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The Risk Reduction and Sustainable Development of Shared Transportation: The Chinese Online Car-hailing Policy Evaluation in the Digitalization Era

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Abstract: Online car-hailing services (such as DiDi and Uber) are one of the typical sharing economy forms of transportation service in the digital era. Related public policies are expected to reduce the risk of online car-hailing and ensure the social sustainable development. However, the empirical evidence regarding the effect of relevant policy implementations is still scarce. This study takes an online car-hailing service in China as a research object to understand and evaluate the effect of implementing related policies. The risk related to an online car-hailing service is classified into three dimensions in this study, namely, institutional, economic and safety perspectives. The empirical results indicate that public policies have significant impacts on reducing conflicts and risk of shared transportation in China, especially the institutional risk. Furthermore, the effects of different policy factors differ for different risk types. Several insights of developing policies and regulations related to sustainable shared transportation in the digitalization era are also provided. The interaction between government authorities, private firms and citizens should be attached to great importance in policy design, which will consequently enhance the sustainable development in the transportation sector under sharing economy.

Keywords: shared transportation; digitalization era; online car-hailing; policy and regulation; sustainable development; risk reduction

1. Introduction

In the digitalization era, the use of Information and Communications Technology (ICT) has created a new pattern of transportation, which influences individual decision-making processes and sustainable development of society [1]. Currently, the sharing economy has been widely adopted via ICT applications, as it is regarded as an important alternative solution of social, economic, and environmental issue by optimizing under-utilized resources in society [2–5].

One of the typical applications of the sharing economy in urban public and sustainable transportation is online car-hailing services, such as Uber and DiDi, including taxi-like and car-pooling services [6]. Online car-hailing services provide peer-to-peer sharing activity through mobile devices. By providing transportation service with high level flexibility and efficiency, these shared mobility solutions have been blurring the boundaries of traditional public transportation systems [7]. Thus, online car-hailing services are becoming a key component of the urban public transportation system [8]. This new ICT app-based shared transportation mode is increasingly making a great sustainable impact on societies, including both under-utilized resources optimizing and users' demand satisfying. To achieve a sustainable transport mode, relevant risk control is important to ensure the transport

security [9]. More specifically, risks related to a new transportation mode may reduce users' satisfaction on the services, and thereby erode the relevant demands. As a result, effectiveness and efficiency will be decreased, further inhibiting the sustainable development of the new transportation mode and the social sustainability. However, online car-hailing services under the sharing economy are questioned, as they may contain certain risks [10]. The risks of this new transportation mode mainly stem from liability of newness incompatibility between flexibility and safety, and the influence on incumbent industries [8,11].

First, as a new socioeconomic system, interest conflicts are inevitable within incumbent stakeholders from the traditional economic system, which leads to high economic risk [12,13]. Second, the degree of social awareness and acceptance towards novelties are relatively low. With the conflicts within incumbent stakeholders, the sharing economy lacks legitimacy initially, which results in high institutional risk [14]. Third, the sharing economy has strong characteristics of a "stranger economy", resulting in high uncertainty and safety risk due to lack of trust [15,16]. These risks inhibit value delivered to users through the sharing economy and exert a negative effect on sustainable development [17]. To tackle this problem, researchers suggest that public policies should help the new transport mode under the sharing economy to overcome conflicts and risks and thereby underpin the creation of sustainability [11,18,19]

Online car-hailing services have expanded in China rapidly. At the end of 2017, the users of online car-hailing in China reached 435 million with the market size of ¥212 billion [20]. However, online car-hailing services are also exposed to relatively high risk in China [21]. As a result, from 2016 to 2018, there were 1191 sentenced cases of online car-hailing service officially released by the Supreme People's Court on China Judgements Online. To cope with this public risk, a series of policies were launched by Chinese governments at different levels. However, very few studies evaluate the effects of implementing these policies and relevant empirical evidence is still scant. In addition, the policies and regulations are made and implemented differently across Chinese government levels. Little is known regarding how policy factors designed by local governments affect this public risk.

To fill the gap in the existing literature, this paper categorizes risks in association with online car-hailing and summarizes relevant policies and regulations from Chinese governments at different levels from October 2016 to the end of 2017. This study provides answers to the following research questions:

1. Do relevant public policies help online car-hailing services overcome the risks for sharing economy?
2. Which policy factor is effective in overcoming these risks and supporting sustainable development of shared transportation in the digitalization era?

Negative binomial regression is adopted for evaluating the effect of online car-hailing policies. With the empirical results, this study further discusses how these risks are affected by the policy factor. This research contributes to the current literature related to public transportation under the sharing economy in three ways:

- Review and categorize risks in connection with online car-hailing services in China from three dimensions: institution, economy, and safety;
- Evaluate whether Chinese government policies effectively control these risks to underpin the new pattern shared transportation to achieve sustainable development through empirical evidence.
- Implemental insights are provided for the further development of regulations and policies on shared transportation based on ICT in China.

The rest of the paper is structured as follows. Section 2 lays out a literature review. A summary of Chinese online car-hailing policies is developed in Section 3. In Section 4, research design is described including data, samples and employed econometric methods. The empirical results are presented in Section 5. Finally, the results are discussed and conclusions are drawn on policy making and implications in Section 6.

2. Literature Review

2.1. The Classifications of Risks of Online Car-Hailing in the Sharing Economy

The sharing economy is exposed to several risks as a new socioeconomic system [22]. There are three types of risks that are predominately discussed in the current literature in association with the shared transport in the digitalization era.

2.1.1. Institutional Risk

The institutional risk of shared transport stems from the conflicts with traditional taxi industries, especially when local governments cannot regulate the service providers due to unfamiliarity with sharing economy [17]. For example, no relevant laws require Uber, a car-sharing company, to pay the same tax as a conventional taxi firm [23] and demand Uber drivers to be qualified as taxi drivers, such as passing the permit test or having commercial insurance when Uber emerged [13,24]. Thus, companies offering online car-hailing services could avoid traditional business obligations such as commercial taxes and social insurance, etc., which enhances the cost of traditional taxi firms to a certain extent [13,25]. This results in an unfair competition between the sharing economy and a traditional socioeconomic system [23].

When stakeholders of traditional industries and government departments realize the "loss of benefits" and "unfair treatments", conflicts with the sharing economy will arise. The legitimacy of sharing economy will be questioned according to existing laws and this leads to the institutional risk of shared transportation [18,26]. For example, taxi drivers strike in protest against online car-hailing firms, i.e., Uber [27], and several local governments prohibit the operation of Uber directly [13].

2.1.2. Economic Risk

The risk of the sharing economy is also related to society and economics [12]. More specifically, in this study, apart from institutional risk, shared transport is facing economic risk due to a larger number of stakeholders and more complicated transaction modes in comparison with the conventional socioeconomic system [27].

