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# Impact of the Real-time Bus Information on Bus Riders, an Evidence from Guangzhou

*Jianrong Liu* and Jiajun Mei*

(*School of Civil Engineering and Transportation, South China University of Technology, Guangzhou 510640, China*)

**Abstract**: This paper evaluates impacts of the real-time information from the smartphone APP and the real-time information board at bus stops on bus users with survey data. Through the analysis of data with t-test and linear regression, it is found that the waiting time of bus riders with real-time information from the smartphone APP is much less than that of bus riders without the real-time information. As to the perceived waiting time of bus users, through the linear regression, the study finds that without the real-time information, bus riders' perceived waiting time is greater than waiting time. At the same time, the perceived waiting time of bus users with real-time information is only slightly larger than their waiting time. Through regressing anxiety on real-time information, perceived waiting time and so on, it is found that real-time information reduces anxiety remarkably.

**Keywords**: real-time information; bus; perceived waiting time; waiting time; anxiety

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## 1 Introduction

Since that satisfaction of the public transit has a significant influence on passengers behavioral intention of traveling by public transit[1-2], and the service quality of the public transit has a great influence on satisfaction of the public transit[3-4], in order to encourage travelers to travel by the public transit and increase the public transit's model split, it is necessary to improve the public transit's service quality. Through the review of papers related to the service quality of the bus transit, it is found that there are lots of factors that influence service quality of the bus transit, such as guidance, comfort, speed, safety, information, reliability and so on[2, 5-6].

As stated by Cheng and Tsai[7], passengers' waiting time (WT) determined their waiting experience and influences the overall perception of service quality. Travelers become anxious and are less likely to travel by the public transit when the public transit is unreliable or WT varies greatly. And these issues deterred or discouraged them from choosing public transit for future trips. Lots of methods have been employed to decrease travelers' WT at the station and to relieve travelers' anxiety when waiting for the bus or the train. In recent years, some transit authorities in the developed countries or regions have begun to install the real-time information board (RTIB) at public transit stations.

Different from developed countries or regions, such as America, Canada, and Europe, cities in developing countries or regions of Asia are rather densely populated, and the income is rather lower compared with people in developed countries or regions. Therefore, it is unrealistic for these cities to rely on private cars, and it is necessary to develop the public transit. Taking Guangzhou (also known as Canton, the third largest cities in China) as an example, most of the travelers in Guangzhou rely heavily on the public transit, which differs greatly from most cities in developed areas. Although the private car-ownership has been growing rapidly in recent years, it is still low compared with the developed areas.

Although some papers had studied the impact of the real-time information (RTI) provided at the station, most of the researches were carried out in

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* Corresponding author. E-mail: ctjrliu@scut.edu.cn.

developed countries. Relatively, few papers had analyzed the impact in the developing countries or regions. As Das and Pandit[8] stated, "Since the service delivery environment differs between developed and developing nations, the user perception of service quality varies between these economic regions", therefore, research results of developed countries may not be suitable for developing countries. Furthermore, with the development of communication technology and the increase of the smartphone usage, lots of travelers in developing countries obtain the real-time information of the public transit from the smartphone app (RTIS). For example, in Guangzhou, travelers can obtain RTI through serval smartphone apps, such as Xingxuntong①, BaiduMap②. Relatively few papers were involved in the impact of RTIS.

When considering investment in the public transit, decision-makers should take into account of the cost and the benefit. Therefore, this paper studies the impact of RTI in the developing counties. There are three goals we want to achieve in this paper: 1) The impact of RTIS on travelers' WT at the station; 2) The impact of RTI on travelers' perceived waiting time (PWT); 3) The impact of RTI on travelers' anxiety at the station.

This paper proceeds as follows. In Section 2, prior researches of the impact of the real information system for transit passengers are presented. Section 3 presents an overview of the data collection. Results are summarized in Section 4. Section 5 presents conclusions and recommendations for policy-makers.

## 2 Literature Review

The use of AVL (Automatic Vehicle Location) only began in the last decade and the provision of RTI to riders is an even more recent development[9]. But the availability of RTI for travelers is becoming more and more widespread all around the world. Several papers have been conducted on various RTI systems (the mobile app, the stop, the website, and so on). Before many transit agencies even had real-time bus tracking capabilities, Reed[10] conducted a conjoint analysis of the response to RTI and found that RTI was of potentially significant value to transit customers. In recent years, researchers focus on the impact of RTI on the passenger's WT, PWT, and satisfaction and traveling behavior.

a) Reducing passengers' WT.

