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Choice behavior of commuters' rail transit mode during the COVID-19 pandemic based on logistic model

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ABSTRACT

To understand whether commuters will take rail transit during the COVID-19 pandemic, a logistic regression model was constructed from three aspects of personal attributes, travel attributes and perception of COVID-19 based on 559 valid questionnaires. The results show that: occupation, commuting tools before the COVID-19 pandemic, walking time from residence to the nearest subway station, the possibility of being infected in private car and the possibility of being infected in public transport have significant influence on the commuters' choice of rail transit. Self-employed people and freelancers, commuters who used non-public transport before the COVID-19 pandemic, and commuters who take longer to walk from their residences to the nearest subway station are less likely to commute by rail transit during the COVID-19 pandemic. Commuters who think that the risk of being infected with the virus in public transport is higher have a lower probability of choosing rail transit. The confidence in bus/subway/taxi/taxi-hailing of commuters who do not choose to commute by rail transit is not high. The study of this paper can provide reference for the formulation of urban rail transit control measures during the COVID-19 pandemic, so as to formulate more perfect measures to ensure the safety of the returning workers.

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1. Introduction

Since the outbreak of the Corona Virus Disease 2019 (COVID-19), many provinces, autonomous regions and municipalities in China have launched level-1 responses to major public health emergencies. According to the Law of the PRC on the Prevention and Treatment of Infectious Diseases, Emergency Response Law of the People’s Republic of China and other relevant laws and regulations, traffic control measures have been taken in these regions, such as closing off external passageways, banning public transportation and non-essential travel, so as to minimize the flow of people and prevent the rapid spread of the virus. During the period of traffic control, except for the production of medical supplies such as masks and disinfectant water, and the production of food supplies such as grain, oil, meat, eggs and vegetables, the whole society basically stops production and the development of socio-economy comes to a standstill (Anhui Network, 2020; Sohu Network, 2020a). In order to minimize the impact of the COVID-19 on the socio-economy, starting from mid-to-late February 2020, many enterprises have been returning to work. At this time, the COVID-19 pandemic is not fully under control, and the return peak will bring huge pressure to the transportation system. Zhou (2020) believed that in the continuous spread period of the virus, it is necessary to do a good job in traffic restriction and orderly organization, limiting the density of people flow in the traffic hubs, limiting the non-essential travel, organizing personalized travel, and organizing special bus lines for commuters.

The local transportation departments have also adopted corresponding emergency measures according to the severity of the local pandemic. Because COVID-19 is highly contagious and has a long incubation period, if the case has been in contact with patients with fever 14 d before the onset of the case, or it is a cluster case, with the symptoms of fever, imaging features of COVID-19, and a significant decrease in the total number of white blood cells, it will be judged as a suspected case. Suspected cases have the risk of contracting the new corona virus to other passengers taking the same vehicle during their travel. Therefore, tracking the trajectory of the suspected cases is an important part of preventing the serious spread of COVID-19. In order to track the trajectory of suspected cases effectively, Xi’an Bus, which builds an public transport system by virtue of “Internet +” and reaches a sharing rate of ground traffic to 48%, requires bus passengers to use mobile phones, staff verification, information upload and other methods to register their real names from February 10th (Huanqiu Network, 2020; Huashang Network, 2019). From February 16th, bus, subway and taxi passengers are required to register their real names in Nanjing and Suzhou (Longhu Network, 2020; Suzhou Government, 2020). In addition to the real name registration, Shenzhen Metro has suspended the sale of one-way tickets and daily tickets (Sina News, 2020). In order to limit the population density in public transport, passengers in Beijing Subway can check the real-time full load rate in the carriage through the official website, WeChat public account, and APP (Sohu Network, 2020b). Bus groups of Beijing, Chengdu and Hefei are collecting the travel needs of the general public. By collecting information of citizens’ departure stations, departure times and destination stations, they can customize commuting routes for citizens to ensure their safety (Sohu Network, 2020c, d, e). Among them, Chengdu and Hefei are the capitals of Sichuan and Anhui provinces respectively. Chengdu City has 786 bus routes, including night buses, campus buses and sightseeing routes (Zhongyan Network, 2019). Hefei City opens 52 customized bus lines in regular days, but the customized bus load rate is only 40%–50% (Netease Network, 2019). The establishment of customized bus routes during the COVID-19 pandemic can not only provide convenience for commuters, but also raise the popularity of customized buses and attract citizens and enterprises to use customized buses in regular days.