The economic risk of shared transport mainly occurs in two scenarios. First, it exists within the relationship between firms offering sharing economy services and their employees [23]. It is argued that there is no close connection between these firms or platforms with their employees [28]. Most of these companies are intermediary platforms only [29]. Their employees who deliver the service (i.e., Uber drivers) are usually temporary workers, third-party workers with zero-hour contractors. Thus, the end-service providers of sharing economy do not gain benefits (i.e., unemployment insurance, formal labor contract, and stable income) from the platforms as they did in traditional industries [23]. This increases more economic risks in shared transport, such as labor disputes, to a certain degree. Second, economic risk exists within the relationship between the online car-hailing firms and their consumers who use the shared transport services [30–32]. This stems from the uncertainty of peer-to-peer (P2P) value exchange under the sharing economy [33]. This exchange relies more on the norm of reciprocity rather than official and clear contractual agreement [34]. Compared with the traditional taxi industry, this value exchange mode is more flexible but the supervision is more difficult, which may lead to opportunistic behavior, thereby increasing economic risk. For example, in China, ride-sharing drivers may refuse to take passengers because of tips, or they may increase taxi fare after consumers get in the cars. Economic risk is easier to be perceived by consumers in comparison to institutional risk [12,35]. Thus, in order to increase consumer acceptance of shared transport, managing economic risk is rather crucial [36].

2.1.3. Safety Risk

Safety is another important risk concern which is widely discussed in the sharing economy [17,19]. The safety risk is rooted in the "stranger economy" [11,16,37,38]. It mainly derives from a lack of trust between the two sides of the value exchange caused by information asymmetry [22,29].

Particularly, shared transportation also relies on transactions between strangers more than traditional industry does [30]. In the sharing economy, online car-hailing firms or platforms lower employment requirements through ICT technologies, and increase effective supply by attracting a number of people offering services [4,24]. However, since participants in the sharing economy come from different class of society, identity information is unclear, transaction motivations are complicated, and transaction behaviors are unpredictable [29,39]. The ability of checking and ensuring information accuracy between providers and consumers is absent in the sharing economy [40,41]. This could cause the risk of leaking personal information and even lead to crime during the transaction process [39,42]. In China, there were two shocking crimes regarding ride-sharing services in 2018. It has caused social concerns about the safety of using online car-hailing services [21].

Although the Chinese online car-hailing platforms set strict screening and censoring criteria, fake information still exists because of negligence and substandard operation. In addition, part-time drivers are unwilling to provide their personal information. These exacerbate the information asymmetry issue in the sharing economy and therefore lead to relatively high safety risk.

2.2. The Risk Governances for Shared Transportation

Self-regulation by relevant firms and platforms is one of the most important ways to cope with risks of shared transportation [43,44]. In self-regulated platforms, on the one hand, they need to encourage communications among strangers, especially between service providers and end users, for the purpose of enhancing trust. On the other hand, they should make rules to cater to regulation and risk distribution [45]. Normally, online car-hailing platforms build trust via ratings [18,46]. However, there are defects in the corporate self-regulation as it may fail to reduce the risks in the sharing economy [23,47]. Stemeler [47] finds that systematic errors exist in the rating on platforms—for example, only 1% of Uber drivers are rated lower than the mean value because ratings can be manipulated by fake comments. Customers are concerned about retaliation after posting negative feedback [29]. In addition to the rating system, DiDi, for example, also developed a stringent driver verification system and a monitoring system on driver behaviors [21]. However, fake information still exists.

Thus, risk governance in sharing economy requires the intervention from governments to make up the defects of self-regulation by making public regulations and policies [23]. Consequently, governments need to explore, study and re-make policies and regulations that are suitable for the shared transport instead of using current regulations for traditional taxi industries [17,19] Based on existing research, the policy designed for coping with the risks of shared transport should focus on the following aspects: first, the rating system of platforms should be censored to ensure the fairness, transparency and accuracy as well as reduce systematic errors, enhance creditability and promote the degree of trust [47]; second, regulators need to balance between protecting relevant traditional industries and supporting sharing economy to obtain institutional legitimacy [23]; third, clear clauses and safety standards should be set targeting firms of sharing economy in order to protect customers [19,48,49].

Public regulations and policies in association with sharing economy and shared transportation system are highly uncertain and complex. Designing relevant policies needs continuous experiments and flexible adaptions [19,27]. Thus, it is important to evaluate the effect of policy implementation and discuss the efficiency of policy factors.

3. Chinese Online Car-Hailing Policy

In July 2014, the Ministry of Transport of the People's Republic of China officially issued one notification, called "Notice on Promoting Orderly Development of Taxi-calling Services such as Mobile Phone Car-hailing" [50]. This notification requires local transportation departments to accelerate the system development in city taxi services information regulation and mobile phone software-calling services. By achieving better information-sharing and interconnection, the full record, timely track and all-time regulation of online car-hailing service can be practicable. The legitimacy for this new pattern shared transportation can be further admitted.

In 2016, governments from national and local levels published online car-hailing regulations one after another, which means full implementation of online car-hailing policy regulations in both central and local levels. In July 2016, the Ministry of Industry and Information Technology of the People's Republic of China, and the other seven ministries issued "The Interim Measures for the Management of Network Reservation Taxi Operating Services" [51]. At the same time, local governments were required to promulgate corresponding Interim Measures for Network Reservation Taxi Operating Services by November 2016.

"Interim Measures" at the local level regulates online car-hailing through three methods: setting entry requirements, standardizing operations, and making regulations of supervision and punishment. Entry requirements include different relevant regulations for platforms, drivers, and vehicles. On the one hand, local policies require entry subjects, including platforms, drivers and vehicles, to obtain certain national-level and universal certificate, such as "Network Reservation Taxi Business License," "Network Reservation Taxi Driver's License," and "Network Reservation Taxi Transport License." On the other hand, local policies makers have introduced policies and regulations with local characteristics, such as vehicle length, wheelbase, driver's age, driver's educational level, driver's residential registration, etc. Taking Beijing and Shanghai as examples, local regulations of these two cities impose strict restrictions on residential registration and license plate number to further control the number and scale of online car-hailing. Summaries and descriptive statistics of policy indicators are shown in Table 1.

By December 2018, 340 local governments on and above the county level have promulgated Interim Measures. This paper sorts out 249 prefecture-level cities of the Interim Measures, and summarizes three indicators category and 32 specific indicators. The specific indicators include two categories, discrete variables and dummy variables. Discrete variables include Platform for Vehicle Insurance Quota, Wheelbase, Electric Vehicle, Electric Vehicle Wheelbase, etc. For the Recharge Mileage of Pure Electric Vehicle, 53.28 percent of the city do not require the cruising range of the vehicle, 0.39 percent of cities require vehicles with 100 km of endurance, 0.39 percent of cities require vehicles with 150 km of endurance, 3.09 percent of cities require vehicles with 170 km of endurance, 14.29 percent of cities require vehicles with 250 km of endurance, and 28.19 percent of cities require vehicles with 260 km of endurance.