Only a few of papers are involved in the impact of RTI on passengers' WT at the bus stop. And all these papers agreed that RTI can reduce riders' WT at the stop.

Watkins et al.[9] and Brakewood et al.[11] found that the bus rider with RTIS waited about 2 min less than the bus rider without RTIS. However, Brakewood et al.[12] found that users with RTI waited on average 0.8 min less than users without RTI. This number is much less than that of Watkins[9] and Brakewood[11]. Ferris et al.[13-14] found that 91% of the respondents reported spending less time waiting as a result of using RTI. Hardy[15] investigated the benefit of RTIS and 45% of respondents stated that they saved 3 min or more per journey.

b) Reducing passengers' PWT.

Most papers involved the impact of RTI on passengers' PWT agreed that RTI has a positive impact on passengers' PWT.

Schweiger and Shammout[16] found that after the installation of the RITB in London, the mean PWT decreased from 11.9 min to 8.6 min (3.3 min less), and 65% of passengers felt that they waited for a shorter time (even though WT did not change significantly). Dziekan and Vermeulen [17] and Dziekan and Kottenhoff[18] investigated the effects of RTIB on passengers' perceived wait time with a before-and-after evaluation study and found that the PWT decreased by 20% (from 6.3 min to 5 min). Watkins[9] found that PWT decreased by 0.73 min because of the implementation of RTI. Chow et al.[19] found that the overestimation of PWT by passengers without RTI was 2.66 min, while the overestimation of WT with RTI decreased to 1.34 min.

Although most papers found that there is a positive influence of RTI on travelers' PWT, Pécheux[20] did not find any decrease in the perceived wait time in the study of the impact of RTIB (Portland's Transit Tracker).

c) Reducing passengers' anxiety and promoting satisfaction at the stop.

Most papers argued that there is a positive

①The Xingxuntong app is developed by the Guangzhou Municipal Commission of Transport.

②The BaiduMap is developed by Baidu, and it is a desktop and mobile phone mapping service app.

influence of RTI on riders' evaluation of the transit service. But some papers did not find a significant improvement in riders' evaluation after the application of RTI system.

Caulfield and O'mahony[21] found that the 80% of respondents felt frustrated because of the absent of RTI. Zhang et al.[22] found that RTI significantly increased rider's feeling of security at night and satisfaction. The results in the paper of Ferris[13] found that 92% of respondents stated that they were more satisfied with public transit as because of RTI. Brakewood, Barbeau and Watkins[11] found RTI increased travelers' satisfaction significantly when waiting for a bus. Fries et al.[23] found that travelers' anxiety level significantly at the bus stop. Gammer et al.[24] found that 65% of the respondents felt the bus arrival times provided via the QR codes made wait time 'a little more' or 'much more' acceptable, and 39% either feeling 'a little' or 'much' safer as a result of the arrival time information. Papangelis et al.[25] found that passengers with RTI perceived more control of their journey.

But still, some papers find that there is not a significant relationship between the application of RTI system and the improvement of passengers' satisfaction and anxiety. Mehndiratta et al.[26] argued that RTI had no significant impact on transit users' overall satisfaction. Watkins[9] argued that there was no significant difference of aggravation between travelers with RTI and travelers without RTI. Pécheux[20] did not find a significant change in overall satisfaction after the installation of RTI system. Dziekan and Vermeulen[17] found no effects of RTI on passengers' perceived security with a before-and-after at-stop RTI implementation evaluation study. Overall, Brakewood[12] found RTI only had limited impact on service quality of the rail.

d) Increasing the ridership.

Evidence on whether RTI, either from RTI board located at bus stops or from the smartphone APP, increase the ridership of public transit, is mixed.

Schweiger[27] argued that RTI assisted in the maintenance of ridership at a minimum. Schweiger and Shammout[16] found that with the introduction of RTI system, ridership increased by 5.8%. Ferris[13] asked bus riders about the number of bus trips they make after the installation of RTI and found that about 15% stated they traveled more by bus. After the development of RTI for 4 years, Gooze et al.[28] and Gooze[29] found that about 16%, 11%, 6% of users stated that they took one, two, or three or more trips because of RTI, respectively. Politis et al.[30] found that 19.7% of the respondent interviewed undertake more trip by bus as a consequence of RTI. Tang and Thakuriah[31] evaluated the effect of RTI on ridership with longitudinal data on route level from January 2002 through December 2010, and found that the RTI increased the ridership modestly-126 more riders per weekday. With the regression model, Chow et al.[19] found that the ridership increased by 1.7% as a result of RTI. Gammer et al.[24] investigated the viewpoint of bus travelers and the result showed that 55% of respondents stated they were either a little or a lot more likely to use a bus after their experience of receiving bus arrival time. Brakewood et al.[32] analyzed the impact of RTIS on ridership and found that the ridership increased approximately 118 trips per route per weekday (1.7% of weekday route-level ridership) because of RTI. Frei and Gan[33] investigated commuters' en route decisions about switching from automobile to park-and-ride while RTI was provided, and found that RTI had significant effects on commuters' mode choice behavior.

