Research on the Dynamic Adjustment Mechanism of Online Ride Hailing Capacity Scale

Rui Qiao [1 a],Guohua Cheng [1 *],Yiyan Zhou [1 b]

[1] Research Center of Highway and Integrated Transportation Development, Research Institute of Highway Ministry of Transport, No. 8 Xitucheng Road Haidian District, Beijing, China;

[1 a] 605116877@qq.com, [1 *]1426995798@qq.com, [1 b] xy205666@163.com

Abstract. This study aims to address the lack of methods for adjusting the scale of online ride hailing capacity. Taking G city as an example, a dynamic monitoring index system for the scale of online ride hailing capacity is constructed by comprehensively considering factors such as order volume, driver labor hours and income levels, and the operation status of the taxi market. Pearson correlation analysis and stepwise linear regression methods are applied to screen the indicators, and key indicators and threshold standards for the dynamic adjustment mechanism of online ride hailing capacity are proposed, providing theoretical basis and decision support for the adjustment of urban online ride hailing capacity scale.

Keywords: Online Ride hailing; Capacity Scale; Dynamic Adjustment Mechanism.

1. Introduction

In recent years, the rapid development of online ride hailing services in China has better met the high-quality and diversified travel needs of passengers, and improved the travel experience of residents. Unlike traditional cruise taxis that use quantity control, various regions generally adopt market regulation measures for ride hailing services. According to statistics, as of the end of 2023, there are a total of 337 licensed online ride hailing platform companies in China, with 6.57 million ride hailing drivers and 2.79 million vehicles. The scale of online ride hailing have significantly exceeded that of traditional cruise taxis, resulting in a decrease in driver income and service quality throughout the industry, which has attracted social attention. Gradually achieving market regulation through the establishment of a reasonable system for adjusting the scale of taxi transportation capacity is an important means for the government to implement macro adjustments to the structure of the taxi industry, as well as an important guarantee for alleviating industry conflicts and promoting the healthy development of the taxi industry.

2. Literature Review

Domestic and foreign scholars have conducted in-depth research on the prediction, monitoring, and evaluation of taxi capacity scale. Lu et al. (2004) applied parameters such as effective mileage, average operating speed, and average daily operating time of taxis to calculate the reasonable number of taxis owned by giving the empty driving rate of taxis [1]. Wang (2011) constructed a GM (1,1) prediction model to forecast the number of taxis [2]. Hu (2011) calculated the reasonable ownership of taxis using the supply-demand balance method based on GPS data of taxis. Lei (2013) used taxi operation indicators to construct BP neural network and wavelet neural network, and calculated the market size of taxis [4]. Ye (2020) and Zhou et al. (2020) constructed a rental car transportation demand prediction model through deep learning, accurately predicting the transportation demand of urban taxis [5-6]. Zhao et al. (2022) analyzed the impact of factors such as economic level and population on the demand and supply of taxis, and studied the quantity of taxis deployed [7]. Wang (2023) proposed a new method for evaluating transportation capacity based on service hours and service mileage, taking factors such as shortened operating hours and reduced operating mileage during the period of new energy transformation of taxis. The rationality of the transportation capacity evaluation method was effectively verified using L city as an example [8].

In summary, current research is mostly based on traditional quantity control ideas, using various mathematical models to calculate the total number of taxis, without dynamically adjusting the scale of ride hailing capacity according to the characteristics of market-oriented development. Therefore, this study establishes a monitoring index system for the ride hailing market, monitors changes in key operational indicators, and constructs a dynamic adjustment mechanism for transportation capacity to better meet the healthy and sustainable development of the online ride hailing market.

3. Research Methods and Data Process

For the development of the online ride hailing industry in a city, it is difficult to accurately calculate the reasonable number and scale of ride hailing vehicles using formulas. The supply-demand balance is constantly changing with changes in travel demand. Overall, there is no need for deliberate and precise calculation of the scale of ride hailing services. Instead, a scientific scale regulation mechanism should be established, a market operation monitoring index system should be constructed, and the existing supply and demand situation of ride hailing services should be regularly monitored. Scientific and reasonable dynamic regulation should be implemented based on the monitoring results.

Based on the research on the online ride hailing industry, taking into account the interests and demands of management departments, enterprises, drivers, and passengers from the perspective of the entire industry, 14 monitoring indicators were selected from 6 aspects: operating licenses, order volume, operating hours, operating income, operating mileage, and ride hailing convenience. The specific indicators are as follows:

(1) In terms of operating licenses, it includes the number of licenses granted to online ride hailing platform companies, ride hailing vehicles, and ride hailing drivers. Meanwhile, due to some licensed ride hailing vehicles not participating in actual operations, in order to reflect the true scale of the ride hailing industry, it is necessary to monitor the daily actual number of vehicles receiving orders.

