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Retraction

Retracted: Operation and Management Strategy of Online Car-Hailing Platforms Based on Big Data Diagnosis and Game Perspective

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] S. Luo and F. Jia, "Operation and Management Strategy of Online Car-Hailing Platforms Based on Big Data Diagnosis and Game Perspective," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 2758619, 15 pages, 2022.

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Research Article

Operation and Management Strategy of Online Car-Hailing Platforms Based on Big Data Diagnosis and Game Perspective

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With the implementation of a series of preferential strategies by online car-hailing companies, the contradiction between online car-hailing and traditional taxis and passengers has become more and more intense. Coordinating the interests of the three parties has become increasingly important. In order to coordinate the contradiction between online car-hailing and traditional taxis and passengers and to manage the online car-hailing and traditional taxis reasonably, this paper conducts research on the operation and management strategy of online car-hailing platform based on big data diagnosis and game perspective. In order to solve the problem of online car-hailing platform operation and management strategy, this paper adopts a research method combining qualitative judgment and quantitative analysis and conducts research by combining specific logic deduction, field investigation, empirical research, mathematical analysis, and computer simulation. The results found that while the platform rate was reduced to 0.085, the daily income of online motorists increased from 170 yuan to 236 yuan, by 38.6%. In the event of a reduction in taxi fares to -3500, one hire the daily income of motorists increased from 134 yuan to 212 yuan, an increase of 57.8%. This shows that reducing the percentage of the platform has the greatest impact on the revenue of online car-hailing companies, and the recharge rebate strategy has the least impact on the revenue of online car-hailing companies. The strategy of reducing elementary money concessions can greatly increase the income of taxi drivers, but it also reduces nearly one-third of the income of taxi companies.

1. Introduction

With the rapid development of the mobile Internet, the virtual world and the real world merge with each other. Based on mobile Internet technology, people, machines, and information can be interconnected and integrated through computing, autonomous control, and the Internet of Things. Mobile Internet has had a profound impact on the development of multiple industries, and multiple forms of sharing economy have gradually emerged [1]. In the field of transportation, various online car rental forums based on the mobile Internet are already in line. Travelers can match cars and drivers at a car rental site online using their mobile terminals (such as smart phones) and receive travel services offered to drivers and vehicles connected to the platform. The advent of this new mode of travel is a subtle shift in human behavior. It can be said that the much-needed travel service represented by network car rental brings about a dynamic change in the traditional transportation system [2]. Online car-hailing travel service, referred to as online car-hailing travel service, online car-hailing service, or online car-hailing, is a new type of travel mode that has entered the urban transportation system in a way similar to taxi services but lower than taxi service prices in recent years. On the whole, different from the traditional taxi industry, the online car-hailing service platform uses the mobile Internet as a medium to match the information of passengers, vehicles, and their drivers in real time and provides them with full consideration of the individual preferences of both users. Travel services are an important part of current urban traffic.

At present, there are more and more researches on online car-hailing at home and abroad, mainly focusing on the analysis of the impact of the development of online car-hailing on taxis and other modes of transportation and the research on online car-hailing matching algorithms and matching modes, such as Belwal R established a "front-to-back comparison" analysis design to study the impact of car sharing on household vehicles and vehicles as a whole [3]. Zhang et al. systematically outlined the optimization challenges faced in developing technology to support car sharing and investigated relevant research models in academic literature [4]. Stergiou and Psannis briefly introduced the development of San Francisco's online taxi-hailing service, compared the traditional taxi model and the shared travel service model, and expounded the range of strategies for drivers or passengers as passengers [5]. Xu et al. reviewed the taxi service modeling system and identified and analyzed the dynamics of the problem, comparing the differences in the different parameters of the three effective taxi service modes (Yang Zhao, platform and delivery) [6]. Athey evaluates the market demand potential of shared passenger vehicle (SRT) services in an organization-based environment. The results show that 30-50% of students are willing to use "shared taxi" services in actual situations, and subsidies may play a key role in increasing SRT passengers [7].

Although there are many researches on online car-hailing at present, they are still relatively one-sided. Most of the research directions focus on the algorithms of online car-hailing. The research on the operation and management strategy of online car-hailing platforms from the perspective of big data diagnosis and gaming has the following innovations: (1) the analysis based on big data makes the statistics of online car-hailing platforms and travelers sufficiently extensive; the support for the conclusion is strong. (2) The contradiction between the operation and management strategies of the car-hailing platform based on the game perspective has practical significance.

2. Experimental Methods for the Operation and Management Strategy of Online Car-Hailing Platforms

2.1. Research and Application of Game Theory in the Field of Urban Transportation. Game theory is an important tool to analyze people's decision-making behavior, and it has a wide range of applications in the field of urban transportation. According to the different research problems, the application research of game theory in the transportation field can be divided into three aspects: research and application in travel choice, research and application in traffic management, and research and application in other transportation fields [7]. (1) For the research and application of game theory in travel choice, travel choice is a key field in the research and application of game theory in the field of transportation. It is mainly divided into travel route selection, travel mode selection, and travel time selection [8]. This type of game often treats people like a game process when making travel decisions. In the selection process, participants always use the increase in expected returns as the basis for selection, but that the increase in return can be achieved not only at participant's decision, but also at strategies or strategies adopted by other participants. [9]. Therefore, according to different influencing factors, this type of game can be classified into two types: the game between participants and virtual participants and the game between participants and other participants.

Game theory is widely used in the management of urban vehicles. In this type of study, game analysis is often used to evaluate the results of different management strategies, in order to select the right management strategy to achieve the management objectives of the manager. Some scholars have developed a game model between car managers and drivers in the management of traffic violations [10]. In the submodel, the characteristics of drivers' violation behaviors under different management strategies adopted by managers are studied. Through research, the article found that the main factor that affects drivers' violations is not punishment but the degree of compulsion to implement the regulations [11]. Construct a cost game model between toll road managers and travelers. In this model, the manager decides the toll standard of the road, and the traveler decides whether to use the road. Through the analysis of the game, it can provide a basis for the manager to formulate an effective toll level [12]. We can use game analysis methods to construct a two-level planning model that includes two managers and all travelers, and this model is ultimately used to guide the formulation of reasonable road toll rates. From the current research and application status of game theory in the field of transportation, it can be seen that the main problem that game theory solves in the field of transportation is to analyze and evaluate people's choices and reactions in traffic behavior, so as to predict people's actions. Among them, game theory has important applications in the field of traffic management and is an important tool for analyzing the effects of management strategies [13].

2.2. Characteristics of Online Car-Hailing Platforms. The online car-hailing platform has the characteristics of high information transparency. The online car-hailing platform relies on Internet big data technology to efficiently collect, calculate, and disclose the relevant data of the operation process [14]. In the process of booking a vehicle, consumers and drivers can observe each other's basic personal information, geographic location, and waiting time, as well as grasp the real-time freight rate and traffic congestion of the platform [15]. Therefore, the perception of the field information is very high, which significantly reduces the knowledge of the asymmetry of the users, reduces the user cost, and improves the overall efficiency of the tourism market. The second is the characteristic of diminishing costs. Car-hailing platform companies rely on Internet technology to develop, and their costs are different from traditional companies [16]. Ride-hailing platforms need to invest relatively high costs when developing taxi-hailing apps. After the software is put into use, the cost of additional copying is very low, and even the marginal cost is close to zero. Therefore, once the online driving platform has reached a certain scale, the cost of platform service will gradually decrease. Lastly, it is a feature of the shared economy. Most drivers involved in car photography services by owners own private cars. The online driving platform integrates these automotive services and the idle time of private car owners and uses Internet technology to minimize resources caused by discrepancy between details. Waste greatly improves the efficiency and use of social vehicles and has seen more resource allocation [17]. Therefore, the online car-hailing platform has a typical color of the sharing economy.