Regarding the research on urban traffic control measures during the COVID-19 pandemic, D.Z. Liu, director of the China Sustainable Cities Program at the World Resources Institute, suggested that people who commute for short and medium distances should try to commute by bike and save public transport for those who need to commute for long distances to ease the pressure on public transport (Sohu Network, 2020f). Zhou et al. (2020) suggested that rail transit adopt a suspension of subway operations strategy, a compartment isolation pandemic prevention strategy, and a demand-response pandemic prevention strategy to play the important role in transportation and emergency-response during the COVID-19 pandemic period. Liu et al. (2020) proposed to further optimize the operation organization of public transport lines, allocated special bus lines for medical personnel and emergency rescue personnel and used big data and advanced detection technology to establish an early warning mechanism for real-time passenger flow monitoring and analysis.

Regarding the research on the spread of virus in rail transit, Cooley et al. (2011) established an influenza agent-based transmission model and simulate based on the epidemiological data of New York from 1957 to 1958. It was estimated that the infection rate of subway passengers is between 4% and 5%. The influence of subway passengers on the transmission of the disease cannot be ignored. The intervention targeted at subway passengers is not effective in containing the pandemic.

Regarding the research on influencing factor analysis problems, various methods have been used. Sovacool et al. (2019) used principal component analysis and regression analysis to study the relationship between the choice behavior of electric vehicles and the performance characteristics of electric vehicles, users’ perception of the benefits of electric vehicles and relevant policies. Kassu and Hasan (2019) used principal component analysis and regression analysis to study the influencing factors of fatal injurious, non-fatal injurious and non-injurious traffic accidents on the road. Al-Ghamdi (2002) used regression analysis method to study the impact of accident location, time, cause, vehicle type, age of the perpetrator and other factors on the severity of the accident. Behnood and Mannering (2017) use the regression analysis method to study the impact of passengers on the severity of the driver’s injury in single vehicle collision. Roshandeh et al. (2016) use
the regression analysis method to study the impact of infrastructure conditions, environment, and accident severity on the escape accident behavior of the perpetrators. Zhang (2019) used principal component analysis and analytic hierarchy process to study the influencing factors of traffic congestion in Beijing. Wang (2019) used factor analysis, grey correlation and regression analysis to study the impact of weather on bike-sharing travel behavior. Logistics regression model is commonly used in the regression analysis method, which can deal with various types of relationships and is widely used in classification problems.

Previous studies have more results on traffic management measures during the pandemic, viral transmission models and analysis of influencing factors. However, few people study the commuters’ choice behavior of modes of transportation during the pandemic and their psychological mechanism. Therefore, this paper starts from investigating commuters’ choice behavior, analyzes their intentions of taking rail transit and other modes of transportation during the resumption of work, and provides support for the transportation department to formulate traffic management measures. Considering that the factors influencing commuters’ choice of rail transit are commuters’ personal attributes, travel attributes, perception of COVID-19 and so on, and the type of dependent variable is a binary (0/1) variable, this paper chooses to establish a logistic regression model for detailed analysis.

The rest of the paper is organized as follows. Section 1 describes the theoretical basis of the logistic model, and introduces the design ideas and survey scenarios of the questionnaire; Section 2 analyzes the influencing factors of rail transit choice behavior based on the questionnaire data; Section 3 establishes a logistic model to analyze rail transit choice behavior of the commuters; Section 4 summarizes the research and provides recommendations for traffic management strategies during the pandemic.

2. Theoretical basis and data acquisition

2.1. Theoretical basis

Logistic regression models address the influence of X (explanatory variable) on Y (dependent variable). When there are two options of Y, binary logistic regression model should be selected for analysis. For example, this paper investigates the influence of various factors on the choice behavior of rail transit. The dependent variable is whether to “choose rail transit”, and “Y = 1” means to choose rail transit, “Y = 0” means not to choose rail transit. The general form of binary logistic model is as follows.

$$\logit P = \ln \left( \frac{P}{1 - P} \right) = \alpha + \sum_{i=1}^{k} \beta_i x_i$$

(1)

$$P = \frac{\exp \left( \alpha + \sum_{i=1}^{k} \beta_i x_i \right)}{1 + \exp \left( \alpha + \sum_{i=1}^{k} \beta_i x_i \right)}$$

(2)

where $P$ is the probability that $Y = 1$, $x_i$ is each explanatory variable, $\alpha$ is a constant term, $\beta_i$ is the regression coefficient of the model.