But there are some articles argued that RTI has no effect on the increase in ridership. With the panel survey data, Zhang et al.[22] found no significant increase in travelers' trip frequency after the installation of RTI system. Controlling effects of population, city density, unemployment, congestion and fuel prices, Vonderschmitt[34] found that the RTIS did not have an effect on ridership in either measure.

## 3 Data Collection

In order to estimate the impacts of RTI from the users' point of view, we conducted a survey in Guangzhou. Three typical bus stops were chosen, that is, the Gangding BRT Station, the Huanong Bus Station, and the Huagong Stop. As a large BRT station, the Gangding Station is a busy and large station, which consists of shelters, seats, and RTI boards. The Gangding Station is assigned to 64 fixed bus lines, in which, most of bus lines' headway is no more than 10 min. The Huanong Bus Stop is a bus stop consist of little more than a sign, and there is no RTI board. There are 12 bus lines across the Huanong Bus Stop, in which, 1 is a peak-hour line and 2 are night lines. The headways of these lines are about

10 min. The Huagong stop is similar to the Huanong bus stop, except that there is only one bus line assigned to it. And the headway of the line is about 15-20 min.

A survey among bus users was carried out on some weekdays between April 2015 and July 2015 (from 07:00 am to 17:00 pm). 3 groups of investigators participated in the investigation, with 2 persons (investigator *A* and investigator *B*) in each group. Investigator *A* recorded the interviewee's arrival time, boarding time and gender. At the same time, Investigator *B* asked the interviewee some questions. These questions included: age, travel purpose, the bus he/she was waiting for; familiar with the bus line the interviewee wanted to take or not; did he/she get RTI through the traffic APP in the smartphone; the anxiety level (Likert scale, 1, indicates "isn't anxious at all", and 5 indicates "very anxious"). Also, Investigator *B* asked the interviewee how long did he/she perceive he/she had waited when the bus was coming. A total of 761 travelers were investigated.

Table 1 provides the descriptive statistics. 47.57% are female. About one-third of interviewees got RTI through a smartphone app. Also, most of the interviewees were familiar with the bus line they wanted to take on.

## 4 Results

a) Impact of RTI on bus users' waiting time.

Because a 10-min bus headway marks the transition from random to coordinated passengers' arrivals[35-36], and the headway of the Huagong Stop is usually more than 15 min, we choose the data investigated from the Huagong Stop as the research object. As mentioned above, there is no RTI board at the Huagong Stop, and travelers can only get RTI through the smartphone app. Statistical characters of WT of the Huagong subgroup are shown in Table 2.

It can be found from Table 2 that the difference between the "without information" subgroup and the "with" subgroup is significant. We then regress WT on gender, age, RTI, travel purpose. The result is shown in Table 3.

All the parameters in Table 3 are statistically significant except for the travel purpose - "return" and age. It can be concluded that the travelers' WT reduced by 1.72 min because of RTI. This result is consistent with the finding of Brakewood[11] and Watkins[9] but is much larger than that of Brakewood[12].

**Table 1 The sample socio-demographic and other travel characteristics of interviewees**

| Category | | Freq. | Percent |
|---|---|---|---|
| Gender | Female | 362 | 47.57 |
| | Male | 399 | 52.43 |
| Information Type | No information | 257 | 33.77 |
| | RTIS | 279 | 36.66 |
| | RTIB | 225 | 29.57 |
| Familiarity | Unfamiliar | 148 | 19.45 |
| | Familiar | 613 | 80.55 |
| Travel Purpose | Return | 256 | 33.64 |
| | Work | 346 | 45.47 |
| | Entertainment | 159 | 20.89 |
| Anxiety Level | 1 | 198 | 26.02 |
| | 2 | 196 | 25.76 |
| | 3 | 275 | 36.14 |
| | 4 | 82 | 10.78 |
| | 5 | 10 | 1.31 |