2.3. Diagnose the Operation and Management Algorithm of the Car-Hailing Platform Based on Big Data. With the rapid development of storage technology and network technology, the information industry has been driven by leaps and bounds, and mobile communications, biological information, social networks, shopping platforms, etc. continue to generate large amounts of data [18]. The widespread use of cloud computing has also provided a solid foundation for source, storage, and processing of big data and hasten the rapid development of data processing technology. Technology collection is an important data processing technology in the data mining industry and is widely used in machine learning, pattern recognition, and other fields [19]. According to the initial conditions of clustering and the nonuniqueness of the application criteria, various clustering algorithms have emerged. This article uses the core point-based big data clustering algorithm to calculate the operation and management strategy of the online car-hailing platform. The basic calculation framework is shown in Figure 1.

It can be seen from Figure 1 that the core point-based big data clustering algorithm is first based on the core point-based big data grouping process, which mainly includes the process of selecting key points according to the similarity between the data and collecting big data based on key points, followed the process of assembling the main set, which included two old methods of assembling the frame [20]. Finally, integrating the above process, the clustering result of the core set is extended to the original data set, and the clustering result of the big data is obtained. The specific steps of the operation are as follows:

$$H(y) = m_j^{-1} \sum_{i=1}^{n_y} i(y_i \leq y), \tag{1}$$

$$Hj(y) = Hj[(1+m)y]. \tag{2}$$

Equation (1) is the distribution function, where n is the growth rate of online car-hailing, and the trend from the distribution function $y1$ to $y2$ is the degree of progress of the increase of online car-hailing. The first-order ending distribution function is smaller than the beginning identification function of the random dominant diagram [21]. For other indicators, it is usually set as the mean ratio $o2/o1$, and the judgment conditions are

$$\nabla(n) = \frac{p2(q)}{p1(q)} - \frac{o2}{o1} > 0. \tag{3}$$

The second-order measurement randomly dominates the result definition function:

$$B_j(P) = \int_0^P H_j(x) dk. \tag{4}$$

The above formula is called the dual method, which corresponds to the criteria for judging the core set of clustering algorithms based on the increase in online ride-hailing. The index for big data analysis mainly considers 3 indexes, among which the growth rate of online car-hailing is defined as m, then:

$$m = \frac{(\lambda_1 - \lambda_2)}{\lambda_2}. \tag{5}$$

Let x be the increase in online car-hailing; the incremental growth index caused by the operation and management strategy of the online car-hailing platform from the game perspective can be defined as follows:

$$x = \frac{f_1(x) - f_2(x)}{M_1(x)}, \tag{6}$$

where $f_1(x)$ represents the watts index of the increase in online car-hailing x and $f(x)$ is the number of online car-hailing at the starting point. If the index is not significantly greater than 0, it can be considered that big data is beneficial to the number of online car-hailing in an absolute sense the growth [22]. If the difference between the increase in online ride-hailing and the growth rate m is significantly greater than 0, then the increase in relative significance can be judged.

$$x = \frac{t_1(x, y) - t_2(x, y)}{t_1(x, y) - t_2(n(\lambda 1/\lambda 2), y)}. \tag{7}$$

Among them, $t\,(x, y)$ is a measurement function, usually set as FGT, and λ is the performance parameter. If it is less than 0, the performance indicator has an advantage in the full definition. The difference between the absolute definition index and the related definition index, if greater than 0, is advantageous in the corresponding sense of the functionality of the function.

$$L = n \frac{t_1(x, y) - t_2(x, y)}{t_1(x, y) - t_2(n(\lambda 1/\lambda 2), y)}. \tag{8}$$

Compared with the previous formula, two dimensions are added, namely, big data diagnosis and game strategy, which are conducive to consistent calculations. According to the data, w and e are defined as absolute and relative

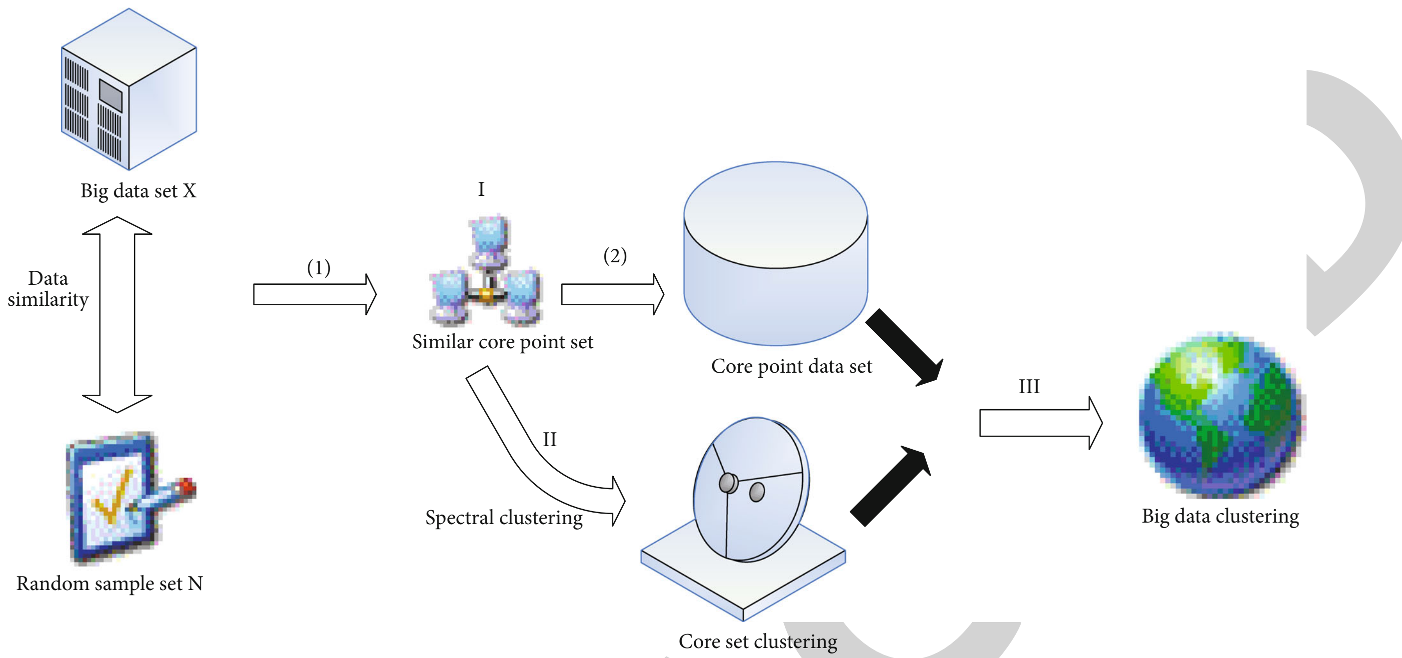

Figure 1: Big data clustering framework based on core points.

variables, and the online car-hailing charges are rationalized. The indicators are

$$\alpha(w, e): t2 \longrightarrow t1\left|\frac{\aleph\beta(w, e)}{\beta}\right| \geq 0. \tag{9}$$

Two dimensions of big data diagnosis and game strategy are added to the function operation. The two-dimensional modernization success rate defined in state j is H, which is the contribution of big data diagnosis to the incremental process of online car-hailing. State j can be defined as follows:

$$j(\lambda, \chi) = \iint_{\wedge(\lambda)} \lambda(a, b, c) l_j K^j(\lambda, \chi). \tag{10}$$