Dummy variables include driver education, drug use records, driver age, etc. For the driver education level, 90.73 percent of cities do not require drivers to provide proof of education, so the value is 0; 9.27 percent of the cities require drivers to provide proof of education, so the value is 1.

In the process of sorting out the local policy of online car-hailing, this paper finds two important trends. There is a small difference between the local government's regulation and the central government's policy towards online car-hailing platforms because the central government's regulations on the platforms are comprehensive and strict, which somewhat limits the space for the local governments to adjust the platform regulation. Moreover, different local government's policies on vehicles and drivers vary greatly. The later the policy is issued, the stricter it is. For example, Shenzhen is the first city to put forward the "only new energy vehicles can apply for being online car-hailing" regulation, which was followed by several regions, such as Foshan. There are two main reasons for this trend. Firstly, the central government has a few regulations on online car-hailing and drivers, providing the flexibility for local governments to adjust their relevant policies and regulations on

online car-hailing. Secondly, imitation and "competition" among local governments caused subsequent policies to become increasingly stricter under the regulations of online ride-sharing.

Table 1. Descriptive statistics of 32 indicators.

First Level Index	Second Level Index	Unit	N	Mean	S.D.	Min	Max
Platform	If There Is a Fixed Business Place for the Platform	Yes (1) No (0)	249	0.94	0.22	0	1
	A Sound Management System	Yes (1) No (0)	249	1	0	1	1
	Require Data Disclosure	Yes (1) No (0)	249	0.99	0.06	0	1
	Platform for Vehicle Insurance Quota	Million Yuan	249	26.99	32.91	10	100
	for Whether Platforms Insure for Passengers	Yes (1) No (0)	249	0.83	0.36	0	1
Vehicle	Wheelbase	mm	249	2549.98	173.81	2350	3000
	Engine Requirements	Yes (1) No (0)	249	0.33	0.47	0	1
	Electric Vehicle Wheelbase	mm	249	2310.4	305.63	2000	2700
	Recharge mileage of Pure Electric Vehicle	Kilometer	249	147.19	76.19	80	260
	Vehicle Price	Million Yuan	249	8.06	2.58	6	16
	Years of Transport Certificate	Year	249	6.36	2.29	3	8
	Age	Year	249	2.67	1.09	1	6
	Vehicle Displacement	Litre	249	2.94	3.73	1.3	2
	Vehicle Registration	Yes (1) No (0)	249	0.94	0.23	0	1
	Body Length Requirement	Yes (1) No (0)	249	0.11	0.31	0	1
	Numbers of Vehicle Seats	Level	249	1.07	0.33	0	3
Driver	Record of Revocation of Non-Practitioner's Qualification Certificate	Year	249	0.69	1.12	0	3
	Driver's Residential Registration	Level	249	0.16	0.5	0	9
	Driver's Criminal Record	Yes (1) No (0)	249	1	0	1	1
	Dangerous Driving Record	Yes (1) No (0)	249	0.98	0.15	0	1
	Drug Record	Yes (1) No (0)	249	0.98	0.15	0	1
	Drink-Driving	Yes (1) No (0)	249	0.98	0.15	0	1
	Violent Criminal Record	Yes (1) No (0)	249	0.97	0.17	0	1
	Educational Level	Yes (1) No (0)	249	0.07	0.26	0	1
	Whether Having Reduction Record	Yes (1) No (0)	249	0.97	0.17	0	1
	Driving Experience	Yes (1) No (0)	249	0.94	0.25	0	1
	Whether to Pass the Honesty and Credit Examination	Yes (1) No (0)	249	0.93	0.25	0	1
	Driver's Age	Yes (1) No (0)	249	0.69	0.46	0	1
	Driver Health Requirement	Yes (1) No (0)	249	0.53	0.5	0	1
	Whether Having Illegal Driving Record	Yes (1) No (0)	249	0.33	0.47	0	1
	Driver's License Duration	Year	249	0.81	1.61	0	8
	Not for Profit	Yes (1) No (0)	249	0.69	0.46	0	1

Note: S.D. is defined as Standard Deviation.

4. Research Design

4.1. Data and Variables

(1) Variables of Risk

This paper uses the number of events that entered the litigation stage as a proxy to represent the risk of online car-hailing. The logic behind it is that public litigation events are more representative, and easier to collect and classify than the prominent online car-hailing events in news reports. The lawsuit data in this paper comes from China Judgements Online [52] and Openlaw [53]. By searching lawsuit events with keywords such as "online car-hailing", "online taxi-hailing", "DiDi" and "Uber", etc., there were 1191 lawsuits related to online car-hailing filed between 2016 and 2018. These lawsuits spread over 100 prefecture-level cities and four municipalities of China, which are divided into 17 categories: contract, improper management disputes, labor disputes, personnel disputes, tort liability disputes, administrative scope, companies, securities, insurance, impairment of social management order, infringement of property, endangerment of public safety; infringement of personal rights, personality rights disputes, property rights disputes, marriage and family, inheritance disputes, intellectual property rights, competition disputes, civil enforcement, corruption and bribery, destruction of the socialist market economy, and so on. Based on the literature review, this study further categorizes the 17 types of risk into three: institutional risk, economic risk, and safety risk.

In addition, 1191 litigation incidents are reviewed one by one and eventually classify 914 litigation incidents including contract disputes, labor disputes, and other types as economic risks; 155 litigation

incidents including tort liability disputes, administrative disputes, and other types as institutional risk; 122 litigation incidents including endangering public safety, infringing on the personal safety of citizens, and other types as safety risk.

Meanwhile, the litigation events from 2016 to 2018 are divided into three period stages: no online car-hailing policy, landing the policy and stabilizing the policy according to the month of promulgation of the regulation in each city. The length of each stage is six months. Some cities only have the periods of no online car-hailing policy and landing the policy due to the late promulgation of the regulation. Among them, there are 457 lawsuits in the period of no online car-hailing policy, 486 lawsuits in the stage of policy landing, and 248 lawsuits in the stable period of the online car-hailing policy. Moreover, the evaluation of policy effect in this paper only assesses cities with litigation events, so 141 cities with policy but no litigation events will be excluded. Because of the different administrative levels, four municipalities, namely, Beijing, Shanghai, Tianjin and Chongqing, will be removed at the same time. The final sample consists of 100 prefecture-level cities and 263 city-time observations.

(2) The Variable of Policy Implementation

In the sample, all cities have promulgated the relevant regulations of online car-hailing, so the main changes come from the implementation of policies. Therefore, the policy implementation variable in this paper is measured by a dummy variable, which is named as *Policy*. When the city is in the no-policy period, the variable equals 0, and when the city is in the policy landing or stable period, the value is 1.