2.2. Data acquisition

2.2.1. Questionnaire design

The content of the questionnaire is divided into three parts: personal attributes, travel attributes and perception of COVID-19. In order to improve the quality of the questionnaire data, this paper will repeatedly consider the expression and wording of each question when designing the questionnaire, so as to avoid the respondents’ misunderstanding of the question. At the same time, in order to reduce the inaccuracy of the data caused by the psychological defense of the respondents, the respondents were informed that the data collected were for scientific research only at the beginning of the questionnaire. In order to reduce the unconscious self-concealment of the respondents, the respondents are reminded to make a rational choice before the questionnaire is started, and the questionnaire response time is set to be no less than 3 min to ensure that the interviewees have enough time to think rationally. The specific contents of this questionnaire are as follows.

1. Personal attributes: gender, age, education, occupation, personal monthly income.
2. Travel attributes: distance from residence to workplace, walking time from residence to the nearest subway station, times of transfers required to get to workplace by rail transit, and commuting tools before the COVID-19 pandemic.
3. Perception of COVID-19: the degree of understanding of the COVID-19 pandemic, the degree of anxiety about the COVID-19 pandemic, the degree of threat that the COVID-19 pandemic, the degree of concern about COVID-19 pandemic.
4. Others: whether there are cases among acquaintances, whether there are cases on the way from the residence to the nearest subway station, and the expectation of the control measures of rail transit.

2.2.2. Survey scenarios

In order to obtain data effectively, a pre-investigation is set up before formal investigation. The questionnaire is distributed to small-scale population through the network. After collecting the questionnaires, the questionnaire is revised based on the results and feedback from the respondents. Then the
formal investigation is mainly carried out on the network platform and distributed through social platforms such as Sojump, WeChat and QQ. Finally, a total of 678 questionnaires were collected. In the initial screening, the questionnaires with an answer time of less than 50 s and obvious logic errors were removed, and 559 questionnaires were finally obtained, with a recovery rate of 82.4%.

3. Analysis of influencing factors of rail transit choice behavior

3.1. Personal attributes

Travelers have different personal attributes, so they have different psychology and choice behavior. Therefore, different personal attributes will ultimately affect whether the sample population will choose rail transit during the COVID-19 pandemic. The results of the survey are shown in Table 1. As for the gender, among the 559 respondents, 308 are women, accounting for 55.1%. As for the age, since the survey was conducted on the online platform, and most of the network users and the main labor force in the society are middle-aged and young people, the age of the respondents is concentrated at 18–45 years old, accounting for 96.6%. As for the education, 74.1% of the respondents are junior college graduates or above. As for the occupation, 80.1% of the respondents are employees of enterprises and institutions who have to return to work during the COVID-19 pandemic. As for the personal monthly income, 76.2% of the respondents’ personal monthly income is between 3001 and 8000 yuan ($420.6–$1121.2) (1 USD = 7.1404 CNY (accessed 25 May 2020)). According to the national bureau of statistics, the annual average salary of employees of enterprises above the national scale in China in 2018 was 68,400 yuan ($9585.8). It can be seen that about 51.2% of the respondents have a monthly income higher than the average level.