According to equation (10), only when $j \geq \lambda$, it can be concluded that the distribution of b is moved to c to increase and standardize the number of online car-hailing. Choose a, b, and c to make a three-dimensional graph and its confidence interval, and observe the distance between the planes. If all the values of a are significantly lower than the b plane and the judgment index is conducive to the standardization of online ride-hailing, usually the estimated value of a draws the upper and lower two terms of the 99% confidence interval, which helps to draw a clear diagram [23]. Here, three-dimensional randomness is a modern measurement in an absolute sense. There is no relevant index in the relative sense. At the same time, the two indicators of per capita payment and usage times of online car-hailing are used for index measurement and analysis, respectively, in the two planes of big data diagnosis and game strategy graphical.

$$p = \frac{1}{1 + e^{-(\alpha+\lambda)}}. \tag{11}$$

In the formula, p is the effect index, which expresses the utility of per capita payment for online car-hailing on the standardization of online car-hailing, and e is the utility of the number of times of use on the increase of online car-hailing. Based on the above two utilities, it affects the progress of the increase of online car-hailing. The model can be expressed as follows:

$$H = p + \lambda_m e_n. \tag{12}$$

In the formula, the variable λ_m includes the frequency, cost, and region of using online car-hailing, and m and n are parameter vectors. Due to the different values of the dependent variables, the model can be divided into ordered, multiple, multicategory, etc., when explained. When the classification of a variable is a dummy variable, a multivariate model is required. The function form of the model is as follows:

$$p\left(y_j = i\right) = \frac{e^{x\beta}}{\sum_{i=0}^{i} e^{x\beta}}. \tag{13}$$

In the formula, p represents the probability that the influencing factor j of the online car-hailing increment process chooses i-th item in the item $i+1$, and e contains the independent variables of the corresponding scheme, but the parameter vector is different for different influencing factors [24]. Taking the increase in the number of online car-hailing as the benchmark plan, formula (4) can be used to obtain the impact index of big data on the increase in the number of online car-hailing, explaining how big data promotes the increase and standardization of the number of online car-hailing. The process of car increment is multifaceted, so according to formula (4), we can get:

$$\ln\left(\frac{B_j}{B_i}\right)=\frac{x\beta}{p}. \tag{14}$$

Use the ordered model to analyze the influence of each influencing factor in the increase of online car-hailing, divide the explanatory variables into multiple categories, and use the binary choice model analysis to obtain the categorical variable index of the increase of online car-hailing, and how much is the charge set it to 1, set the time of the sports car to 0, and divide the progress of the online car-hailing incremental process into three levels, and formula (15) can be obtained:

$$L=e\int\frac{m_1(x,y)-n0(x,y)}{m_1(x,y)-n0(\beta(\lambda 1/\lambda 2),y)}. \tag{15}$$

From the perspective of big data sampling, this article reduces and compresses complex large data sets to obtain a small-scale sample set and then uses the core set to obtain the result of the sample set and generalize it to the large data set. Obviously, the validity of the clustering results depends on the quality of the sample points selected. Therefore, this article starts from improving the quality of the sample set in order to obtain a reasonable incremental calculation result of online car-hailing data [25–27].

3. Experimental Design of Online Car-Hailing Platform Operation Management Strategy Based on Big Data Diagnosis and Game Perspective

3.1. Research Content. First, clarify the conceptual features of online car-hailing and make a dialectical distinction between online car-hailing and taxis. Clarify theoretical support, be familiar with stakeholder theory, use cases for flexible application, and lay a good theoretical foundation for topic selection. Secondly, it discusses the different interest demands of each subject, uses the stakeholder theory to subdivide the conflicts of the various stakeholders, and analyzes the core points of the interest game. Then, based on the survey data, analyze the top-level design requirements of online car-hailing and the subsequent implementation of different policies in various regions, and make a corresponding summary and comparison. Finally, discuss multiagent dynamic incentives to find a balance of interests, and better promote the new business form of online car-hailing under the sharing economy, which will better bring convenience to people in travel and relieve part of the employment pressure.

3.2. Experimental Method. This article will comprehensively use relevant theories of traffic engineering, behavioral decision-making, mathematical statistics, management, economics, social psychology, and other disciplines. As a whole, it will use research methods that combine qualitative judgment and quantitative analysis and will specifically integrate logical deductions and field investigations. Using empirical research, mathematical analysis combined with computer simulation and other means to carry out research on this. First of all, the basis of the research in this article is the analysis of the system structure of the online car-hailing service. In this process, research methods such as system theory, logical analysis, and qualitative judgment are mainly adopted. Second, in a study of travelers' willingness to use and preferred behaviors for online car-hailing services, questions were used extensively to obtain research data, and further dynamic analyses were performed with structural measurement models and alternative selection models. Next, in the study of decision-making problems for online car-hailing platforms that discuss offline and offline situations, research methods such as statistical analysis of the concept of bilingualism are widely accepted. Finally, in discussing the policy regulation of the online car-hailing service market, the evolutionary game theory is used to construct a tripartite evolutionary game model for the policy regulation of the online car-hailing service market, and numerical simulation and other methods are used for research.

3.3. Statistical Methods. All data analyzes in this article accept SPSS22.0, a statistical test using two-dimensional tests; the value is defined as 0.05, and $p < 0.05$ is considered the significant difference. Statistical results are shown as standard deviations ± ($x \pm$ SD). When test data comply with standard distribution, double t-test is used for comparison within group, and independent sample t-test is used for comparison between groups. If standard distribution is insufficient, two independent samples and two related samples will be used.

4. Experimental Analysis of the Operation and Management Strategy of the Online Car-Hailing Platform Based on Big Data Diagnosis and Game Perspective

4.1. Operational Game Strategy and Impact of the Urban Car-Hailing Market. With the implementation of the new car-hailing policy, a large number of online car-hailing platforms and online car-hailing platforms that do not meet the requirements have been filtered out, and the compliant online car-hailing companies have obtained the qualifications for online car-hailing operations. Didi, Yidao, car-hailing companies such as Shenzhou and Shouqi have successively obtained licenses for car-hailing operations in Beijing. Taxi service quality regulations are mainly limited from two aspects: access conditions and operational service quality standards. The specific contents of the operational service quality standards include restrictions on taxi models and exhaust capacity, mandatory deadlines for taxis to be scrapped, and driver's driving experience and driving skills

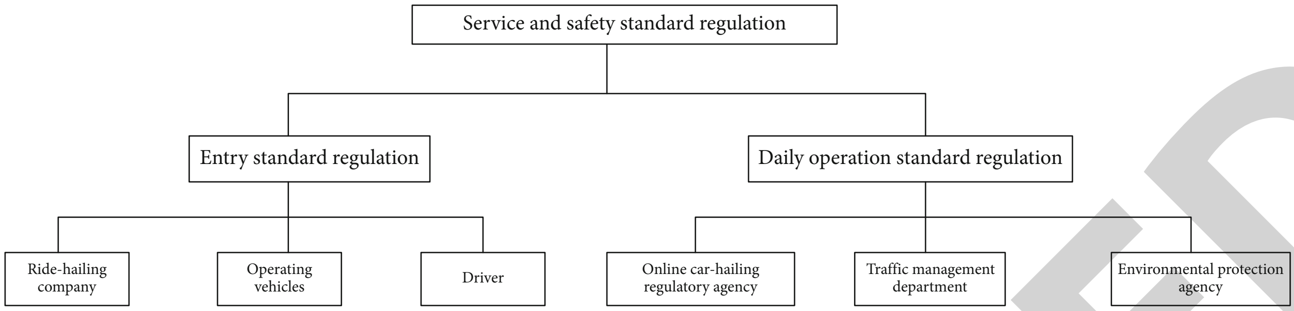

Figure 2: Implementation structure of taxi service and safety standard regulation.

in each city. Its purpose is to improve the passenger's riding environment and the driver's operating environment by improving the requirements for the applicability of taxi vehicles and the quality of the drivers and to ensure the safety of the operation process, and the taxi service and safety standards are regulated. The implementation structure is shown in Figure 2.