**Table 2 Statistical characters of WT of the Huagong Stop**

| Category | | Mean | Std. Dev. | Freq. | $t$ | $p$ |
|---|---|---|---|---|---|---|
| Information | Without | 10.79 | 4.97 | 99 | 270 | 0.008 |
| | With | 9.14 | 4.66 | 179 | | |

**Table 3 Estimation results for WT**

| Category | Reg |
|---|---|
| Male | 1.337* <br> (0.573) |
| RTI | -1.717** <br> (0.613) |
| Return | 0.871 <br> (1.000) |
| Work | 2.254* <br> (1.010) |
| Age | 0.043 <br> (0.047) |
| Constant | 7.655*** <br> (1.625) |

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

b) Impact of RTI on bus users' perceived waiting time.

In this section, we analyze the impacts of RIT on PWT of bus users. Statistical characters of PWT of interviewees are shown in Table 4 and Fig.1.

Male, RTI, Return and Work are dummy variables. Male equals to 1 if the interviewee is male, and equals to 0 if the interviewee is female. RTI equals to 1 if the interviewee can get the real-time information through the smartphone app. Return equals to 1 if the interviewee's travel purpose is returning, otherwise, it equals to 0. Work equals to 1 if the interviewee's travel purpose is commuting, otherwise, it equals to 0.

**Table 4 Statistical characters of WT of sub-groups**

| Information Type | Time | mean | st.d | $t$ | $p$ |
|---|---|---|---|---|---|
| No information | WT | 9.21 | 4.20 | 26.022 | 0.000 |
| | PWT | 11.57 | 4.69 | | |
| Smartphone app | WT | 8.22 | 4.21 | 4.306 | 0.000 |
| | PWT | 8.55 | 4.53 | | |
| RTI board | WT | 7.43 | 2.95 | 7.182 | 0.000 |
| | PWT | 8.32 | 3.20 | | |
| Total | WT | 8.32 | 3.94 | | |
| | PWT | 9.51 | 4.49 | | |

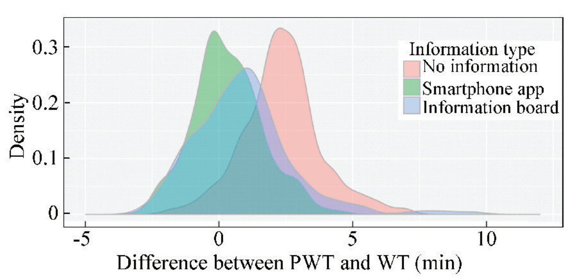


**Fig.1 The distribution of the difference between PWT and WT of the sub-group**

It can be figured out from Table 4 the difference between PWT and WT of the smartphone app subgroup is small, that is, the smartphone-app subgroup's average WT and average PWT are 8.22 min and 8.55 min, respectively. So does RTI board group. In contrast, the difference between PWT and WT of the no-information subgroup is rather significant, that is, the average WT and the average PWT are 9.21 min and 11.57 min, respectively. Fig.1 shows the distribution of gaps between PWT and WT of the three sub-groups. It seems the smartphone-app subgroup and the RTI-board subgroup distribute around 0.5 min, which is not so far from 0. To the contrary, the no-information subgroup distributes around 2 min, which is obviously different from 0.

To control potentially confounding variables influencing PWT and get the impacts of RTI on PWT, we regress PWT on WT, gender, age, and RTI and so on, with the results shown in Table 5. The overall goodness-of-fit of the model is high. It can be concluded from Table 5 the impacts of WT, gender, RTI on PWT are significant, while the coefficients of age, familiarity, and travel purpose (return and work) are below the significant level.

**Table 5 Estimations of PWT**

| Category | Reg1 | Reg2 |
|---|---|---|
| WT | 1.023*** | 1.019*** |
| | (62.73) | (62.65) |
| Male | −0.268* | −0.263* |
| | (−2.40) | (−2.33) |
| Age | 0.000 | 0.003 |
| | (0.03) | (0.58) |
| Familiarity | −0.102 | −0.089 |
| | (−0.57) | (−0.50) |
| Return | 0.035 | −0.050 |
| | (0.19) | (−0.28) |
| Work | 0.106 | 0.098 |
| | (0.73) | (0.69) |
| Board | −1.425*** | |
| | (−9.01) | |
| App | −1.992*** | |
| | (−16.02) | |
| RTI | | −1.742*** |
| | | (−14.91) |
| _cons | 2.302*** | 2.262*** |
| | (8.12) | (8.11) |
| $R^2$ | 0.884 | 0.881 |

Note: $t$ statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In Table 5, Board, App, and Familiarity are dummy variables. Board equals to 1 if there is RTI board at the bus stop. App equals to 1 if the interviewee can get the RTI from the smartphone app. Familiarity equals to 1 if the interviewee is familiar with the bus he/she want to take on.