### Table 1 – Statistical characteristics of the sample.

| Variable                  | Category                              | Frequency | Relative frequency (%) |
|---------------------------|---------------------------------------|-----------|------------------------|
| Gender                    | Male                                  | 251       | 44.9                   |
|                           | Female                                | 308       | 55.1                   |
| Age                       | Under 18 years old                    | 3         | 0.5                    |
|                           | 18–25 years old                       | 211       | 37.7                   |
|                           | 26–35 years old                       | 202       | 36.1                   |
|                           | 36–45 years old                       | 127       | 22.7                   |
|                           | Above 46 years old                    | 16        | 2.9                    |
| Education                 | Low education (senior high school or below) | 145       | 25.9                   |
|                           | Middle education (junior college)     | 177       | 31.7                   |
|                           | Higher education (undergraduate or above) | 237       | 42.4                   |
| Occupation                | Employee of enterprises and institutions | 448       | 80.1                   |
|                           | Self-employed people                  | 38        | 6.8                    |
|                           | Freelancer                            | 73        | 13.1                   |
| Personal monthly income^a | 1–3000 yuan ($0.1–$420.4)             | 41        | 7.3                    |
|                           | 3001–5000 yuan ($420.6–$700.7)        | 232       | 41.5                   |
|                           | 5001–8000 yuan ($700.9–$1121.2)       | 194       | 34.7                   |
|                           | Above 8000 yuan (above $1121.2)       | 92        | 16.5                   |

Note: ^ 1 USD = 7.1404 CNY (accessed 25 May 2020).

3.2. Travel attributes

Travel attributes include distance from residence to workplace, walking time from residence to the nearest subway station, times of transfers required to get to workplace by rail transit and commuting tools before the COVID-19 pandemic. The length of travel distance and times of transfers will affect whether respondents commute by rail transit or not. The travel attributes of commuters are shown in Fig. 1. 70.8% of the respondents have a commuting distance of less than 20 km, which is a medium and short distance travel. 63.3% of the respondents walk within 10 min from their residences to the nearest subway station, which is convenient. 33.6% of the respondents take rail transit from their residences to their workplace without transfer, and 42.4% of the respondents only need to transfer once. Before the COVID-19 pandemic, 31% of the respondents used bus or subway, 29% used bicycle or electric car, and 25% used private car for commuting.

3.3. Perception of COVID-19

Perception of COVID-19 is similar to thinking of COVID-19. Perception of COVID-19 refers to the individual's knowledge and understanding of COVID-19, and the perspective of COVID-19 after the processing of individual feelings, thinking and imaginations. The perception of COVID-19 includes five aspects: the degree of understanding of the COVID-19 pandemic, the degree of concern about the COVID-19 pandemic, the degree of anxiety about the COVID-19 pandemic, the degree of threat that the COVID-19 threatens his or her life, the probability of self-infection with COVID-19, and the possibility of being infected in public transport/private car/taxi/taxi-hailing/bike/on foot. The perception level is divided into five levels: level 1 represents the lowest degree, with the least understanding and attention to the COVID-19 pandemic, and the most optimistic mindset about the...
Level 5 represents the highest degree, with the most understanding and attention to the COVID-19 pandemic, and the least optimistic mindset about the development of the COVID-19 pandemic and their own health. The results of the survey are shown in Figs. 2 and 3. The degree of understanding of the COVID-19 pandemic, the degree of concern about the COVID-19 pandemic, the degree of anxiety about the COVID-19 pandemic and the degree of threat that the COVID-19 threatens his or her life are concentrated in levels 3 and 4, accounting for 64.2%, 57.6%, 62.3% and 63.5% respectively. The probability of self-infection with COVID-19 is concentrated in levels 1 and 2, indicating that most respondents are concerned and worried about the protection knowledge and latest progress of the COVID-19 pandemic. Though they believe that COVID-19 poses a high degree of threat to life and health, they...
believe they are less likely to be infected with COVID-19. In the opinion of the commuters, the possibility of being infected in private car or on foot/by bicycle is concentrated in levels 2 and 3, accounting for 67% and 67.3% respectively. The probability of being infected in public transport and taxi or taxi-hailing is concentrated in levels 3–5, accounting for 85.2% and 83.4% respectively, indicating that most respondents believe that the risk of being infected in public transport and taxi/taxi-hailing is high during the COVID-19 pandemic.