Regarding the enterprise-driver game model under the game strategy, we can have the following model assumptions: the travel demand of passengers is affected by the preferential strategy of online car-hailing; both online car-hailing drivers and taxi drivers are rational participants in the car-hailing travel market. To provide ride-hailing services to passengers who need to take a taxi, they obtain the ride-hailing fee from the passengers as the starting point for providing the service; the service fee charged by the platform is proportional to b; the revenue function of online car-hailing companies and online car-hailing drivers is as follows:

$$w = a(M - B). \tag{16}$$

Among them, w is income, a is the market demand coefficient, operating income is M, and the cost of operation is B, that is, income = market demand coefficient $*$ (income-cost), and the expression of the online car-hailing demand coefficient a is

$$a = 1 + xi. \tag{17}$$

Among them, i save travel costs for passengers, and x is a constant. The simulation and table of online car-hailing user regulations are shown in Table 1.

In Table 1, n represents the length of time, the beginning of 2017 is used to represent the zero point of n, and y represents the number of users (100 million). Through the fitting analysis of the online car-hailing user data reported in the annual reports of online car-hailing companies in different periods, we can know that the demand for online car-hailing has increased linearly from the beginning of 2017 to the end of 2019. The value of R is 0.9451, and the fitting effect is better. It is good. Therefore, the growth coefficient of online car-hailing demand takes a linear function. For the game under the discount strategy of online car-hailing, we can assume that the discount of the platform is x, and $Q1$ is the initial demand. F is the average cost of a single order that online car-hailing passengers should pay when the preferential strategy is not implemented, N is the average number of orders per day for an online car-hailing driver, A is the cost when the online car-hailing platform does not implement the preferential strategy, and B is the average cost of online ride-hailing drivers. The revenue that the online car-hailing driver obtains through other means is G yuan; when the online car-hailing company does not implement preferential policies and the online car-hailing driver does not withdraw from the cooperation, the online car-hailing company makes a profit of$bFQ1 - A$yuan, and the driver receives the profit of$(1 - b)\ FN - B$yuan; when the online car-hailing driver does not withdraw from the cooperation and the online car-hailing company does not implement the preferential strategy, we set the enterprise profit $E1$ and the driver profit as $E2$, then:

$$\begin{aligned} E1 &= (1 - a)F, \\ E2 &= (1 - b)FN. \end{aligned} \tag{18}$$

Among them, E is the income of the online car-hailing company implementing the preferential strategy, the profit of the online car-hailing company is $E1$, and the profit of the online car-hailing driver is $E2$, then:

$$\begin{aligned} E3 &= baFQ1(1 + \beta(1 - a)F, \\ E4 &= (1\text{-}b)aFN(1 + \beta(1 - a)F. \end{aligned} \tag{19}$$

Here, the profit of the driver when he withdraws from the cooperation is calculated by per capita GDP. G represents the per capita income that taxis can get when they withdraw from the cooperation. G is the per capita GDP value of the area in that year divided by 365 days; then, the game matrix between online car-hailing drivers and enterprises under the discount strategy can be expressed as shown in Table 2.

According to the analysis of Table 2, we can see that when the online car-hailing driver chooses to withdraw from the cooperation, the profit of the online car-hailing company who does not implement the preferential strategy is equal to the income of the preferential strategy. When the online car-hailing driver chooses not to withdraw from the cooperation and when$F = 1/\beta a$, the benefits of car-hailing companies

Table 1: Fitting table of the scale of online car-hailing users.

Time	2017	2018	2019	2020	Fitting formula
n	2.1	2.6	3.8	4.1	$y = 1.662x + 2.14$
User scale y (100 million)	5.23	8.42	9.64	10.11	

Table 2: Game matrix between online car-hailing drivers and companies under the discount strategy.

		Ride-hailing companies	
		No discount	Discounts
Enterprise	Withdraw from cooperation	$(1-a)F$	$baFQ1(1+\beta(1-a)F$
Driver	Have been working together	$(1\text{-}b)FN$	$(1\text{-}b)aFN(1+\beta(1-a)F$

choosing to implement and not implementing preferential policies are equal. When an online car-hailing company chooses to implement a preferential strategy, an online hailing car company chooses to use a promotional strategy, where $F = 1/2\beta(1-a)$, the benefits of choosing an online car driver partnership and choosing not to give up equal partnerships. When a car-hailing company online chooses not to use the preferred treatment, thus, when $F = F = (G + a)/(1-b)N$, the benefits for online car-hailing drivers who choose to withdraw from the partnership and choose not to cooperate are equal. The implementation of preferential policies will lead to different interests of all parties. The specific analysis diagram of the interests of all parties is shown in Figure 3.

It can be seen from Figure 3 that under the 20% discount strategy, the daily income of online car-hailing drivers increased from 170 yuan to 220 yuan, an increase of 24.7%. Under the preferential strategy of recharging 200 yuan and cashing back 10 yuan, the net daily income of car-hailing drivers increased from 170 yuan to 173 yuan, an increase of 2.8%. With the reduction of the platform percentage to 0.085, the daily income of online car-hailing drivers increased from 170 yuan to 236 yuan, an increase of 38.6%. When the taxi cost was reduced to 3,500 yuan, the daily income of a single taxi driver increased from 134 yuan to 212 yuan, an increase of 57.8%. Among them, a reduction in the percentage of revenue-generating platform for motorists working online is greater than that of drivers' salary discounts, and the option to renew and withdraw money has a small impact on online car earnings-driving drivers. The basic cost-cutting strategy can directly increase the income of taxi drivers, and the level of impact is quite obvious. Under the discount strategy, the daily income of online car-hailing companies was reduced from 512.3 million yuan to 312.4 million yuan, a reduction of 40.9%. Under the recharge and cashback strategy, the daily income of online car-hailing companies was reduced from 453.2 million yuan to 31,500. With a reduction of 13.2%, the daily income of online car-hailing companies will be reduced from 4.2 million yuan to 2.3 million yuan, a decrease of 46%, while reducing the percentage of the platform. The daily income of taxi companies decreased from 5.1 million yuan to 3.5 million yuan, a decrease of 31.3%. Among them, reducing the percentage of platform fees has the greatest impact on the revenue of online car-hailing companies, and the recharge rebate strategy has the least impact on the revenue of online car-hailing companies. The strategy of reducing elementary money concessions can greatly increase the income of taxi drivers, but it also reduces nearly one-third of the income of taxi companies. From the general trend, the implementation of preferential strategies will increase the driver's income level, but this is based on the premise of sacrificing the interests of enterprises. The reasons why companies implement preferential policies may be as follows: (1) reduce the travel cost of a single passenger, stimulate passenger demand, and gain a larger market; (2) increase driver income and improve driver's motivation and cooperation stability. The impact of different preferential strategies on drivers and enterprises will vary greatly.

4.2. Game Strategy Model of Online Car-Hailing and Taxis in the Urban Taxi Market. Online car-hailing has built a livelihood platform for millions of car owners and brought fast and convenient services to millions of passengers. After several years of exploration, the management model and profit method of online car-hailing have become increasingly mature. Both online car-hailing and taxis are aimed at providing passengers with travel services and charging service fees, and service fees are the main source of income. Online driving and taxis compete in the tourism market, and their unique features make the market more complete. Online car mitigation has a shared environment. Interacting with online car forums can reduce the level of empty driving traffic. However, due to the unrestricted cooperation and exit of its drivers, the supply of online car-hailing has changed dramatically; the supply of cars is affected in the market. On the other hand, the market supervision of online car-hailing is also stricter. At the same time, the operating hours of taxis will not change too much, and they can meet the places that online car-hailing cannot serve in terms of time and space.

