

Analysis on the Trends and Characteristics of Vehicle Recalls in the United States

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Abstract

Based on the statistical data released by the National Highway Transportation Safety Administration (NHTSA), this study analyzed the trends and characteristics of vehicle recalls in the United States from 2010 to 2019 by using descriptive statistics and correlation analysis. Research shows that vehicle recall is the main type of motor vehicle recall. According to the reasons of recall, the recall is further divided into the recall due to defects and the recall due to non-compliance. And the recall due to none-compliance are more affected by NHTSA. In recent years, the number of influenced recalls has been declining, and uninfluenced recalls are becoming more and more normal.

Keywords: vehicle recall; trends; characteristics

1. INTRODUCTION

Vehicle recall is a management system that relies on the administrative power and functions of the government to supervise the manufacturers to take measures to eliminate product defects. It originated in the United States in the 1960s. Subsequently, the European Union, Japan, South Korea and other countries began to establish vehicle recall systems. After more than 50 years of development, the vehicle recall system has achieved remarkable results in protecting the personal and property safety of consumers, promoting the development of safety technology.

With the development of the vehicle recall system, the studies on the recall system have gradually received extensive attention. Bates et al. pointed out that the single batch recall amount of Chinese automobile manufacturers is not much different from that of the United States, but the number of recalls is seriously insufficient [1]. Malec et al. uses panel data on 677 U.S. vehicle recall campaigns from 2006 to 2015 to identify the correlates of completion rates for the Detroit and the three largest foreign vehicle manufacturers[2]. Feng et al. figured out that vehicle recall in China has become a normal trend, there is a recall almost every two days and most recalls are initiated by a few automobile

manufacturers[3]. Wilson and Page described the recall data transformation that permits better use of its information, and its application is illustrated for treating industry trends and subsequent impact on domestic/import sales[4]. In summary, the trends and characteristics of vehicle recalls have become an important content in the field of recall system study, but there is no special study on the trends and characteristics of vehicle recalls in United States in recent years.

The structure of this paper is as follows. In the second part, the study samples and data sources of this paper are described. In the third part, the characteristics of vehicle recalls in the United States were studied from the aspects of vehicle recall scale, category, completion rate for vehicle recalls, and correlation of influenced recalls and total recalls. Finally, the main study conclusions of this paper are summarized.

2. STUDY SAMPLES AND DATA

The United States, the first country in the world to implement vehicle recall system, is a country with relatively perfect system. In 1966, Congress enacted the National Traffic and Motor Vehicle Safety Act, which formally established the motor vehicle recall system. In 1970, the National Highway Traffic Safety Administration (NHTSA) was established in the United

States to supervise motor vehicle safety. NHTSA has both administrative regulatory functions and strong professional technical analysis and research capabilities. The Office of Vehicle Safety Supervision (OVSC) is staffed with defect investigation and testing engineers who conduct hundreds of testing for standard-compliance per year in accordance with U.S. vehicle safety standards. Automotive Research and Test Center (VRTC), a defect technical analysis and determination laboratory, has been set up for the defect analysis of automotive products and related vehicle safety research.

From 1966 to 2019, NHTSA and its predecessor agencies managed recalls of more than 766 million cars, trucks, buses, recreational vehicles, motorcycles and mopeds, as well as 120 million tires, 61 million child car seats and 180 million other motor vehicle equipment due to safety defects[5]. The implementation of the motor vehicle recall system not only makes the overall traffic accident death rate decreased, but also accumulates valuable data for the analysis of the automobile safety situation in the United States. Therefore, this study takes the vehicle recalls in the United States from 2010 to 2019 as the research sample and the statistical data released by the NHTSA as the data source to analyze the trend and characteristics of vehicle recalls in the United States in recent years.

3. ANALYSIS OF TRENDS AND CHARACTERISTICS

3.1 Scale of vehicle recalls

According to the National Traffic and Motor Vehicle Safety Act of the United States, the recall covers motor vehicles and motor vehicle equipment, including vehicles, motor vehicle equipment, child safety seats, tires and other products. Statistics on the proportion of vehicle recalls in the United States from 2010 to 2019 show that the number of vehicle recalls in the United States accounts for about 90% of the number of motor vehicle recalls. The proportion of affected population of vehicle recalls to that of motor vehicle recalls fluctuates greatly, and the proportion is the lowest in 2015, accounting for 57.77%. In 2011, the proportion is highest, accounting for 87.44%. It can be seen that vehicle recall is the main category of motor vehicle recall in the United States.