(2) In terms of order volume, the main monitoring indicators are the daily average order volume of the ride hailing industry and the daily average order volume of ride hailing vehicles. The daily average order volume of the ride hailing industry mainly reflects the development and prosperity of the industry, and the daily average order volume of ride hailing vehicles is closely related to driver income.

(3) In terms of operating hours, it mainly monitors two indicators: the daily average online time of vehicles and the daily average passenger carrying time of vehicles. The daily average online time of vehicles is mainly used to analyze the labor intensity of drivers; The daily average passenger carrying time of a vehicle is mainly used to analyze the operation of ride hailing services.

(4) In terms of operating revenue, the main monitoring indicators are the daily average revenue of vehicles and the average revenue per trip. The daily average income of vehicles mainly reflects the income situation of drivers, while the average income per trip mainly reflects the changes in fares in the ride hailing market.

(5) In terms of operating mileage, it mainly monitors three indicators: daily average operating mileage of vehicles, daily average passenger mileage of vehicles, and average passenger mileage per trip. Similar to the operating hours, the daily operating mileage and daily passenger mileage of vehicles mainly measure the mileage utilization rate to reflect the operational efficiency of ride hailing services. The average passenger mileage per trip mainly reflects the distance traveled by passengers.

(6) In terms of ride hailing convenience, the main focus is on monitoring the average waiting time of passengers, which is the difference between the time when passengers place orders on ride hailing apps and the time when ride hailing vehicles accept orders. The longer the average waiting time for passengers, the more likely it is that there is a shortage of ride hailing services and difficulty in finding a taxi.

4. Dynamic Adjustment Mechanism of Ride Hailing Capacity

4.1 Data Sources

To verify the quantitative correlation between the scale of ride hailing capacity and monitoring indicators, a correlation analysis was conducted by establishing an econometric model. This study selected monitoring data on the operation of the ride hailing industry in G city from January 2022 to December 2023, sourced from the city's ride hailing regulatory information platform. In addition, due to the lack of daily online duration and operating mileage data for vehicles on the city's platform, and the fact that the scale of online ride hailing capacity mainly considers the number of vehicles, the number of online ride hailing platforms and driver licenses have not been included in the model. Therefore, this study constructed a model based on the remaining 10 monitoring indicators.

4.2 Selection of Key Warning Indicators

To make the dynamic adjustment mechanism of ride hailing capacity more convenient and operable, the above 10 monitoring indicators can be simplified, and 2-3 key warning indicators that are more representative can be selected for monitoring.

At the level of industry development, the daily average order volume of an industry is a direct reflection of its scale, and its changes directly reflect the prosperity of the industry's development. Therefore, the daily average order volume changes in the industry can be used as a key warning indicator.

At the operational level, as the income of ride hailing drivers directly affects industry stability and service quality, driver income should be considered as an important regulatory indicator for the scale of ride hailing services. However, due to the lack of guiding requirements for the income of employees in China, it is not appropriate to directly use the daily average income of ride hailing drivers as a key warning indicator. Therefore, indicators that are highly correlated with the daily income of drivers and reflect the level of industry operation can be selected. This study constructs a Pearson correlation analysis model. From the results, it can be seen that the daily income of drivers is most correlated with the daily average order volume and passenger time of vehicles, with correlation coefficients of 0.939 and 0.873, respectively. The significance P value is less than 0.05, indicating that the analysis results are significant.