It can be seen from Figure 4 that in 2014, the number of passengers transported by taxis reached the highest value over the years, with 45 billion passengers. Since 2015, the number of passengers transported by taxis has declined. In 2016, my country's taxis transported 37.2 billion passengers, down 4.2% year-on-year. After 2014, the number of online

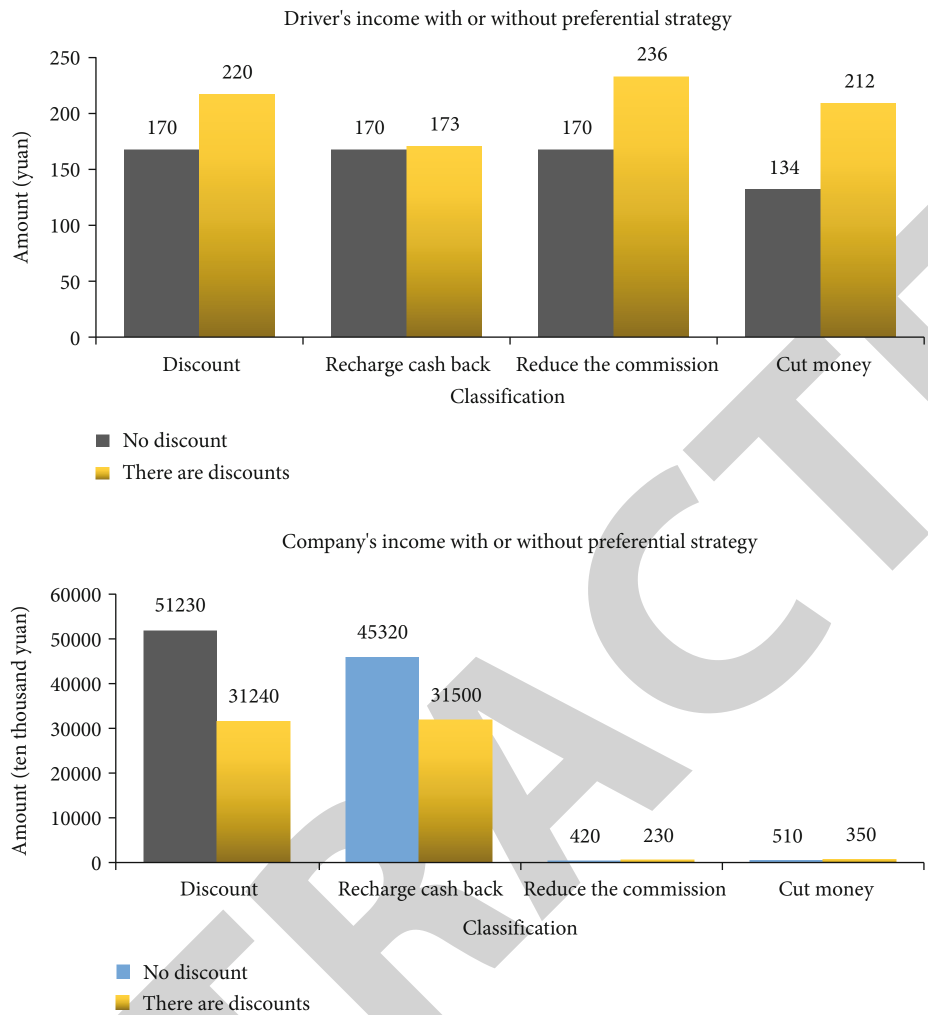

Figure 3: The interests of all parties involved in the implementation of preferential policies.

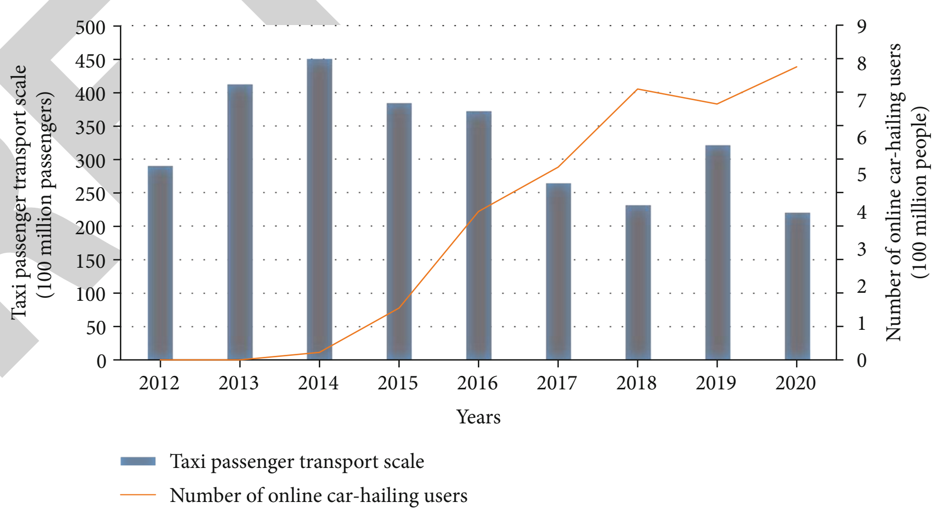

Figure 4: The development trend of taxis and online car-hailing from 2012 to 2020.

car-hailing users has maintained a year-on-year growth. In 2015 and 2016, the number of online car-hailing users has increased year by year. Affected by the new car-hailing policy, the growth of users in 2018 has declined. It can be seen that the development trend of the user scale of online car-hailing and the change trend of the overall model of taxi

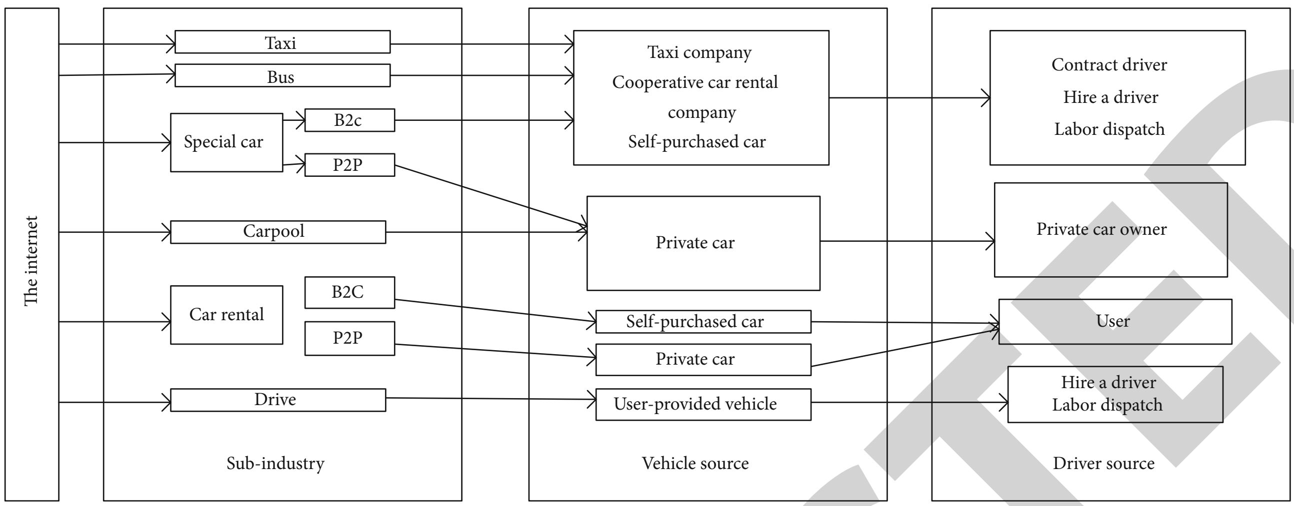

FIGURE 5: Classification and composition of traffic "O2O."