(3) Relevant Variables of Policy Factors

Relevant variables of the policy factors with respect to online car-hailing are measured based on expert ratings—so is the degree of strictness of various policy factors.

For instance, the requirements of local regulation for vehicle wheelbase include 12 standards: no requirement, 2350, 2450, 2600, 2650, 2675, 2690, 2700, 2800, 2900, 2950, and 3000. Based on the expert scoring, the larger the wheelbase, the stricter the local regulations for ride-sharing vehicles. Therefore, the rate ranges from 0 to 12, 0 represents the least stringent and 12 is the strictest. For policy factors in association with drivers, such as health requirements, driver's age, driving experience and educational level, the weight of this classification is co-scored by experts, online car drivers, and online car platform staff.

Based on the score of policy factors, 12 policy factors were selected as explanatory variables in this study. Among them, in terms of the regulation of online car registration platform, the study retains the "platform needs to buy insurance for vehicles", excluding other four indicators, because they are basically the same in the policies issued by each city. With regard to vehicle regulation, the research retains the four most important indicators in the expert scoring, namely, vehicle wheelbase, vehicle price, vehicle age, and vehicle displacement. These indicators can reflect the difference between cities, which is conducive to observing the impact of online car-hailing policy on risk. With regard to driver regulation, the study combines four indicators, namely, no dangerous driving record, drug abuse record, drunk driving, violent crime record, to get the indicator of "risk of driver breaking the law", according to expert opinions.

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record, drunk driving, violent crime record, to get the indicator of "risk of driver breaking the law", according to expert opinions.

(4) Control Variables

This study selects the number of taxis per capita, the number of buses per capita, the total size of land area of administrative region, the population of urban districts (in 10,000 persons), the registered unemployed population (Registered Unemployed Persons in Urban Areas), No.95 and No. 92 gasoline prices, and financial self-sufficiency. Rate and other indicators are used as control variables. The main source of data is "China Urban Statistics Yearbook" (2016–2017).

The number of taxis per capita in the city is the ratio of the number of taxis to the urban population, and the number of buses per capita in the city is the ratio of the number of buses to the urban population. These variables are popular indicators of equipment per capita measurement, which are used to evaluate the matching situation of taxi supply and demand with public transport supply and demand in the city.

Financial self-sufficiency ratio is the ratio of public financial income to public financial expenditure, which reflects the degree of a city's financial self-sufficiency, openness and acceptance of new things, as well as the consistency with the policies of the central government. The prices of No. 95 and No. 92 gasoline are also controlled, reflecting the development level and prices of a place.

One of the important social benefits brought by sharing economy is to make the most of idle resources and eliminate certain social inequalities as well as alleviate unemployment. However, the more unemployed, the more likely it is to trigger social conflicts and raise the level of risk. Therefore, the number of registered unemployed people in urban areas is also controlled in this study.

In addition, the total size of land area of administrative region and population (10,000 persons) at districts under city control the size of the city.

To test the existence of serious multi-collinearity problems, a multi-collinearity test is conducted in this study. The result shows that VIF values of the selected variables are acceptable, and there is no serious multi-collinearity problem. Variable settings and descriptive statistics are demonstrated in Table 2, and the correlation matrix is reported in Table A1 in the Appendix A.

Table 2. Variables and descriptive statistics.

	Risk Variable	**Variable Name**	**Unit**		**N**	**Mean**	**S.D.**	**Min**	**Max**
	Total number of lawsuits	Total_Risk	Case		104	2.60	5.37	0	33
	Number of Institutional Risk-related Litigation	Ins_Risk	Case		104	0.33	0.81	0	5
	Number of economic risk-related litigation	Econo_Risk	Case		104	1.92	4.23	0	25
	Number of Safety Risk-related Litigations	Safe_Risk	Case		104	0.35	0.86	0	5
	Effectiveness of Policy Implementation								
	The policy implementation	Policy	Dummy Variable		104	0.98	0.14	0	1
	Policy Factor Variable								
Platform	Vehicle Insurance Quota A1	Insurance	Ten Thousand Yuan		104	2.00	2.42	0	7
Vehicle	Wheelbase B1	Wheelbase	mm		104	3.63	3.16	0	12
	Vehicle Price B2	Car_Price	Ten Thousand Yuan	104		4.54	4.30	0	13
	Vehicle's Age B3	Car_Age	Year	104		2.38	1.32	0	8
	Vehicle Emission B4	Emission	Litre		104	3.27	4.03	0	11
	Policy Factor Variable	**Variable Name**	**Unit**		**N**	**Mean**	**S.D.**	**Min**	**Max**
Driver	Record of Revocation of Non-Practitioner's Qualification Certificate C1	Revo_Record	Year		104	1.01	1.23	0	3
	Driver's Residential Registration C2	Resi_Register	Level		104	1.62	2.04	0	9
	Educational Level C3	Edu_level	Yes (1) No (0)		104	0.07	0.26	0	1
	Driving Experience C4	Experience	Yes (1) No (0)		104	0.94	0.23	0	1
	Driver's Age C5	Driver_Age	Yes (1) No (0)		104	0.71	0.45	0	1
	Driver Health Requirement C6	Health	Yes (1) No (0)		104	0.43	0.50	0	1
	Driver's Criminal Risk C7	Crimi_Risk	c1+c2+c3+c4		104	3.92	0.55	0	4
	Dangerous Driving Record c1		Yes (1) No (0)		104	0.98	0.14	0	1
	Drug Record c2		Yes (1) No (0)		104	0.98	0.14	0	1
	Drink-Driving c3		Yes (1) No (0)		104	0.98	0.14	0	1
	Violent Criminal Record c4		Yes (1) No (0)		104	0.97	0.10	0	1
	Control Variable								
	The number of buses per capita in cities	Public_Trans	Vehicle/Ten Thousand People		104	11.10	9.26	2.01	86.56
	The number of taxis per capita in cities	Taxi	Vehicle/Ten Thousand People		104	18.72	11.62	1.61	50.25
	The number of registered unemployed people in urban areas	Unemploy	People		104	42992	51732	3413	275100
	The price of No. 95 oil	Fuel_95	Yuan/Litre		104	6.33	0.20	5.80	7.59
	The price of No. 92 oil	Fuel_92	Yuan/Litre		104	5.92	0.18	5.70	7.09
	Financial self-sufficiency ratio	Self_Ratio	Rate		104	0.59	0.21	0.17	1.07
	Total land area of administrative region	Land_Area	Square Kilometer		104	1002.65	1890.03	62.20	16410
	Population at districts under city	Population	Ten Thousand People		104	273.67	325.81	38.00	2449.00

4.2. Evaluation Model

This paper mainly studies whether the promulgation of the Interim Measures has restrained the risk of online car-hailing, and which policy element plays an important role in reducing the risk. In this paper, a number of lawsuits for online car-hailing in prefecture-level cities of China are used as the proxy of the risk. Because the number of lawsuits is a non-negative discrete integer, the linear regression model will lead to inconsistent and biased estimates. Thus, counting models are adopted to address this problem.