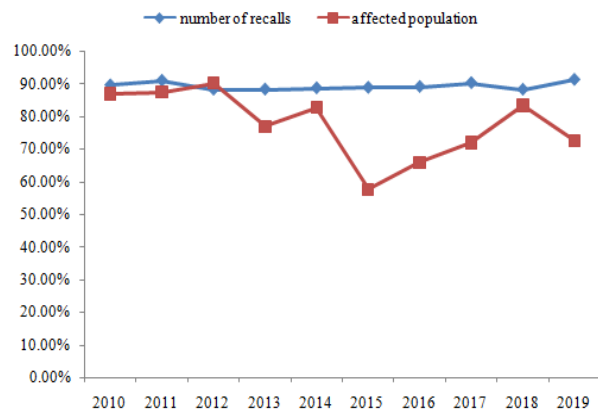


Figure 1. The proportion of vehicle recalls to motor vehicle recalls.

3.2 Number and affected population of vehicle recalls

The affected population of vehicle recalls in the United States fluctuates greatly, with an annual average of more than 30 million people being affected. In terms of the number of vehicle recalls, the average annual number of automobile recalls in the United States is about 760, showing a steady trend.

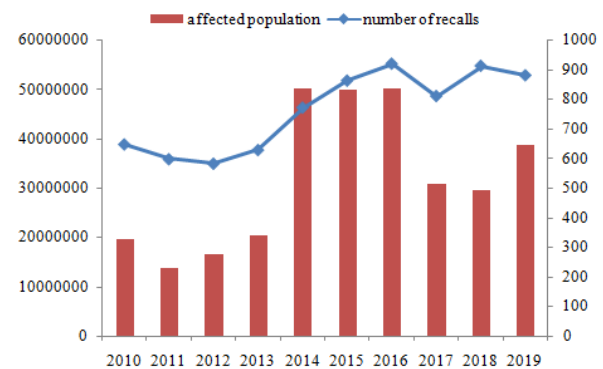


Figure 2. Number and affected population of vehicle recalls in 2010-2019.

3.3 Category of vehicle recalls

Vehicle recall is divided into uninfluenced recall and influenced recall. Uninfluenced recall means that the enterprise carries out the recall through independent investigation and analysis, and the government does not intervene in any work before the recall. Influenced recall includes the recall influenced by the investigation of the government regulatory department and the recall ordered by the government regulatory department. Recall influenced by investigation refers to the fact that the government department in charge finds the existence of defects by analyzing the defect information and notifies the producer to implement the recall after investigation and evaluation. According to the recall data released by NHTSA, from 2010 to 2019, the proportion of vehicle

recalls influenced by defect investigations in the United States has been declining year by year since 2013. The proportion of the affected population of vehicle recalls affected by the investigation of defects fluctuates greatly, but they are all below 60%.

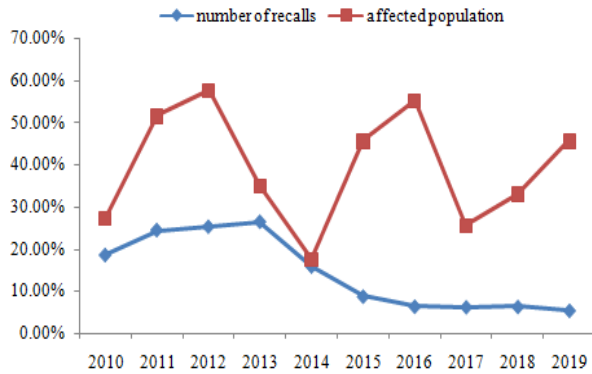


Figure 3. The proportion of of influenced vehicle recalls to vehicle recalls

According to the ODI’s risk-based processes, there are two general categories of investigations, defect investigations and administrative investigations. Defect investigations are used to investigate the existence of a defect relating to motor vehicle safety. Administrative investigations involve related compliance and enforcement issues[5]. Therefore, From the point of view of the reasons for recall, there are two types of recalls managed by NHTSA. One category involves defects and the other involves issues that do not meet federal Motor Vehicle Safety standards (FMVSS). According to the statistics of vehicle recall conducted by NHTSA from 2010 to 2019, the number of recalls due to defects accounted for about 85%, and the number of recalls due to non-compliance accounted for about 15%. In terms of the affected population of recalls, except for 2019, the affected population of recalls due to defects accounted for about 95%, and the affected population of recalls due to non-compliance accounted for about 5%. It can be seen that the recall due to defects is the main category of vehicle recall.