3.4. Others

The questionnaire also includes questions about whether there are cases among acquaintances, whether there are cases on the way from the residence to the nearest subway station, and the expectation of the control measures of rail transit. 88.4% of the respondents have no cases among their acquaintances and 78.7% of the respondents have no cases on their way from their residences to the nearest subway station. The expectation of the control measures of rail transit is shown in Fig. 4. 80.1% of the respondents expect for real name registration in subway station and 73.7% of the respondents expect for limitation of the density of people on subway platforms. Only a few of the respondents expect for query of real-time full load rate in the carriage and suspension of the sale of one-way tickets and daily tickets. In addition, some respondents suggest increasing the frequency of disinfection in the subway station and isolating individual carriages. Registering real name in subway station can effectively track the travel path of the suspected cases, which helps to find passengers who are in contact with the suspected cases faster and more accurately. Limiting the density of passengers and increasing the frequency of disinfection are routine operations during the COVID-19 pandemic, which can prevent a wider spread of the virus. Isolating individual carriages can stop the virus from spreading between carriages and this measure requires platform staff on duty to guide the passenger flow into various carriages. Fewer respondents ask for real-time query of the full load rate inside the carriages, presumably because the query takes time and the number of passengers inside the carriages can be observed on the platform. Fewer respondents ask for suspension of the sale of one-way tickets and daily tickets, presumably because the respondents haven’t realized that it is difficult to register real-name for one-day tickets and daily tickets, which would lead to the inability to track passengers who are in contact with the suspected cases in time. Therefore, it is necessary to suspend the sale of one-day tickets and daily tickets during the prevention and control period of the COVID-19 pandemic.

43.1% of the respondents who have cases among their acquaintances are willing to take rail transit. The chi-square analysis shows that whether there are cases among acquaintances have no significant impact on whether they will choose rail transit or not. Among the respondents who have cases on the way from their residences to the nearest subway station, 45.4% are unwilling to take rail transit. The chi-square analysis shows that whether there are cases on the way from the residence to the nearest subway station have no significant impact on whether they will take rail transit.

4. Modeling analysis of choice behavior of rail transit

Based on the questionnaire data, variables are selected from personal attributes, travel attributes, and perception of COVID-19 to establish a binary logistic model, analyzing
whether commuters will choose rail transit. The dependent variable is whether to “choose rail transit”, and “Y = 1” means to choose rail transit, “Y = 0” means not to choose rail transit. The utility function of Y = 0 is 0, i.e., the reference selection is not to choose rail transit. We hypothesise that occupation, walking time from residence to the nearest subway station, times of transfers required to get to workplace by rail transit, and commuting tools before the COVID-19 pandemic, the probability of self-infection with COVID-19 perceived by commuters, and the possibility of being infected in public transport/private car will significantly affect whether commuters choose to travel by rail transit during the resumption of work. Self-employed people can independently decide whether to go to work, freelancers can independently decide where to work. However, employees of enterprises and institutions are faced with fixed work requirements (time, location), so employees of enterprises and institutions are more likely to commute by rail transit. The shorter the walking time from residence to the nearest subway station, the lower the probability of contacting strangers on the road. And the residents who live near the subway station are pursing the convenience of easy access to the subway generally, thus they are more likely to commute by rail transit. People who commuted by public transport before the COVID-19 pandemic are more likely to change their commuting tools during the resumption of work, because commuters may think that the probability of being infected in public transport is greater than in other modes of transportation. People who commuted by private cars before the outbreak are less likely to change their commuting tools during resumption of work, because private cars can provide a private and free space and reduce the risk of infection. Commuters who think they are more likely to be infected with the virus will be more cautious and will try to avoid contact with strangers, so the probability of choosing rail transit is lower. Commuters who think that the risk of being infected with the virus in public transport is higher have a lower probability of choosing rail transit.

Before establishing the regression equation, the col-linearity test of each explanatory variable was conducted. The results show that the VIF value of each explanatory variable is less than 10, indicating that the collinearity relationship between the variables is weak, and a logistic regression model can be established (He and Min, 2008; Wang et al., 2006). This paper adopts a stepwise selection strategy, which is based on maximum likelihood estimation. Dummy variables and continuous variables are identified in Table 2. The estimation results of parameters and variables in the final model are shown in Table 3. According to the data in Table 3, the following logistic regression equation can be obtained,

$$
\text{Logit } P = -4.631 - 1.549X_1(1) - 1.023X_1(2) - 4.446X_2(1)
- 5.736X_2(2) - 3.865X_3(3) - 5.768X_3(4) - 4.519X_3(5)
+ 2.082X_4(1) + 1.618X_5(2) + 0.708X_5(3) + 0.686X_5(4)
- 0.533X_5
$$