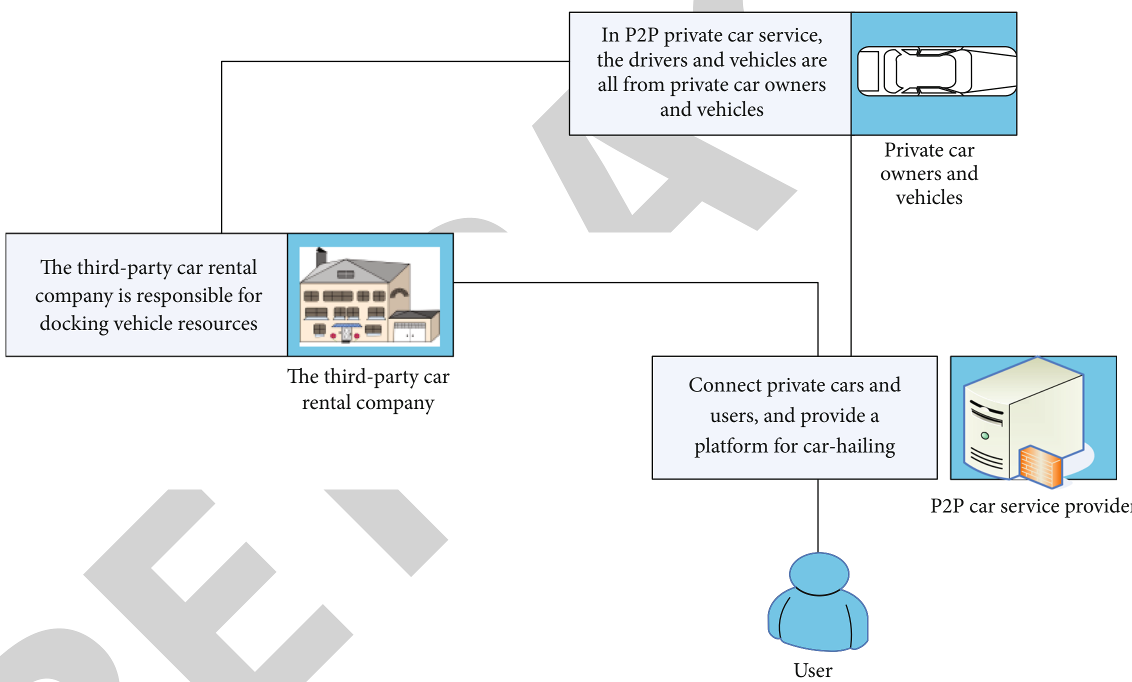

FIGURE 6: "P2P" private car business model.

passenger transportation have time nodes. The two are direct competitors in the travel market. When one of the car dealerships online and the taxi companies use alternative strategies, it will increase the number of passengers or drivers. In this process, the game of interests is involved, and both sides compete with interests. Car-hailing companies and taxi companies use preferential strategies to gain a larger market share, all for the purpose of obtaining their own best interests.

It can be seen from Figure 5 that the "O2O" mode of urban travel refers to urban transportation travel services after internetization. User needs and payments are made online, and travel services are delivered offline. According to car source and driver source, the O2O urban traffic industry can be divided between Internet travel, Internet bus, Internet private car, Internet car rental, Internet travel, Internet calling on behalf of others, etc. The two industries under private car and car rental continue to be separated by B2C and P2P methods. Among them, active B2C/car rental car rental vehicles are mainly sourced from the company they purchase or partner with, and P2P private car/rental car functional cars come from private car owners. In the traditional taxi industry, operating vehicles are usually purchased independently by operating companies, and the number of vehicles is determined by the number of operating licenses owned by the company. In the Internet travel service industry, in addition to a small number of companies adopting the self-purchasing model, more companies adopt

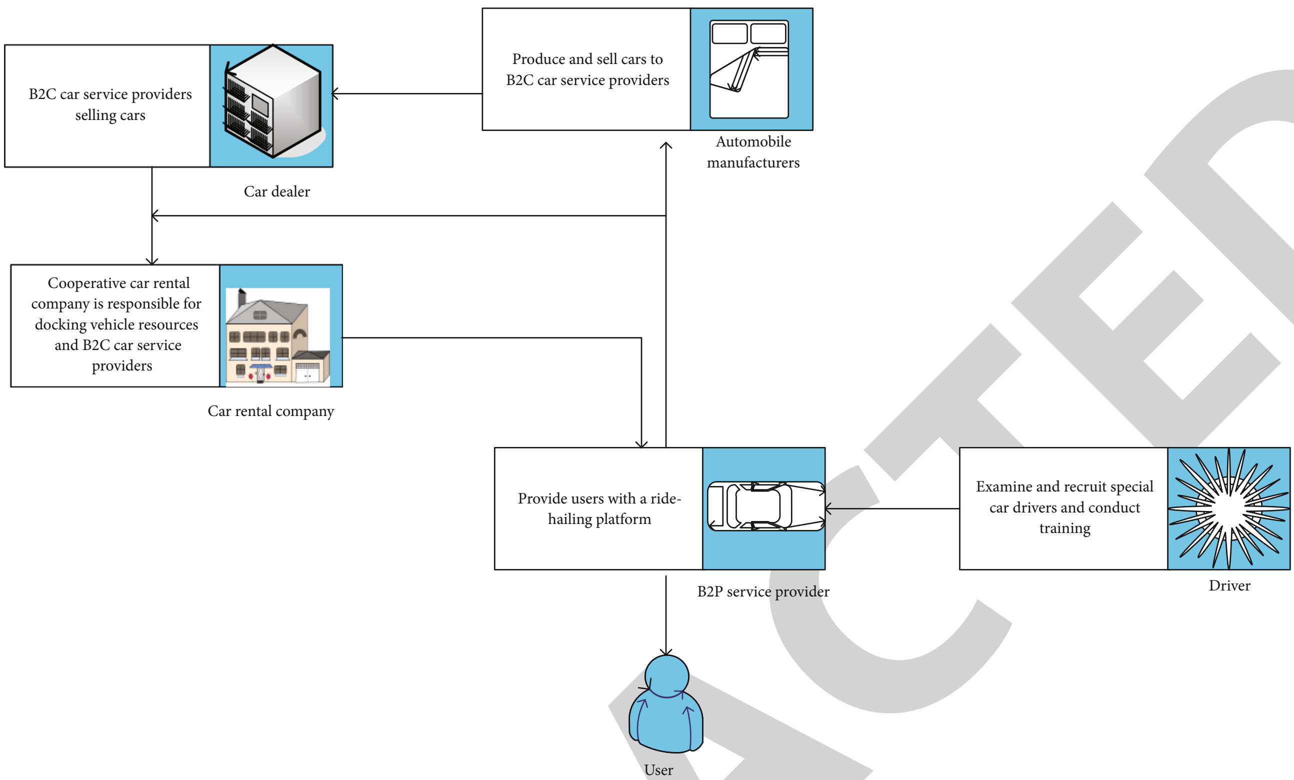

Figure 7: "B2C" private car business model.

Table 3: Specific classification table of online car-hailing.

Name	Standard	Price (yuan/km)
Starting price	Period	12
	Normal time	1.9
	24 : 00-6 : 00	3.3
Mileage fee	6 : 00-9 : 00	2.3
	17 : 00-23 : 00	2.3
	23 : 00-24 : 00	3.2
	Period	Price (yuan/min)
Low speed fee	Normal time	0.4
	0.7 : 00-9 : 00	0.7
	17 : 00-20 : 00	0.7
Far-distance fee	Exceeding 12 kilometers, additional	1 yuan/km
Waiting fee	Every minute after passengers arrive late	1 yuan/min

the "asset-light" business model; that is, companies are mainly responsible for establishing service platforms and do not purchase vehicles that provide services. It is to attract social vehicles to provide travel services through the platform. Therefore, the current vehicle organization methods of private car companies mainly include "P2P" and "B2C" shown in Figure 6.