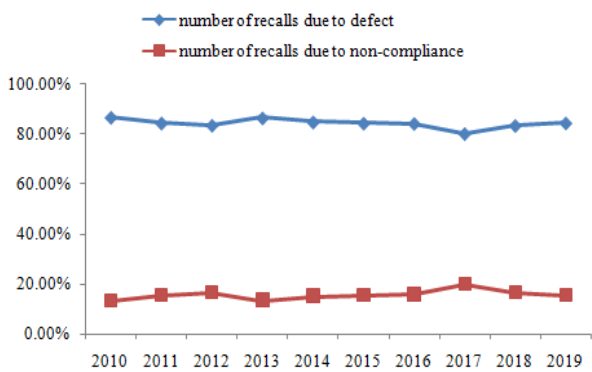


Figure 4. The proportion of the number for different categories of vehicle recalls.

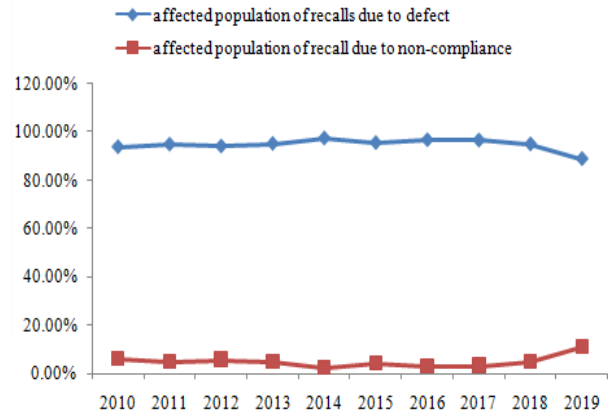


Figure 5. The proportion of affected population for different categories of vehicle recalls.

3.4 Completion rate for vehicle recalls

The purpose of automobile recall is to reduce product safety risk and protect the personal and property safety of consumers. Therefore, recall completion rate is one of the important indicators to measure the effect of vehicle recall. The recall completion rate provides a technical basis for automobile manufacturers to improve recall strategies in time and for regulators to supervise recall activities.

According to the Vehicle Safety Recall Completion Rates Report submitted to the US Congress by NHTSA, recall completion rate = count of vehicles remedied ÷ (count of vehicles in recall - vehicles exported, stolen, scrapped, other) *100[6]. From 2010 to 2019, the completion rate of vehicle recalls in the United States fluctuated between 50% and 70%, with the lowest rate of 52.4% in 2015 and the highest rate of 68.5% in 2018.

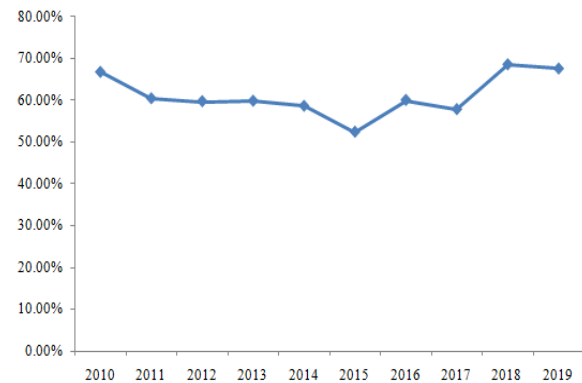


Figure 6. Completion Rate for Vehicle Recalls.