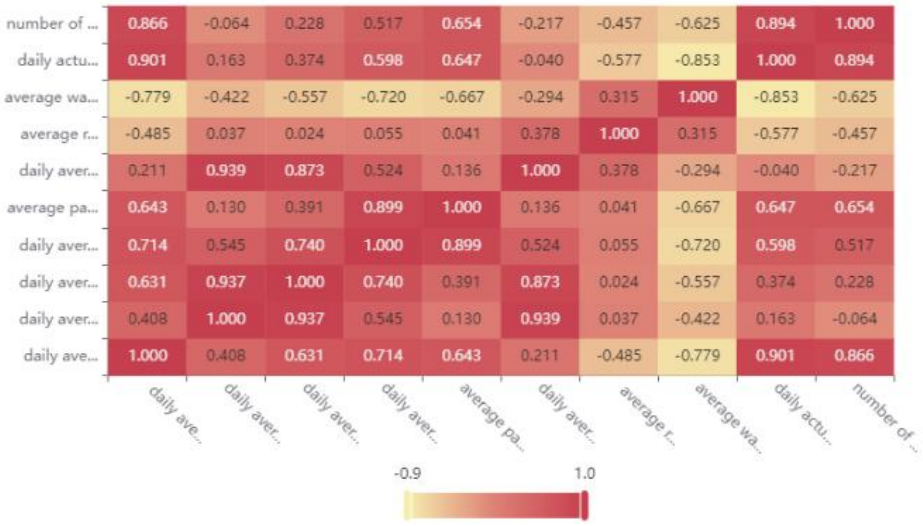

Fig. 1 Heatmap of Correlation coefficient

To further investigate the quantitative relationship between daily driver income and other monitoring indicators, this study used the least squares method to construct a linear model through stepwise regression. From the results, it can be seen that only two indicators, the daily average order

volume of vehicle(DAOV) and the average revenue per trip(ARPT), were retained. Due to the lack of significant changes in the average revenue per trip in G city from 2022 to 2023, the key warning indicator at the operational level can be selected as the daily average order volume of vehicle.

Table 1. Results of Stepwise Regression Model

	Non standardized coefficient		Standardized coefficient	t	p	VIF	R2	Adjust R2	F
	B	standard deviation	Beta						
constant	-154.024	3.76	0	-40.965	0.001	-	0.999	0.999	F=7874.091 P=0.001
DAOV	23.185	0.2	0.926	116.183	0.001	1.001			
ARPT	6.637	0.154	0.343	43.094	0.001	1.001			
dependent variable: average daily driver income									

From the analysis of the F-test results, it can be concluded that the significance P-value is 0.001, indicating a significant level and rejecting the null hypothesis with a regression coefficient of 0. The R2 value is 0.999, indicating a good fitting effect. For the collinearity of variables, all VIFs are less than 10, indicating that the model does not have multicollinearity issues and is well constructed. The model formula is as follows:

$$y = -154.024 + 23.185 * \mathrm{DAOV} + 6.637 * \mathrm{ARPT} \quad (1)$$

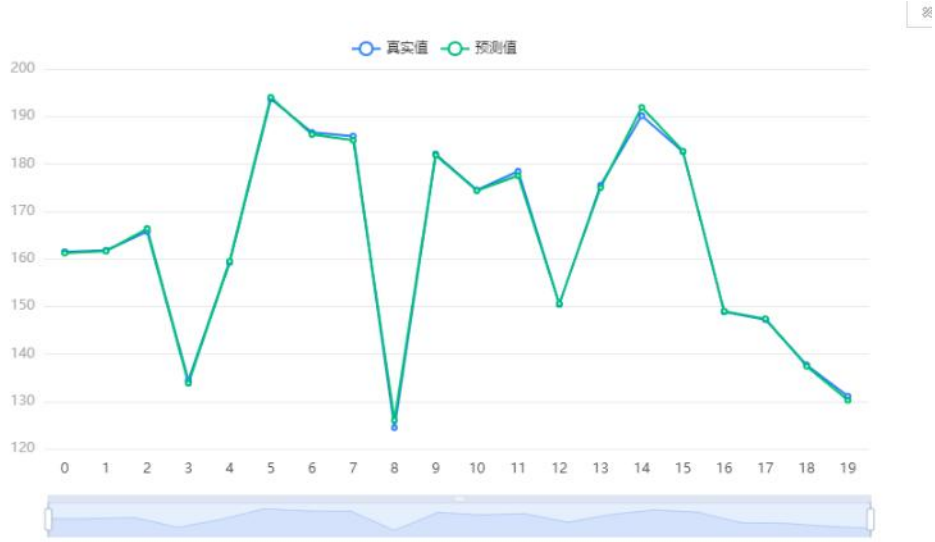

Fig. 1 Gradual Regression Fitting Curve

In addition, the expansion of ride hailing services has had a significant impact on the operation of tour taxis, which can easily lead to conflicts between new and old business models. Therefore, the operation of the taxi industry is also an important factor in determining the scale of ride hailing services. The utilization rate of cruising mileage can directly reflect the operating situation of cruising vehicles and is an internationally recognized indicator for monitoring the scale of taxis. Therefore, the utilization rate of cruising mileage will be included in the key warning indicators.

