000	16.000
nac2023	365	7.310	3.593	0.000	23.000
nac	730	6.025	3.396	0.000	23.000
ncar2022	365	1.899	1.513	0.000	10.000
ncar2023	365	2.699	1.827	0.000	10.000
ncar	730	2.299	1.723	0.000	10.000
nmot2022	365	1.899	1.513	0.000	10.000
nmot2023	365	2.699	1.827	0.000	10.000
nmot	730	0.655	0.916	0.000	6.000
wea	730	0.033	0.178	0.000	1.000
traf	730	3.772	0.488	0.000	5.133
day	730	4.007	2.003	1.000	7.000
dday	730	0.025	0.155	0.000	1.000

Source: Author's calculation.

Figure 1 illustrates the trend of daily road accidents in Bangkok before and after the implementation of the driver's license point deduction policy. The pre-policy period is depicted by a blue line, while the post-policy period is represented by a red line. Although the overall trend in accident frequency remains upward, the post-policy trend exhibits a noticeably reduced slope, indicating that the policy may have contributed to decelerating the rate of increase in daily accidents. However, to assess the policy's effectiveness more rigorously, further

analysis incorporating control variables is necessary and will be presented in Section 4.2.

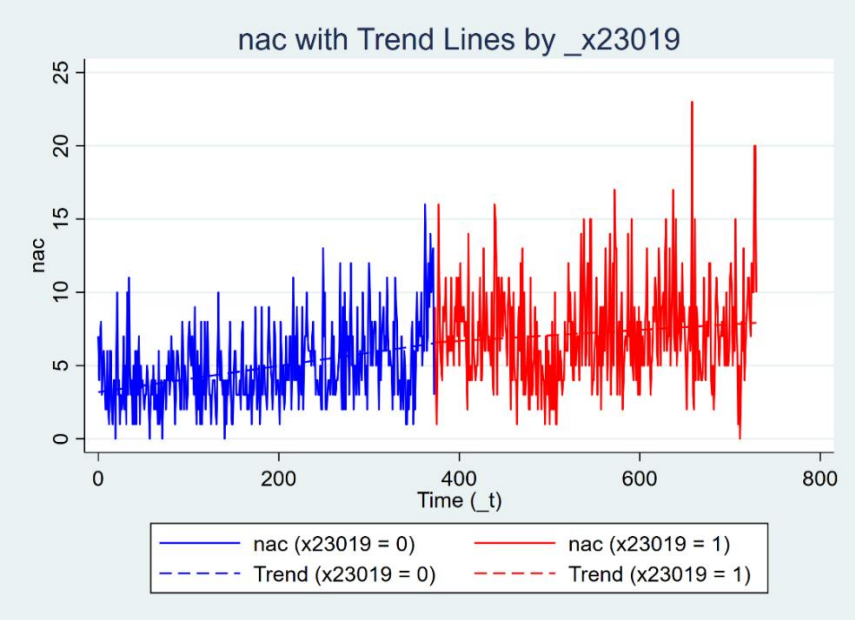

Figure 1: The trend of daily accident occurrences before and after the policy implementation

Source: Author's calculation.

4.2 Regression Result of Interrupted Time-Series Analysis

The regression estimates presented in Table 2 indicate that the demerit point policy is associated with a statistically significant moderation in the upward trend of daily road accidents. Specifically, for all vehicle types combined, the coefficient of the interaction term (Policy × Time) is –0.005, suggesting that the policy slowed the rising trend in accident frequency by approximately 0.005 accidents per day.

For accidents involving private and public passenger vehicles, as well as motorcycles, the policy also demonstrates statistically significant effects at the 5% level. The rate of increase in daily accidents declined by approximately 0.003 and 0.002 incidents per day, respectively, following policy implementation.

Among the control variables, weather conditions, day of the week, and festival holidays emerged as statistically significant determinants of accident frequency. Notably, on days with non-clear weather, motorcycle-related accidents decreased by about 0.31 incidents per day, possibly reflecting more cautious rider behavior or a reduction in travel.

In terms of weekly patterns, relative to Monday, accidents involving private/public passenger vehicles increased significantly on Tuesday (10% significance level). For Friday and Saturday, accident frequencies rose sharply for both all vehicle types and private/public passenger vehicles, with statistical significance at the 1% level. On Fridays, overall road accidents increased by 1.84 incidents per day, and those involving private/public passenger vehicles rose by 0.99. On Saturdays, these figures were 1.21 and 0.72, respectively—likely driven by increased mobility and behavioral changes during the weekend.

During major holidays such as Songkran and New Year, road accident frequencies rose significantly

across all vehicle categories. On average, total daily accidents increased by 3.39 ($p < 0.01$), while accidents involving private/public passenger vehicles rose by 1.26 ($p < 0.05$), and motorcycle accidents by 0.77 ($p < 0.05$). These findings highlight elevated accident risks during long holiday periods, underscoring the importance of targeted policy adjustments during such times.