Counting data has two kinds of probability distribution: one is Poisson distribution, and the other is negative binomial distribution. Although the Poisson model is appropriate for counting data, it will be constrained by the assumption that the mean and variance are equal, while the data used in this paper in the case of online restraint car litigation show excessive dispersion, that is, the variance is significantly greater than the mean. In addition, the probability of occurrence varies in different regions and time, and there may be some aggregation. Therefore, this paper uses the negative binomial regression model, which assumes that the sample comes from a negative binomial distribution and uses the maximum likelihood estimation method to estimate.

Given a set of independent variables, the Poisson model is used to estimate the probability of the observed values. In order to avoid negative mean values, the independent variable is written in exponential form. To avoid the constraints of equal mean and variance, this paper considers that it is a gamma distribution function, that is, a negative binomial regression model with the parameter is obtained:

$$p(y_i) = \int_0^{\infty} \frac{e^{-\lambda_i}\lambda_i^{y_i}}{y_i!} f(\lambda_i) d\lambda_i = \frac{\Gamma(\gamma_i + y_i)}{\Gamma(\gamma_i)\Gamma(y_i + 1)} \left(\frac{\delta}{1+\delta}\right)^{\gamma_i} \left(\frac{\delta}{1+\delta}\right)^{y_i}.$$

The model of evaluating the effect of implementing Interim Measures through negative binomial regression is formulated as follows:

$$\gamma_i = \exp(a_0 + a_1 Taxi + a_2 Public_{Trans} + a_3 Unemploy + a_4 Fuel_{95} + a_5 Fuel_{92} + a_6 Self_{Ratio} + a_7 Land_{Area} + a_8 Population + a_9 Policy).$$

In the formula: γ_i represents the number of legal cases representing the risk of online car -hailing, and i represents the type of risk. *Policy* is the proxy variable of policy implementation.

Based on the negative binomial regression, the model for evaluating the effect of policy elements regarding Interim Measures on the risk of online car-hailing service is as follows:

$$\gamma_i = \exp(a_0 + a_1 Taxi + a_2 Public_{Trans} + a_3 Unemploy + a_4 Fuel_{95} + a_5 Fuel_{92} + a_6 Self_{Ratio} + a_7 Land_{Area} + a_8 Population + a_9 Car_{Age} + Car_{Price} + Wheelbase + Emission + Insurance + Resi_{Register} + Drive_{age} + Edu_{level} + Experience + Health + Revo_{Record} + Crimi_{Risk}).$$

5. Empirical Results

5.1. Evaluation of the Effects of Implementing the Online Car-Hailing Policy

As shown in Table 3, the implementation of the policy significantly reduces the total number of lawsuits (Model 2), thus reducing overall risk. To prove the robustness of the empirical results, this research uses fixed effect model of negative binomial regression (Model 1 & 2), the mixed effect model (Models 3 and 4), and the fixed effect model with municipalities directly under the Central Government (Models 5 and 6) to carry on the regression, and obtains significant negative effects, which proves that the policy of online car-hailing significantly reduces the overall risk.

Under the fixed effect model, the overall probability of lawsuits in prefecture-level cities is reduced by 23.7% ($1-e^{-0.27}$), which is significant at the level of 10%. In terms of control variables, the size of land area of urban districts will significantly increase the risk of online car-hailing, and the result is

rather robust. Specifically, the overall probability of litigation cases in Prefecture-level municipalities increases by 0.1% for every one square kilometer increase in municipal districts, which is significant at the level of 1% (Model 2). This means that the larger the area of the city, the more difficult the supervision is, thus increasing the risk probability of online car-hailing.

Table 3. Evaluation of the effect of the online car-hailing policy on restraining the online car-hailing risk.

	Model 1	Model 2	Model 3	Model 4	Model 5 Add Municipality	Model 6 Add Municipality
Taxi	−0.000	0.003	−0.021	−0.024	−0.004	−0.000
	(0.010)	(0.010)	(0.017)	(0.021)	(0.010)	(0.010)
Public_Trans	0.069	0.070	0.012	0.016	0.076 *	0.071 *
	(0.056)	(0.054)	(0.013)	(0.018)	(0.042)	(0.041)
Unemploy	0.069	0.053	0.092 **	0.101 **	0.029	0.017
	(0.050)	(0.052)	(0.044)	(0.045)	(0.043)	(0.046)
Fuel_95	1.019	−0.136	3.788 **	3.769 **	−2.074	−1.883
	(5.813)	(5.604)	(1.677)	(1.712)	(4.151)	(4.243)
Fuel_92	−2.542	−1.194	−3.971 **	−3.828 **	1.187	1.029
	(6.543)	(6.047)	(1.817)	(1.851)	(4.610)	(4.630)
Self_Ratio	3.019 *	2.409	0.064	0.078	1.802 **	1.826 **
	(1.695)	(1.570)	(0.203)	(0.209)	(0.836)	(0.844)
Land_Area	0.001 **	0.001 ***	0.000 *	0.000 *	0.000	0.000
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Population	−0.005 **	−0.004 **	0.002 **	0.002 **	0.000	0.001
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Policy		−0.270 *		−0.465 **		−0.210 *
		(0.138)		(0.208)		(0.128)
_cons	5.566	5.337	−0.955	−1.458	3.553	3.430
	(17.189)	(15.380)	(2.493)	(2.427)	(13.072)	(12.829)
N	263	263	263	263	275	275
City	100	100	100	100	104	104
Log pseudolikelihood	−211.3906	−209.4623	−499.0305	−495.9370	−244.2143	−242.7994
Prob > chi2	0.0033	0.0002	0.0000	0.0000	0.0014	0.0001

Note: (1) Standard errors in parentheses; (2) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5.2. Analysis of the Effects of Policy on Different Online Car-Hailing Risks

The introduction of online car-hailing policy effectively reduces the relevant risks, but what kind of risk specifically is reduced is another major research question in the research.

The empirical results show that the policy introduction significantly reduces the institutional risk of online car-hailing. After implementing the policy, the probability of occurrence of lawsuits related to the risk of online car-hailing is reduced by 51.5%, which is significant at the level of 5% (Table 4, Model 7). However, the implementation of policies has no significant impact on economic and safety risks. The empirical results show that the current implementation of the local government's policy has improved the legitimacy of the online ride-sharing industry, but has no immediate effects on economic conflicts and security risk and it may take longer to make a difference.