The negative and significant values of the Board's coefficient (−1.425) and the App's coefficient (−1.99) show that RTI can significantly decrease the interviewee's PWT. Furthermore, the difference between the coefficient of Board and the coefficient of App is significantly at 5% level. Therefore, RTIS has a greater influence on travelers than RTI from the board at the bus stop. On average, RTI can reduce PWT by 1.74 min on average (as shown in Reg2 of Table 5). The result is smaller than the result of Schweiger and Shammout[16], and is similar to that of Dziekan and Vermeulen[17] (1.3 min), Dziekan and Kottenhoff[18] (1.4 min), and is larger than the result of Watkins[9].

c) Impact of RTI on bus users' anxiety.

In this section, we analyze the impacts of PWT, gender, age, the familiarity of bus travel, and travel purpose on PWT of bus users.

Fig.2 shows the distribution of the anxiety of the three sub-groups. Obviously, there is a negligible difference between the distributions of the RTIS subgroup and the RTIB subgroup. But the difference between the no-information subgroup and RIT subgroups (including the smartphone-app subgroup and the RIT-board subgroup) is large. Less than 5.5% of the respondent of the RTIS subgroup and the RTIB subgroup felt anxious, at the same time, about 23% of the interviewees without RTI felt anxious. Also, about one-third of interviewees of the RTIS subgroup and the RTIB subgroup did not feel anxious at all, but only 13.6% of interviewees of the "no RTI" subgroup did not feel anxious at all.

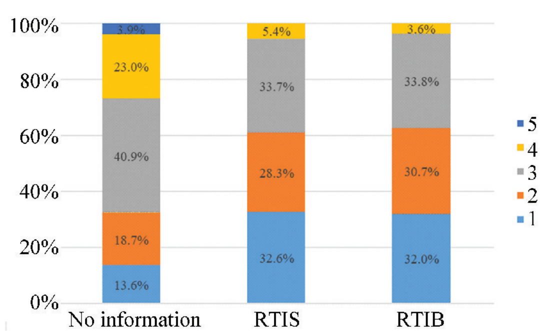


**Fig.2 The distribution of interviewees' anxiety**

In order to analyze the impacts of RTI and other factors, we regress anxiety on RTI, PWT, familiarity, gender, age, and travel purpose.

The evaluation of the traveler's anxiety is an ordinal scalar. Therefore, except for the linear regression method, we also analyze the impacts of interviewees' factor with the ordered logit regression. The results are shown in Table 6.

As shown in Table 6, PWT, familiarity, RTI, and Work are significant, but variables such as age, male and return, are insignificant. Since the coefficient of male is insignificant, we can conclude that there is no impact of gender on bus users' anxiety. The coefficient of return is insignificant, therefore, there are no differences between the impacts of the travel purpose-return and travel purpose-entertainment on bus users' anxiety. The coefficient of Work is significant at 0.1% level and is large, therefore commuters are much more anxious than non-commuters, and the result is consistent with the result of Rahman et al.[37], who found that commuters care more about RTI. The factor of age is not significant at 5% level, which shows that there is no relationship between anxiety and age, and it is inconsistent with the conclusions of Ferris[13]. The coefficient of familiarity is significant and positive, which means that bus users familiar with the bus they want to take on are more anxious than those who are unfamiliar with the bus they want to take on.

**Table 6 Estimations of bus users' anxiety**

| Category | Linear | Logit |
|---|---|---|
| PWT | 0.045*** | 0.100*** |
| | (0.008) | (0.019) |
| Male | −0.003 | 0.020 |
| | (0.066) | (0.138) |
| Age | 0.007 | 0.014 |
| | (0.003) | (0.007) |
| Familiarity | 0.203* | 0.457* |
| | (0.091) | (0.201) |
| RTI | −0.643*** | −1.343*** |
| | (0.077) | (0.168) |
| Return | 0.061 | 0.013 |
| | (0.094) | (0.194) |
| Work | 0.569*** | 1.132*** |
| | (0.091) | (0.189) |
| adj. $R^2$ | 0.244 | |
| pseudo $R^2$ | | 0.105 |

Standard errors in parentheses; * $p<0.05$, ** $p<0.01$, *** $p<0.001$. For the sake of brevity, we do not present the parameter of the constant.