Table 2: Regression Results

	1	2	3
	All	Car	Motorcycle
Time	0.008***	0.004***	0.002***
	(0.002)	(0.001)	(0.0000)
Post	0.185	-0.109	-0.039
	(0.509)	(0.283)	(0.147)
TimexPost	-0.005*	-0.003**	-0.002**
	(0.002)	(0.001)	(0.001)
wea	0.133	0.02	-0.306***
	(0.761)	(0.435)	(0.113)
traf	0.414	0.014	-0.071
	(0.302)	(0.16)	(0.081)
Tuesday	0.548	0.380*	0.001
	(0.392)	(0.214)	(0.121)
Wednesday	-0.497	-0.153	0.01
	(0.379)	(0.195)	(0.118)
Thursday	0.268	0.274	-0.014
	(0.395)	(0.226)	(0.111)
Friday	1.843***	0.988***	0.163
	(0.41)	(0.213)	(0.123)
Saturday	1.212***	0.723***	0.032
	(0.428)	(0.235)	(0.123)
Sunday	-0.476	0.298	-0.043
	(0.366)	(0.202)	(0.123)
dday	3.389***	1.262**	0.769**
	(1.064)	(0.572)	(0.377)
Constant	1.231	0.763	0.477
	(1.103)	(0.563)	(0.297)
No. of Obs.	730	730	730
R-Squared	0.239	0.126	0.065

Source: Author's calculation.

Note: The numbers reported in parentheses are robust standard errors. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

5. Discussion

The results from the Interrupted Time Series analysis indicate that in Bangkok, the trend of road accidents remained upward despite the implementation of the demerit point policy. However, the rate of increase declined, suggesting that the policy helped moderate accident growth. This finding is consistent with Pulido et al. (2010), who reported a 14.5% reduction in fatalities following the introduction of a similar system in Spain. Compared to other studies, however, the magnitude of the effect observed here is less pronounced, which may be understood through two perspectives: traditional economics and behavioral economics.

From a traditional economic standpoint, individuals are assumed to make rational decisions by weighing expected benefits against expected costs. The demerit point system increases the cost of traffic violations by threatening license suspension, which should theoretically deter risky behavior. Yet, the persistent upward trend in accidents suggests that other external factors—such as rising vehicle numbers, infrastructure limitations, or inconsistent enforcement—may have offset these deterrent effects.

Alternatively, a behavioral economics perspective highlights the role of bounded rationality (Just, 2013) in driver behavior. Three key behavioral biases are particularly relevant:

Status quo bias (Just, 2013) may cause drivers to maintain habitual behaviors despite the new policy. Within the one-year observation window, many drivers may not have sufficiently adjusted their behavior.

Present bias (Ainslie, 1975; Laibson, 1997) leads individuals to prioritize short-term convenience (e.g., speeding) over long-term consequences (e.g., cumulative point loss). This suggests that immediate enforcement (e.g., real-time fines or alerts) may be more effective in altering behavior.

Optimistic overconfidence may lead drivers to underestimate the risk of being caught or believe they can manage their points to avoid license suspension, undermining the policy's intended deterrent effect.

Among the control variables, traffic congestion was not found to significantly influence accident rates, aligning with Quddus et al. (2010), but contrasting with Dickerson et al. (2000), who observed more accidents under lower traffic flow.

Weather conditions significantly affected motorcycle accidents. On non-clear weather days, motorcycle accidents decreased, likely due to reduced usage and increased caution. This aligns with Wang et al. (2024), who found that lower visibility may lead to more cautious driving, thereby reducing accident severity.

Temporal variables also played a role. Compared to Monday, accident rates were higher on Tuesday, Friday, and Saturday, with Friday and Saturday showing the greatest increases. These findings likely reflect increased travel and social activity at the end of the week. Furthermore, public holidays such as Songkran and New Year were associated with a statistically significant rise in accidents, consistent with Eboli et al. (2020), who noted that accidents are more frequent during holidays than regular workdays.

A key limitation of this study is the lack of a formal control group. Because the demerit point system was implemented nationally, no unaffected comparison area exists, which restricts the ability to rule out other time-varying confounders. Additionally, the high correlations between the post-policy indicator and the time variables

(r = 0.87 for Time and Post; r = 0.96 for Post and Time × Post) reflect common challenges in short post-intervention ITS designs. Although Prais–Winsten regression was used to address serial correlation and robust standard errors were applied to improve inference, multicollinearity may still affect the precision of coefficient estimates. Therefore, interpretations of trend and level changes should be made with caution.

Lastly, the analysis is limited to Bangkok, the only region with consistent daily traffic index data. Findings may not generalize to other provinces with different traffic conditions or enforcement practices.

6. Conclusion

This study investigated the impact of Thailand's driver's license point deduction policy on daily traffic accidents in Bangkok. Analyzing data across all vehicle types—private passenger vehicles, public passenger vehicles, and motorcycles—the findings reveal that although the policy did not reverse the rising accident trend, it contributed to a measurable deceleration in that trend. Environmental and temporal variables such as weather conditions, day of the week, and festival holidays also significantly influenced accident rates, with effects differing by vehicle type.

Several policy recommendations emerge from the findings. While the demerit point system appears to moderate accident growth, its limited ability to reverse the trend highlights the need for more robust implementation. Public communication strategies should emphasize loss-framed messaging (e.g., "loss of driving privileges") rather than gain-framed appeals to improve behavioral responses. In addition, increasing point deductions during high-risk periods such as long holidays—and possibly on Fridays and Saturdays, when accident rates spike—may further incentivize safer driving.

This study also acknowledges several limitations. First, the single-group Interrupted Time Series (ITS) design lacks a formal control group, limiting causal inference. Second, the analysis focuses only on the policy's short-term effects within its first year of implementation. Public awareness and behavioral adaptation may take more time to manifest. Third, the dataset is limited to Bangkok and lacks driver-level variables (e.g., age, gender, repeat offenses), which may affect the policy's effectiveness.

Future research should consider a broader geographic scope to assess the policy's nationwide impact and evaluate regional differences in enforcement and compliance. Extending the post-policy observation period could help capture long-term effects. Incorporating law enforcement or traffic violation data—such as citations, license suspensions, and recidivism—would also enrich the analysis and enhance the explanatory power of future models.

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