In terms of control variables, it is worth noting that, with the increase of urban unemployment, the risk of online car-hailing systems also increases. The probability of litigation cases related to institutional risk increases by 6.7% with the increase of one unemployed person registered in the city, which is significant at the level of 5%. According to the Employment Research Report of DiDi Platform in 2017, from June 2016 to June 2017, a total amount of 21.178 million people (including special cars, express cars, downwind cars, driver substitutes) earned income from the DiDi platform, including 1.33 million unemployed people, over 12% of whom had been unemployed for more than one year before becoming DiDi drivers. Although online car-hailing provides jobs for the urban unemployed, with the increase of urban unemployment, the institutional risk also increases. There are multiple factors involved. First, there are lots of unemployed people who become online car-hailing drivers. With the introduction of policies, most of them do not satisfy the entry requirement of being online car-hailing drivers, thereby they have litigation disputes with online car-hailing platforms or car rental companies. Second, as online car-hailing drivers, most unemployed people are full-time

online car-hailing drivers, which is heavily overlapping with the traditional and seriously affected the taxi driver's business. As a consequence, it has triggered disputes between online car-hailing and taxi industry.

Table 4. Effects of policies on the influence of different online car-hailing risks.

	Model 7 Ins_Risk	**Model 8 Econo_Risk**	**Model 9 Safe_Risk**
Taxi	−0.012	−0.031	0.009
	(0.028)	(0.029)	(0.020)
Public_Trans	−0.025	0.019	0.029 ***
	(0.022)	(0.030)	(0.004)
Unemploy	0.065 **	0.128	0.033
	(0.031)	(0.084)	(0.023)
Fuel_95	4.846	5.491 **	−4.643 ***
	(3.155)	(2.398)	(1.323)
Fuel_92	−6.693	−4.918 *	4.543 ***
	(4.185)	(2.536)	(1.561)
Self_Ratio	1.271	0.094	0.378 ***
	(1.618)	(0.245)	(0.122)
Land_Area	0.000	0.001 **	−0.000
	(0.000)	(0.000)	(0.000)
Population	0.002	0.003	0.003 ***
	(0.001)	(0.002)	(0.001)
Policy	−0.723 **	−0.328	−0.443
	(0.322)	(0.266)	(0.282)
_cons	7.139	−6.676 **	−0.154
	(8.606)	(3.320)	(3.854)
N	263	263	263
City	100	100	100
Log pseudolikelihood	−203.2224	−401.9190	−157.507
Prob > chi2	0.0037	0.0000	0.0000

Note: (1) Standard errors in parentheses; (2) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5.3. The Analysis of the Effects of the Policy Factors on Different Risks

As shown in Table 5, at an overall level, the policy factors of regulation on vehicles have a mixed effect on risk reduction. In particular, vehicle age and wheelbase are two indicators that affect vehicle safety and comfort and have a significant impact on the overall risk, especially on the reduction of economic risk. However, the other two indicators, vehicle price and vehicle displacement, have significantly increased the overall risk and economic risk.

The policy factors to regulate the drivers of e-hailing cars are mainly to help reduce the overall risk and economic risk. Specifically, the stricter the requirements for the driver's health and driving record, the lower the overall risk and economic risk. The higher the educational requirement for contract drivers, the lower the economic risk. For every higher level of the educational requirement for contract drivers, the probability of economic risk-related litigation cases is reduced by 74.4%, which is significant at a 5% level (Model 12).

It is worth noticing that the requirement for the registered permanent residence of contract drivers has no significant impact on the reduction of various risks. The higher the age requirement of contract drivers, the higher the overall risk. Restrictions on the registered permanent residence and age of the drivers are the most discriminatory policy factors in the policy. On the one hand, these policy factors violate the principle of equality in the sharing economy; on the other hand, they cannot effectively release social resources. In addition, this kind of discriminatory policy aggravates the illegal operation of false information and increases the risk.

The regulation of the platform has both positive and negative effects on the subdivision of risk. For every ¥10,000 increasing in the insurance quote of online contract car, the probability of litigation cases related to institutional risk is reduced by 24.8%, which is significant at the level of 1%. However,

the probability of litigation cases related to economic risk is increased by 9.2%, which is significant at the level of 10%. This shows that providing basic job security for the drivers can effectively enhance the legitimacy of online car-hailing platform yet increase the operational cost of the sharing platform, leading to an increase of economic risk.

It is noted that none of the current policy factors can have a significant impact on reducing safety risk (Model 13). First, improvements are needed in the maintenance of life safety under the policy of online car restraint. Second, the platform needs a stricter self-regulation in health and safety. Third, relevant government departments, such as the police, need to strengthen supervision and policy implementation.

Table 5. The effects of policy factors on different risks of online car-hailing.

	Model 10 Total_Risk	**Model 11 Ins_Risk**	**Model 12 Econo_Risk**	**Model 13 Safe_Risk**
Taxi	−0.011	−0.005	−0.008	−0.000
	(0.012)	(0.031)	(0.016)	(0.025)
Public_Trans	0.018 *	−0.009	0.013	0.027 **
	(0.010)	(0.028)	(0.015)	(0.011)
Unemploy	0.105 ***	0.103 ***	0.108 ***	0.018
	(0.029)	(0.038)	(0.041)	(0.030)
Fuel_95	0.963	6.047 **	1.562	−5.633 ***
	(1.049)	(2.584)	(1.708)	(1.684)
Fuel_92	−0.364	−7.919 **	0.277	6.099 ***
	(1.228)	(3.415)	(1.809)	(2.122)
Self_Ratio	0.115	0.854	0.137	0.665 **
	(0.203)	(1.210)	(0.267)	(0.300)
Land_Area	0.000 ***	0.000	0.001 **	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Population	0.003 ***	0.001	0.003 ***	0.003 ***
	(0.001)	(0.001)	(0.001)	(0.001)
Car_Age	−0.225 ***	−0.135	−0.228 ***	−0.020
	(0.068)	(0.148)	(0.075)	(0.125)
Car_Price	0.046 *	0.022	0.057 *	0.015
	(0.025)	(0.045)	(0.032)	(0.041)
Wheelbase	−0.067 *	−0.034	−0.099 **	0.057
	(0.037)	(0.077)	(0.039)	(0.053)
Emission	0.085 **	−0.015	0.111 ***	0.043
	(0.034)	(0.063)	(0.036)	(0.051)
Insurance	−0.008	−0.285 ***	0.088 *	0.047
	(0.041)	(0.092)	(0.049)	(0.062)
Resi_Register	0.010	−0.018	−0.002	0.061
	(0.049)	(0.113)	(0.055)	(0.063)
Driver_Age	0.780 ***	0.775 **	0.849 ***	−0.079
	(0.187)	(0.368)	(0.220)	(0.307)
Edu_level	−0.524	0.454	−1.364 **	−1.324
	(0.581)	(0.890)	(0.620)	(0.905)
Experience	0.190	1.020	0.047	0.146
	(0.394)	(0.977)	(0.523)	(0.574)
Health	−0.425 **	0.713	−0.843 ***	−0.237
	(0.210)	(0.445)	(0.264)	(0.365)
Revo_Record	−0.234 ***	−0.087	−0.254 **	−0.117
	(0.083)	(0.146)	(0.101)	(0.121)
Crimi_Risk	0.072	0.498	0.022	−0.044
	(0.114)	(0.295)	(0.192)	(0.222)
_cons	−5.062 *	3.590	−13.183 ***	−3.681
	(2.716)	(7.591)	(4.189)	(5.291)
N	263	263	263	263
City	100	100	100	100
Log pseudolikelihood	476.6327	−194.0146	−380.1651	−155.1724
Prob > chi2	0.0000	0.0046	0.0000	0.0000