The "P2P" model (i.e., peer-to-peer) is also known as the "point-to-point" model, which refers to the free franchise of private cars through the private car platform, and private cars provide users with private car services. The revenue generated by the service is divided between the private car service platform and the owner of the private car, as shown in the figure below. The representative companies currently adopting the "P2P" car model include Didi and Uber. The flowchart of "B2C" mode is shown in Figure 7.

The "B2C" model (i.e., BusinessToCustomer) is also known as the "business-to-customer" model, which refers to the private car service providers purchasing cars themselves or cooperating with car rental companies and hiring private car drivers to provide users with private car services, as shown in the figure below. The representative companies currently adopting the "B2C" car model include Shenzhou Car Rental and AA Car Rental. The "P2P" model is favored

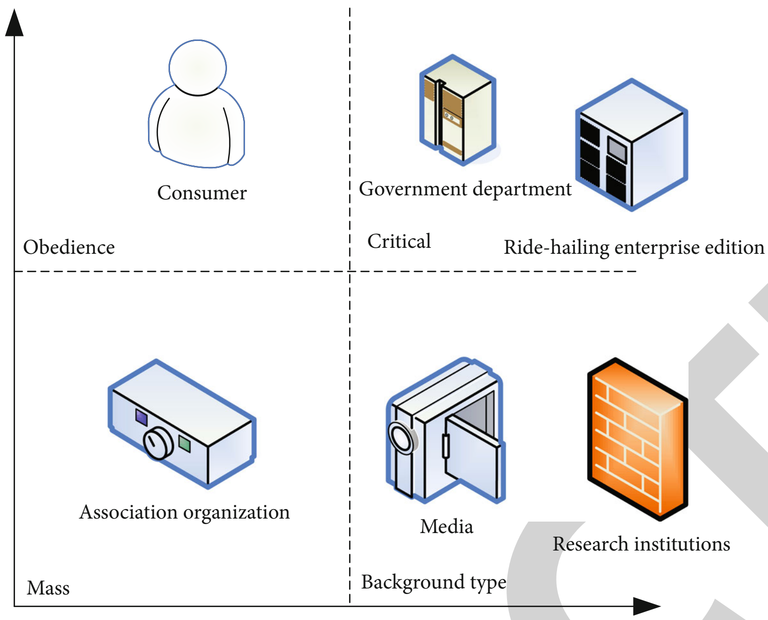

Figure 8: The stakeholder “benefit-influence” matrix of online car-hailing.

Table 4: Problems in the supervision of online car-hailing operations.

Operational problems	Question details
Government regulations tend to be conservative	Excessive regulations, black cars resurgence Increased costs and difficulties in operation Reduced vehicles, inconvenient to hire a car Under government antitrust investigation
Insufficient development potential of online car-hailing companies	Raise taxi fares frequently Waiting too long
Obvious differentiation among online ride-hailing drivers	Mostly part-time drivers before Part-time drivers exit the market
Insufficient supervision organization building	Frequent vicious incidents of strict online car-hailing Criminals register fake accounts

by platforms and the public due to the wide range of vehicle sources, flexible supply, low operating costs, rapid expansion of the dedicated car platform, and cheap fares, but its disadvantage is that the sources of vehicles are diverse, making it difficult to unify the quality of service, and the current law prohibits private vehicles from providing for-profit transportation services, so enterprises are subject to greater policy risks. In the “B2C” model, the source of vehicles is limited, and due to the cost of vehicle purchase, leasing, maintenance, and personnel costs, high operating costs make it difficult for the platform to expand rapidly, but it can guarantee a good and unified service quality, so it mainly meets high-end demand for travel.

4.3. Urban Online Car-Hailing Operation Supervision and Improvement Countermeasures from the Perspective of Stakeholders. As a new achievement and new business form of the sharing economy, online car-hailing has a unique operating mode and management method that traditional taxis do not have. The specific features are as follows: (1) Online car-hailing models are relatively rich and provide a wealth of service types. Taxis in different cities are regulated in the same way to use one or more designated vehicles, major brands Santana, Jetta, BYD, etc. Car models that participate in the performance of online car-hailing are rich and have different grades. The online models of car honors are divided into four categories: economic, luxury, luxury, and business. (2) Online car-hailing charges vary, and the charging method is different from that of taxis. The starting price of a taxi in a certain place is 10 yuan for 3 kilometers (no more gas surcharge), and the fare per kilometer is 2.0 yuan. Compared with taxi prices, online car-hailing service prices are more flexible, as shown in Table 3.

By constructing the “benefit-influence” matrix of the stakeholders in the urban car-hailing safety, we can determine the role status of different stakeholder groups in the urban car-hailing activities, analyze the conflicts between the main stakeholders, and determine how various stakeholders should participate in the management decision-making of urban car-hailing activities. The “benefit-

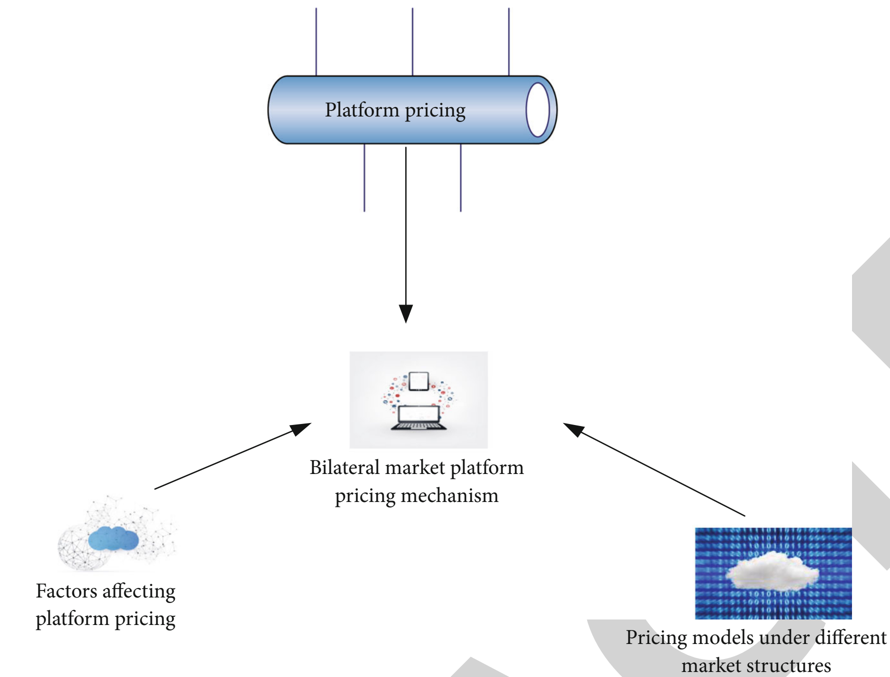

Figure 9: Pricing mechanism diagram of online car-hailing platform.