Table 4 shows the results of the test for the logistic model. The p value corresponding to the Wald observation of the coefficient significance test of each explanatory variable is less than the significance level of 0.05, indicating that the linear relationship between the explanatory variable left behind and Logit P is significant (Wang and Guo, 2001; Woodridge, 2006). The Hosmer and Lemeshow test is used to judge how good the model fits. If the p-value is greater than the significance level, it means that there is no significant difference between the predicted value and the observed value, so the fitting degree of the model is high. In the model the p-values tested by Hosmer and Lemeshow are greater than 0.05, indicating that the model fits well. Cox & Snell R² and Nagelkerke R² describe the percentage of the change in the dependent variable explained by the model's independent variables. The closer the values are to 1, the more fitting the model is. In the model, the two values are 0.565 and 0.782 respectively, indicating that the accuracy of

| Variable | Category | Detail |
|----------|----------|--------|
| X₁: occupation | Categorical variable | Dummy variable |
| X₂: commuting tools before the COVID-19 pandemic | Categorical variable | Reference variable |
| X₃: walking time from residence to the nearest subway station | Categorical variable | Reference variable |
| X₄: the possibility of being infected in private car | Continuous variable |
| X₅: the possibility of being infected in public transport | Continuous variable |
the model is acceptable. The overall accuracy indicates the consistency between the results predicted by the model and the results of the actual choice behavior. The closer the value is to 100%, the more fitting the model is. In the model, the fitting accuracy of the overall data is 93.4%, indicating that the model is good. In summary, the results of the model are credible.

The parameter estimation results show the results as follows. 1) Occupation, commuting tools before the COVID-19 pandemic, walking time from residence to the nearest subway station, possibility of being infected in private car and possibility of being infected in public transport have a significant impact on commuters’ choice of rail transit. 2) Compared with employees of enterprises and institutions, self-employed people and freelancers are less likely to commute by rail transit, with the probability being 0.212 and 0.360 times respectively. This is consistent with the priori hypotheses that employees of enterprises and institutions are faced with rigid commuting requirements, while self-employed people and freelancers can independently decide the time or location of work. Therefore, employees of enterprises and institutions are more likely to take rail transit. 3) Compared with those who commuted by public transport before the COVID-19 pandemic, people who commuted by non-public transport before the COVID-19 pandemic are less likely to take rail transit during the COVID-19 pandemic. Among them, those who commuted by private car and bicycle/electric car before the COVID-19 pandemic are 0.003 times more likely to take rail transit during the COVID-19 pandemic than those who commuted by public transport before the COVID-19 pandemic. In other words, those who commuted by public transport before the COVID-19 pandemic are more likely to take rail transit during the COVID-19 pandemic. Presumably because walking and commuting by bicycle or electric vehicles are safer and healthier. In addition, bike-sharing companies have launched the “Free Bicycle for Resumption of Work” activity to encourage citizens to commute by bicycle (Sohu Network, 2020d). Therefore, people who walked and commuted by bicycle/electric vehicles before the COVID-19 pandemic have no need to change their commuting modes. As for taxi/taxi-hailing, under the premise of no car-sharing, the commuters commute by taxi or taxi-hailing accept one-to-one service, and the driver’s personal information and health status are managed and checked by the car-hailing platform. Therefore, the safety of taxi or taxi-hailing is guaranteed. As for the customized shuttle buses, they carry commuters whose starting point or destination is within the same area. The personal information and health status of the passengers is managed by the bus company, thus ensuring a high degree of safety. As for private cars, during the resumption of work, many cities encourage citizens to travel by private cars. For example, in order to alleviate urban traffic congestion, Guangzhou City implements the “four days permitted and four days prohibited” measure, which requires that small and medium-sized passenger cars (including temporary license plates) from non-Guangzhou cities should enter the controlled area for a maximum of 4 consecutive days and there must be an interval of 4 d between driving in. But the implementation of this measure is suspended during the resumption of work to decentralize the flow of public transport (Su et al., 2020). Therefore, the majority of commuters who take rail transit during the COVID-19 pandemic are those who commuted by public transport before the COVID-19 pandemic. 4) The longer it takes for commuters to walk from their residences to the nearest subway station, the less likely they will commute by rail transit. Among them, commuters who walk less than