Note: (1) Standard errors in parentheses; (2) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

6. Discussion

This research reviews the regulations and policies of online car-hailing of Chinese governments at different levels and finds that the current policy of online car-hailing has made meticulous restrictions on platforms, operating vehicles, and drivers. The empirical results show that Chinese online car-hailing policy significantly reduces the overall risk of sharing economy. After categorizing the risks into three dimensions, the results show that the policy effectively reduces the institutional risk, but has no significant impacts on economic risk and safety risk.

In the further study of policy factors, it is found that some entry restrictions on drivers and vehicles of online car-hailing services cannot reduce the risk of sharing economy, whereas it increases the institutional risk and economic risk. In particular, policy factors such as restricting the drivers' age, household registration, and limiting vehicle prices are discriminatory and may exclude individual drivers who want to be part-time drivers for online car-hailing. This has caused inequality to some extent and could bring the emerging sharing economy back to the old track of the original internet rental industry, which would impede the social sustainable development by new pattern transportation modes. This conclusion echoes Posen's study [19] that the sharing economy should not be regulated by the previous regulations that restrict traditional industries.

When exploring the policy factors of the regulations on platforms, it is found that those regulations have distinctive effects on different types of risk. In the current literature, most scholars argue that the main challenge of the sharing economy is that the service providers cannot obtain job security as the traditional industry practitioners do, while the sharing economic platform does not have to take the social responsibility of the traditional industry. This has resulted in unfair competition between the sharing economy and traditional industries. On the other hand, the service providers of the sharing economy provide non-professional services [23]. These have greatly increased the institutional risk of the sharing economy. The empirical results show that the more stringent requirements that car insurance online platforms paid for its vehicles, the less institutional risk that shared transportation occur. Standardized regulation of the platforms in the sharing economy means that they will take corresponding social responsibilities as existing traditional industries do, enhancing the legitimacy of the sharing economy and reducing the institutional risk as a result.

However, such policy factors of constraints on platforms may increase the economic risk due to the growing operational cost of the platform. Reducing economic competitiveness of platforms offering sharing economy services may result in two possible consequences. The first one is that the platform would be unwilling to comply with regulations, which will lead to labor disputes and economic conflicts between individuals and platforms. Second, with the increase of operational cost, online car-hailing service providers will transfer the cost to consumers, such as default refusal of online car-hailing and unilateral price increase, which will increase the economic risk.

In addition, in the study of policy factors, there is an indicator worth discussing, which is the requirement of drivers' educational levels. The empirical results show that the higher the requirement, the lower the economic risk of the shared transportation. This echoes the view of existing research. Individuals with high educational background are more willing to participate in the sharing economy and have more advantages in the use of technology related as well as reduces the probability of sharing economic conflicts and thus reduces the risk [54,55]. At the same time, our research findings also confirm several scholars' concerns about the sharing economy, which is that highly educated individuals may gain higher benefits in the sharing economy. This causes economic inequality and undermines the sustainable development of shared transportation [14,55,56].

Finally, the empirical result shows that the current policy factors of Chinese governments at different levels have not significantly reduced the safety risk of online car-hailing services. Although the policy strictly executes criminal background check for drivers, and China's online car-hailing platform also carries out strict self-regulation, vicious criminal cases have emerged one after another. This shows that the sharing economy has penetrated into the private sector, and the huge cost of screening a large amount of information online results in enormous regulatory costs, which makes

the traditional statistical monitoring system unsustainable. This will be a critical challenge for the sustainable development of the transportation system in the digital era.

7. Conclusions

The conclusions of this study provide implicational insights for the government to formulate the relevant policies of the online car-hailing services under the sharing economy in order to promote social sustainable development. The new form of public policy on reduction of shared transportation risk emphasizes the interactions among government authorities, private firms and citizens, which stems from the European plans for the smart city [57]. More specifically, public policy for new pattern shared transportation should ensure the information flow and value transfer between governments, service providers and users as the basis of a sustainable transport system and social sustainability. The policy design should emphasize the interactions between various actors around the transport system from three perspectives.

Firstly, the interactions between governments and online car-hailing service providers are required for the institutional learning of governments to design appropriate new policy. There is excessive administrative intervention in some government policies, and using the old policies to regulate the new patterns of transportation under the sharing economy. Such policies fail to reduce the probability of related risk. Referring to the recommendations of Cannon and Summers [17], the government can actively interact with firms of new pattern transportation. This helps governments to collect the feedback of users through the sharing economy platforms. Furthermore, governments can understand the challenges and problems under the new socioeconomic system for the design and improvement of existing policies. The avoidance of potential conflicts between new transport patterns and traditional systems to provide legitimacy to shared transportation is the prerequisite of sustainability of such a transport mode.

Secondly, the interactions between governments, shared transportation firms and consumers are also important. Governments at different levels need to improve the construction of information platforms of online car-hailing and the sharing of public resources to ensure the smooth information flow and reduce the degree of information asymmetry under the digitalization era. Reduction of information asymmetry and increase in mutual trust can help to enhance the safety level and better match the supplies and demands. Through information sharing among governments, online car-hailing services providers and consumers, in-app feedback related to safety risk can be more efficiently submitted to public security departments to prevent potential dangers [21]. At the same time, information sharing also help online car-hailing service providers optimize the algorithms to better meet the demand based on ICT, and thereby reduce the cost and relevant economic risk [58]. This is key to optimizing the under-utilized resources to achieve the sustainability of the societies. This also facilitates the new pattern shared transportation to sustainably supplement the current public transport system.

Thirdly, the interactions should be emphasized between governments, shared transportation firms and e-hailing car drivers. Governments should cooperate with the online car-hailing firms to improve the individual skills of shared transportation service providers, i.e., drivers. By individual skills improvement, not only can the shared transportation quality be enhanced to better satisfy related demands, but the rights of service providers can be also protected, especially for the drivers with lower education levels. This can, to a certain extent, reduce the economic inequality generated by advanced ICT to keep the sustainability of new pattern transportation and the social sustainable development in the digitalization era. For example, DiDi has established its own big data center based on an e-learning platform to educate drivers on service standards and safety guidelines [21]. Government can encourage relevant firms to establish such platforms for continuous training and education.