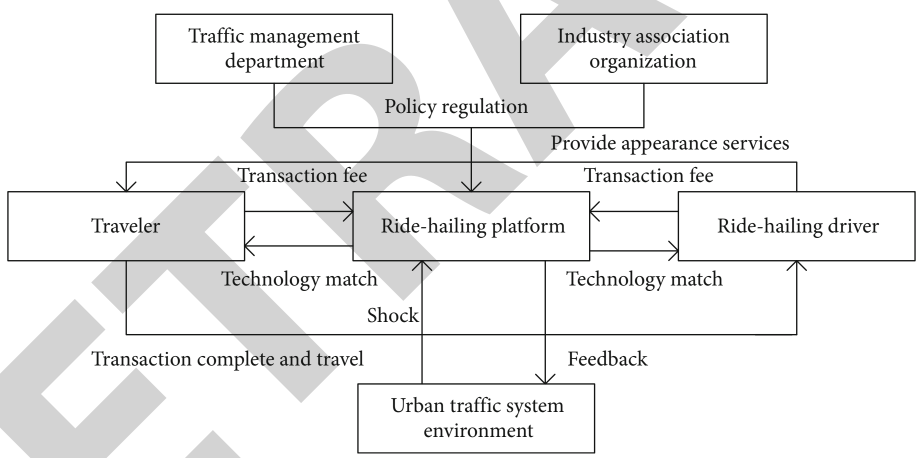

Figure 10: System structure of online car-hailing service.

influence" matrix of stakeholders in urban car-hailing safety is shown in Figure 8.

It can be seen from Figure 8 that government departments, online car-hailing companies, and taxi companies have a high level of influence at the level of interest needs and influence, and they are key participants in online car-hailing operations. They dominate the direction of urban car-hailing operations. Based on the attitude and recognition of urban car-hailing management decisions, they will affect the development direction and final implementation of the policy. Scientific research institutes and the media are back-to-back participants. Consumers are obedient participants. They have an immediate need for interest in online operations. However, because of their power of weakness and inadequate influence, they can only use the media and scientific research institutions to articulate their needs. Non-governmental organizations are mass participants in urban online car-hailing activities. Due to their own development, they have low interest in urban online car-hailing operations and have very limited influence. Regarding the problems in the supervision of online car-hailing operations, the main findings are as follows.

It can be seen from Table 4 that the current government has tended to be conservative in the regulation of online car-hailing, which is mainly reflected in the following points: (1) extra regulations and black car upgrades, (2) additional costs and operational difficulties, (3) vehicle reductions and car rental disruptions, and (4) independent government investigations. Online ride-hailing companies have insufficient development stamina. They often increase ride-hailing fees, and the waiting time for ride-hailing is too long. Before the policy is introduced, ride-hailing drivers are mainly part-

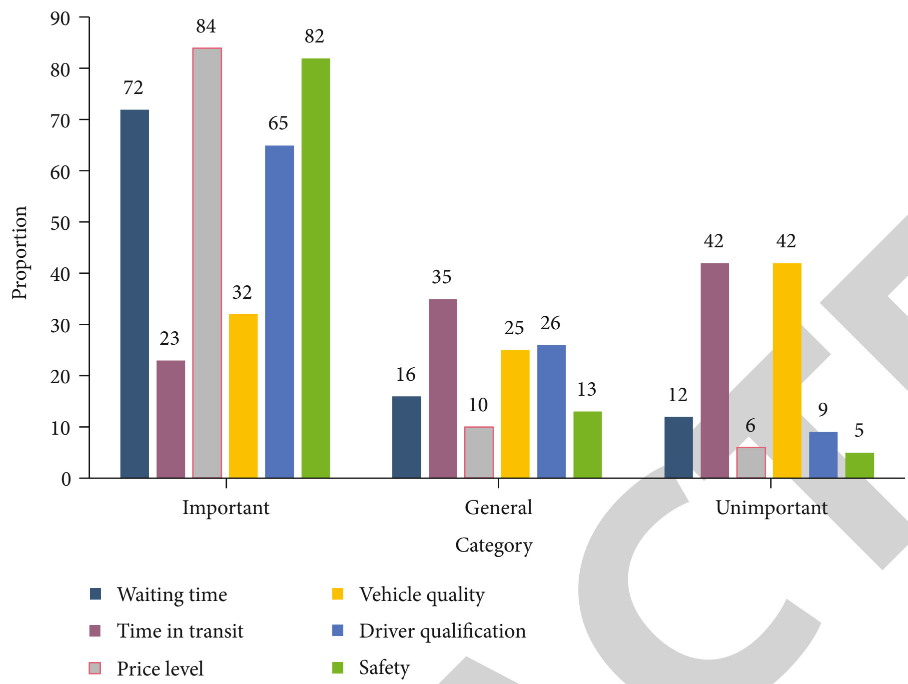

Figure 11: The main factors that travelers pay attention to when using online car-hailing services.

time drivers. After the introduction of relevant policies, part-time drivers gradually began to withdraw from the market. Moreover, the construction of the supervision organization of online car-hailing companies is not strong enough, and vicious online car-hailing incidents often occur. Criminals can register false accounts, which can easily lead to dangerous incidents.

4.4. Willingness of Travelers to Choose and Platform Strategies under Online Car-Hailing Services. Armstrong can divide the platform into monopolistic and competitive platforms according to the market structure, builds pricing models for monopolistic and competitive platforms, and analyzes the pricing mechanisms and strategies of the platforms. This article follows Armstrong's research framework, combined with specific industry characteristics, and analyzes platform pricing issues with bilateral market characteristics. Based on Armstrong's framework for planning and market research in both countries, we are developing models of online monopolistic platforms and automotive competitions, introducing a Hotelling model to competitive pricing platforms, and considering in detail the factors contributing to the price of the platform-car-hailing pricing platform the prices of online car-hailing platforms under different market segments, how each impact factor affects the price and profit of the platform, and what platform strategy should be used under the various market segments. The pricing mechanism of the online car-hailing platform is shown in Figure 9.

The online car-hailing platform establishes a connection between travelers and online car-hailing drivers through the APP software, and the platform itself can also realize revenue by charging travelers and drivers with registration fees and transaction fees. With a discussion of a low-passenger system and a low-level driver program, a relationship between an online hailing car, traveler, and an online car driver who can photograph cars can be found. In addition, in the analysis of online vehicle service policy and subregulation, it is recognized that the performance of online hailing car services also requires effective monitoring by the administrative department, and at the same time, it is necessary to consider the impact of the online hairdressing industry. The impact and other factors, based on the above analysis, the structure of the online car-hailing service system can be obtained as shown in Figure 10.

A questionnaire survey is conducted on daily ride-hailing users, and the importance of the main factors that travelers pay attention to in the process of using online ride-hailing services is shown in Figure 11.

It can be seen from Figure 11 that the three points that are most concerned by travelers are price, safety, and waiting time. 72% of the respondents believe that waiting time is extremely important, and 84% and 82% of respondents believe that price level and safety are the most important. Sex is extremely important. Speaking of which, travel time and vehicle quality are considered insignificant, with 42% of respondents believing that two outcomes in their travels are only moderate. Through this study, we can find that the majority of travelers pay close attention to travel safety and personal safety, and the need for the type of vehicle and quality is not very high.

5. Conclusion

Through this research, we can find that online car-hailing platforms should pay more attention to the safety of travel and the timeliness of vehicle arrival in terms of their own reforms. Starting from the platform's strategy of making money, reducing the platform's percentage of fees has the greatest impact on the revenue of online car-hailing companies, and the recharge rebate strategy has the least impact on the revenue of online car-hailing companies. Reducing the preferential policy of elementary money can greatly increase the income of taxi drivers, but it also reduces the income of online car-hailing companies. Moreover, the current development of online car-hailing has also fallen into a bottleneck stage, which is mainly reflected in the current government's conservative regulation of online car-hailing, and the lack of stamina for the development of online car-hailing companies. Ride-hailing fees are often raised, and part-time online car-hailing drivers are gradually being used. The market is cleared, and the supervision organization of online car-hailing companies is not strong enough. Frequent vicious incidents have led to a decline in reputation.

Data Availability

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Conflicts of Interest

The authors state that this article has no conflict of interest.

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