3.5 Correlation analysis of influenced recalls and total recalls

The overview of vehicle recalls reflects a country’s automobile safety situation. The overview of influenced recalls reflects the role of NHTSA play in the recall system. In this study, the correlation analysis model

based on Pearson correlation coefficient was established to analyze the correlation and significance test of influenced recalls and total recalls. Where, R is the Pearson correlation coefficient, X is the influenced recall and Y is the total recall.

$$R_{xy} = \frac{n \sum x_i y_i - \sum x_i \sum y_i}{\sqrt{(n \sum x_i^2 - (\sum x_i)^2)(n \sum y_i^2 - (\sum y_i)^2)}}$$

Correlation analysis is a very common statistical method to study the closeness between different variables. Generally, we give that the threshold of the probability p of hypothesis establishment is 5%. When the probability p is less than 5%, it is considered that the original hypothesis is not tenable. Otherwise, we accept the original hypothesis and consider that the two variable correlation coefficient is 0.

Firstly, the correlation model is applied to analyze the correlation between the affected population of influenced vehicle recalls and the total affected population of vehicle recalls. As shown in Table 1, it can be considered that the correlation coefficient is 0.741, P < 0.05, indicating significant and closely related.

TABLE 1.Correlation of Affected population of influenced vehicle recalls and vehicle recalls

		Influenced Vehicle Recalls	Vehicle Recalls
Influenced Vehicle Recalls	Pearson Correlation	1	.741*
	Sig. (2-tailed)		.014
	N	10	10
Vehicle Recalls	Pearson Correlation	.741*	1
	Sig. (2-tailed)	.014	
	N	10	10

*. Correlation is significant at the 0.05 level (2-tailed) .

Secondly, the correlation model is applied to analyze the correlation between the affected population of influenced vehicle recalls due to defect and the affected population of total vehicle recalls due to defect. As shown in Table 2, it can be considered that the correlation coefficient is 0.733, P < 0.05, indicating significant and closely related.

TABLE 2.Correlation of Affected population of influenced vehicle recalls and vehicle recalls due to defect

	Influenced Vehicle Recalls	Vehicle Recalls

Influenced Vehicle Recalls	Pearson Correlation	1	.733*
	Sig. (2-tailed)		.016
	N	10	10
Vehicle Recalls	Pearson Correlation	.733*	1
	Sig. (2-tailed)	.016	
	N	10	10

*. Correlation is significant at the 0.05 level (2-tailed) .

Thirdly, the correlation model is applied to analyze the correlation between the affected population of influenced vehicle recalls due to non-compliance and the affected population of total vehicle recalls due to non-compliance. As shown in Table 3, it can be considered that the correlation coefficient is 0.882, P < 0.01, indicating significant and closely related.

TABLE 3.Correlation of Affected population of influenced vehicle recalls and vehicle recalls due to non-compliance

		Influenced Vehicle Recalls	Vehicle Recalls
Influenced Vehicle Recalls	Pearson Correlation	1	.882*
	Sig. (2-tailed)		.001
	N	10	10
Vehicle Recalls	Pearson Correlation	.882*	1
	Sig. (2-tailed)	.001	
	N	10	10

*. Correlation is significant at the 0.01 level (2-tailed) .

The above correlation analysis shows that NHTSA plays an important role in the automobile recall system in the United States. The above correlation analysis also shows that the correlation between the affected population of influenced vehicle recalls due to non-compliance and the affected population of total vehicle recalls due to compliance is higher than that due to defects. This shows that the recall involving non-compliance with federal motor vehicle safety standards (FMVSS) is more affected by NHTSA than the recall involving safety defects.

4. CONCLUSIONS

By analyzing the trend and characteristics of vehicle recalls in the United States from 2010 to 2019, this study finds that, first, the laws and regulations of motor vehicle recall in the United States are relatively perfect, covering more comprehensive product categories, but vehicles are still the main type of motor vehicle recall. Second, the classification of motor vehicle recall in the United States is more detailed. According to the reasons of recall, the recall is further divided into the recall due to defects and the recall due to non-compliance. The recall involving non-compliance with federal motor vehicle safety standards (FMVSS) is more affected by NHTSA than the recall involving safety defects. Third, the number of recalls influenced by NHTSA in the United States has declined in recent years, and uninfluenced recalls are becoming more and more normal. Fourth, the recall completion rate of vehicle recalls in the United States fluctuates between 50% and 70%. NHTSA strives to improve the safety recall process and to ensure as many owners as possible seek remedies for recalled vehicles[6]. These characteristics are closely related to the perfect legal system and technical support system in the United States, which provides reference for the construction of motor vehicle recall system in other countries.

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