This study enriches and enhances the understanding of risk of new transportation pattern under the sharing economy. This study also contributes to the research regarding how governments can help underpin a sustainable transport system, and generate social sustainable development in the sharing

economy. Empirical evidence of evaluation on Chinese government policies for new patterns shared transportation are provided to support the argument.

Based on this study, future research could further explore social news and emergencies and complement the framework of the risk of new transportation systems in the digital era, especially in the context of the sharing economy. Through the dynamic tracking of government policies, further research could test and capture more causal effect of policy adaptions to ensure the security of new patterns of transport in the sharing economy to promote social sustainable development. Other data sources, such as data from online car-hailing platforms, can be adopted for the estimation of demand mobility. Based on the analysis of the match between demand and supply, the effect of public policy on the economic risk of shared transportation can be further tested at a more accurate level.

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Appendix A

Table A1. The correlation matrix.

		1	2	3	4	5	6	7	8	9	10	11	12
1	Total_Risk	1											
2	Ins_Risk	0.4043 *	1										
3	Econo_Risk	0.9854 *	0.2640 *	1									
4	Safe_Risk	0.5044 *	0.2921 *	0.4090 *	1								
5	Policy	0.0069	−0.0288	0.0112	0.0064	1							
6	Insurance	0.0638	0.0127	0.0602	0.0784	0.0076	1						
7	Wheelbase	0.0827	0.1261 *	0.0548	0.1700 *	−0.0114	−0.0634	1					
8	Car_Price	−0.0372	−0.0621	−0.0186	−0.1276 *	−0.0218	−0.0134	0.0259	1				
9	Car_Age	−0.1258 *	−0.0933	−0.1095	−0.1440 *	−0.0119	−0.0393	−0.1848 *	0.2048 *	1			
10	Emission	0.0937	0.086	0.0687	0.2111 *	−0.0403	0.0505	0.4089 *	−0.3415 *	−0.1489 *	1		
11	Revo_Record	0.1081	−0.0197	0.1115	0.0998	0.016	0.0936	0.0758	0.108	0.0995	0.1639 *	1	
12	Resi_Register	0.0971	0.0548	0.0719	0.2623 *	0.0276	−0.0724	0.1124	−0.0983	−0.073	0.0234	0.2245 *	1
13	Edu_level	−0.0185	0.0072	−0.0271	0.0576	0.0207	−0.1153	0.0514	−0.1232 *	−0.1358 *	0.0499	0.1135	0.0253
14	Experience	0.0017	0.0394	0.015	−0.1888 *	−0.009	0.1218 *	−0.0119	−0.0436	0.1249 *	0.0839	0.012	−0.2145 *
15	Driver_Age	−0.0011	−0.0145	0.0216	−0.2058 *	−0.0222	0.1187 *	0.047	0.0146	0.1352 *	0.038	0.0284	−0.0768
16	Health	−0.0724	0.0135	−0.0725	−0.0885	−0.034	0.2720 *	0.0859	−0.0969	0.0187	0.1545 *	−0.0095	−0.1249 *
17	Crimi_Risk	−0.0014	0.093	−0.0206	0.0507	−0.0211	0.0889	0.0908	−0.0037	−0.0587	0.1176	−0.0606	0.0595
18	Public_Trans	0.1511 *	0.0491	0.1234 *	0.3473 *	0.0345	−0.0536	0.0995	−0.1326 *	−0.1266 *	0.0317	0.1472 *	0.3494 *
19	Taxi	0.3157 *	0.2195 *	0.2723 *	0.4085 *	0.0364	0.0783	0.3041 *	−0.1739 *	−0.0145	0.2506 *	0.0736	0.1055
20	Unemploy	0.4928 *	0.3354 *	0.4349 *	0.5500 *	0.0597	0.095	0.2309 *	−0.1378 *	−0.1815 *	0.2096 *	0.1507 *	0.1936 *
21	Fuel_95	0.0248	−0.0193	0.0297	0.0035	0.0169	−0.052	0.0689	−0.1278 *	−0.0364	−0.056	−0.0929	0.0073
22	Fuel_92	0.0092	−0.029	0.0103	0.0408	0.0197	−0.0907	0.0165	−0.0918	0.0373	−0.1507 *	−0.1073	0.0355
23	Self_Ratio	0.2212 *	0.1411 *	0.1899 *	0.3147 *	0.0218	−0.0456	0.0648	0.1349 *	0.0966	−0.1143	0.0639	0.1710 *
24	Land_Area	0.4764 *	0.3629 *	0.4207 *	0.4709 *	0.0316	0.1663 *	0.1373 *	−0.1409 *	−0.0191	0.1600 *	0.1808 *	0.2133 *
25	Population	0.4743 *	0.2852 *	0.4225 *	0.5462 *	0.0502	0.0552	0.1493 *	−0.1729 *	−0.1181	0.2765 *	0.2279 *	0.3600 *

Table A1. *Cont.*

		13	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
13	Edu_level	1												
14	Experience	−0.083	1											
15	Driver_Age	0.0385	0.2162 *	1										
16	Health	0.0537	0.1544 *	0.3217 *	1									
17	Crimi_Risk	−0.0695	0.1301 *	−0.0425	0.0112	1								
18	Public_Trans	−0.0139	−0.3721 *	−0.2542 *	−0.0766	−0.1493 *	1							
19	Taxi	0.0675	−0.0989	−0.1432 *	0.1178	−0.0095	0.5680 *	1						
20	Unemploy	0.1600 *	−0.1162	−0.2973 *	−0.1494 *	0.099	0.1662 *	0.4162 *	1					
21	Fuel_95	0.1893 *	−0.02	−0.0447	−0.0116	−0.1253 *	0.2289 *	0.2611 *	−0.0378	1				
22	Fuel_92	0.2670 *	−0.0523	−0.0294	0.0283	−0.1464 *	0.1908 *	0.2496 *	−0.0442	0.9254 *	1			
23	Self_Ratio	0.0257	−0.1780 *	−0.2641 *	−0.1649 *	−0.0104	0.3874 *	0.4324 *	0.3246 *	0.1589 *	0.2251 *	1		
24	Land_Area	0.1074	−0.0058	−0.0296	0.0958	−0.0393	0.2463 *	0.5745 *	0.4423 *	0.033	0.0582	0.2990 *	1	
25	Population	0.3006 *	−0.0728	−0.1812 *	−0.0078	0.0586	0.1977 *	0.4222 *	0.6985 *	0.007	0.0442	0.3205 *	0.7490 *	1

* $p < 0.05$.

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