In summary, the key warning indicators for the dynamic adjustment of ride hailing services in G city are the industry's daily average order volume change rate, the daily average order volume of vehicles, and the utilization rate of cruising mileage.

4.3 Threshold Setting for Key Warning Indicators

From the perspective of minimum income, the hourly minimum wage standard for part-time employees in G city is 19.60 yuan per hour. Based on the average daily operating hours of 7.16

hours for ride hailing vehicles in G city in 2023, the minimum daily income for ride hailing drivers in G city is 200 yuan. In terms of average income, the per capita disposable income of urban residents in G city in 2023 is 48364 yuan. Calculated based on drivers working 280 days a year, the average daily income of ride hailing drivers in G city is 247 yuan. Therefore, based on formula (1), assuming that the average income per trip remains stable at 22 yuan in the future, in order to ensure that the daily income of ride hailing drivers remains stable between 200 yuan and 247 yuan, the daily average order volume per bike should be between 9-11 orders. Therefore, when the daily average order volume of ride hailing services is less than 9, it is recommended to suspend the issuance of ride hailing licenses; When the daily average order volume of ride hailing services exceeds 11, the issuance of ride hailing licenses should be resumed.

In terms of the rate of change in industry order volume, according to data from January 2022 to December 2023, the monthly average order volume of the ride hailing industry in G city increased by 5.3%. To maintain a stable industry scale, it is recommended to set the monthly rate of change in industry order volume at 5%. When the monthly change rate of ride hailing orders is less than -5%, it is recommended to suspend the issuance of ride hailing licenses; When the change rate of online ride hailing orders exceeds 5%, the issuance of online ride hailing licenses should be resumed.

In addition, according to industry recognized standards both domestically and internationally, the utilization rate of cruising mileage should be maintained between 60% and 70%. Considering the future development trend of ride hailing services, it is difficult to set a minimum standard for the utilization rate of cruising mileage. In order to maintain the stable and orderly development of the industry, the utilization rate of cruising mileage should be measured by changes. Due to the average utilization rate of cruising mileage in G city in the past two years being 61.7%, with a maximum of 63% and a minimum of 57%, it is recommended to set the change in cruising mileage utilization rate at around 3%. When the cruising mileage utilization rate should be reduced by 3%, it is suggested to suspend the issuance of ride hailing licenses; When the utilization rate of cruising mileage should increase by 3%, the issuance of ride hailing licenses should be restored.

Table 2. Threshold Setting for Key Warning Indicators

Key Warning Indicators	Suspend licenses	Maintain stability	Restored licenses
Monthly average order volume of the ride hailing industry	≤-5	-5-5	≧5
Daily average order volume of ride hailing	≤9	9-11	≧11
Utilization rate of cruising mileage	≤-3	-3-3	≧3

5. Conclusions and Recommendations

5.1 Research Conclusion

This study combines the actual development of the ride hailing market and constructs a monitoring index system for the operation of the ride hailing market, which includes 14 indicators from 6 aspects. Based on the actual data of the ride hailing regulatory information platform, Pearson correlation analysis and stepwise linear regression methods are applied to screen the indicators. The key warning indicators for the dynamic adjustment of ride hailing in G city are the industry average daily order volume change rate, single vehicle average daily order volume, and cruising mileage utilization rate. Finally, the interval values of the ride hailing dynamic adjustment mechanism are calculated based on the fitting equation.

5.2 Policy Recommendations

(1) Adhere to the direction of market-oriented reform. Practice has proven that the direction of market-oriented reform is in line with the actual development of the industry. Focusing on eliminating institutional differences in management, accelerating the improvement of policy systems, perfecting standards and norms, guiding the digital transformation and upgrading of ride hailing vehicles, enhancing the level of standardized development of ride hailing services, and promoting the integration of new and old business models.

(2) Promote flexible and diverse regulatory measures. For the regulation of the transportation capacity scale in the online ride hailing market, more flexible methods such as market risk warning should be used to maintain a certain amount of inflow and outflow under the premise of total volume regulation, in order to promote the dynamic relative balance of total volume.

(3) Strengthen the monitoring of the operation of the ride hailing market. Adhere to a regular reporting mechanism for the operation and compliance of ride hailing services, provide business risk warnings to employees in the industry who intend to enter, and guide reasonable expectations.

(4) Create a fair competitive environment. Properly handling the relationship between the government and the market, fully leveraging the regulatory role of market mechanisms and the guiding role of the government, we should encourage innovative development while also promoting fair and orderly competition. Strengthen the supervision of the ride hailing market and regulate the business behavior of leading enterprises.

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