### Table 3 — Parameter estimation results of the logistic model.

| Variable | B     | S.E. | Wald | Sig  | Exp(B) |
|----------|-------|------|------|------|--------|
| Occupation | 1.549 | 0.567 | 10.567 | 0.005 | 0.212 |
| Occupation (1) | -1.023 | 0.445 | 5.292 | 0.021 | 0.360 |
| Commuting tools before the COVID-19 pandemic | 4.446 | 0.628 | 50.075 | 0.000 | 0.002 |
| Commuting tools before the COVID-19 pandemic (1) | -5.736 | 0.571 | 100.815 | 0.000 | 0.003 |
| Commuting tools before the COVID-19 pandemic (2) | -3.865 | 0.697 | 30.753 | 0.000 | 0.003 |
| Commuting tools before the COVID-19 pandemic (3) | -5.768 | 0.530 | 118.370 | 0.000 | 0.003 |
| Commuting tools before the COVID-19 pandemic (4) | -4.519 | 1.069 | 17.861 | 0.000 | 0.011 |
| Walking time from residence to the nearest subway station | 2.082 | 0.796 | 6.854 | 0.009 | 8.021 |
| Walking time from residence to the nearest subway station (1) | 1.618 | 0.717 | 5.085 | 0.024 | 5.041 |
| Walking time from residence to the nearest subway station (2) | 0.708 | 0.714 | 0.986 | 0.321 | 2.031 |
| Walking time from residence to the nearest subway station (3) | 0.686 | 0.531 | 9.656 | 0.000 | 1.985 |
| The possibility of being infected in private car | -0.533 | 0.195 | 7.453 | 0.006 | 0.587 |
| The possibility of being infected in public transport | -4.631 | 1.066 | 18.885 | 0.000 | 0.100 |

Note: B is the regression coefficient and the constant term, which can be negative. If the B value is equal to 0, Exp (B) is 1, indicating that there is no significant difference between the two groups.

### Table 4 — The result of the test for the logistic model.

| Index                  | Value    |
|------------------------|----------|
| p-value                | <0.05    |
| Hosmer and Lemeshow test (p-value) | 0.385 (>0.05) |
| -2log likelihood       | 252.174  |
| Co. & Snell R²         | 0.565    |
| Nagelkerke R²          | 0.782    |
| Overall accuracy (%)   | 93.4     |
5. Conclusions

This paper investigates commuters’ intention of choosing rail transit and other modes of transportation during the resumption of work in advance, which helps to estimate the passenger flow distribution of various modes of transportation roughly in the city, providing data support for traffic management departments to make traffic control plan and emergency measures in advance. Through the screening of the influencing factors and the analysis of the regression model, it is found that occupation, commuting tools before the COVID-19 pandemic, walking time from residence to the nearest subway station, possibility of being infected in private car and possibility of being infected in public transport have a significant impact on commuters’ choice of rail transit. In addition, of the commuters who don’t choose rail transit during the COVID-19 pandemic, 97% choose private car, walking and bicycle/electric car, indicating that commuters have a strong sense of self-protection and their trust in the safety of bus, subway, taxi, taxi-hailing is not high.

According to the research results, this paper puts forward some suggestions on urban traffic management during the resumption of work. It is suggested that the enterprises should report the resumption plan in detail. Traffic management departments should allocate traffic flow reasonably. The government should formulate preferential policies to encourage customized and personalized travel. The density of people in rail transit entrances, platforms and carriages should be strictly controlled, and carriages should be isolated to prevent the spread of the pandemic. The signal timing should be adjusted according to the local traffic demand temporarily to improve the road capacity. The safety of taxi/taxi-hailing should be promoted to help to relieve parking pressure.

The analysis of this paper is based on the data obtained from the questionnaire and a non-aggregate model. The sample size obtained this time is not large enough and the specific area and the severity of the local pandemic are not considered. When investigating the commuting tools of commuters before the COVID-19 pandemic, this paper classified bus and subway into public transport, ignoring the difference between bus and subway. The problems above lead to certain limitations of the data and the results.

Conflict of interest

The authors do not have any conflict of interest with other entities or researchers.

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