As to the impact of RTI, the coefficient is significant at 0.1% level in the linear regression model and the ordered logit model, both. In the linear regression model, the coefficient of RTI is −0.643. Since the anxiety of interviewees only varied from 1 to 5, the coefficient of RTI (−0.643) is rather large. It indicates that there is a great influence of RTI on bus users' anxiety. In the ordered logit model, the coefficient of RTI (−1.343) is considerable compared with other factors such as work and familiarity.

In order to analyze and study data information further, we obtain odds ratios of the above-mentioned ordered logit model. The results are shown in Table 7. In the output above the results are displayed as proportional odds ratios. As shown in Table 7, all the variables except Male, Age and Return, are significant at 5% level. Since that the purpose of this part is to analyze the impact of RTI on bus users' anxiety, we focused on the impact of RTI. Given that all of the variables except for RTI in the model held constant, for a one-unit increase in RTI, going from 0 to 1, the odds of the higher anxiety versus the lower anxiety is 0.26 times. The data is significantly smaller than 1, which indicates that there is a great influence of RTI on bus users' anxiety.

**Table 7 Proportional odds ratios of the ordered logit model**

| Anxiety | Odds ratio | Robust Std. Err. | $z$ | $P > z$ |
|---|---|---|---|---|
| PWT | 1.106 | 0.021 | 5.220 | 0.000 |
| Male | 1.020 | 0.141 | 0.140 | 0.887 |
| Age | 1.014 | 0.007 | 1.910 | 0.057 |
| Familiarity | 1.579 | 0.317 | 2.280 | 0.023 |
| RTI | 0.261 | 0.044 | −7.980 | 0.000 |
| Return | 1.013 | 0.196 | 0.070 | 0.945 |
| Work | 3.102 | 0.585 | 6.000 | 0.000 |

## 5 Discussions and Conclusions

### 5.1 Research Findings

The goal of this paper is to analyze the impact of RTI on passengers' WT, PWT, anxiety at the bus stop. This analysis results in this paper show that RTI not only reduces passengers' WT, PWT, but also reduces passengers' anxiety significantly when waiting for the bus. Although RTI will not improve the reliability of transit, it can improve the perceptions relating to reliability by giving riders more control.

We study the impact of RTI system on passengers' WT with the linear regression analysis. It was found on average, WT of bus users with RTI obtained from the smartphone APP is 1.72 min less than bus users without RTI. This result in this paper is consistent with the result found by Watkins[9] (1.98 min). Linear regression is used in this paper to analyze the impact of RTI on bus users' PWT. The result shows that RTI can reduce bus users' PWT by 1.7 min. We also analyze the impact of RTI on bus users' anxiety at the bus stop. The linear regression and the ordered logit regression show that there is a considerable impact of RTI on bus users' anxiety. RTI can reduce anxiety by 0.64 in the linear regression model, which is rather large since the anxiety of interviewees only varied from 1 to 5. We can draw the same conclusion from the ordered logit regression, too.

In summary, RTI from the smartphone APP can reduce bus users' WT. Additionally, RTI, no matter from a smartphone APP or from an RTI board at the bus stop, can reduce passengers' perceived waiting time and anxiety significantly.

### 5.2 Policy Implications

Since that the service quality of the public transit has a great influence on travelers' willingness of traveling by public transit, in order to increase the model split of the public transit, it is necessary to improve the service quality of the public transit. A large and growing body of literature has focused on aspects of service quality of public transit.

However, some methods, such as the installation of priority bus lanes, has a great impact on private cars, and it will trigger opposition by travelers with private cars. As to the transit signal priority, lots of cities in developing countries or regions of the Asia are rather congested, and it is difficult to give priority to the public transit at the intersection. Taking Guangzhou as an example, the delay-ratio of Guangzhou is about 2 in recent years①. Although the agent of Guangzhou wants to implement the transit signal priority and to install more priority bus lanes, only a few actions have been implemented. Comparatively, the distribution of the real-time information of the public transit does not affect the well-being of travelers with private cars. Therefore, in order to improve the service quality of the public transit, the government should pay attention to the installation of the real-time information board at the bus stop. Furthermore, with the development of the economy, the smartphone ownership increases rapidly in recent years. The relative agent should pay more attention to the promotion of the smartphone app related to RTI the public transit.

①The delay-ratio is defined as the ratio between the travel time based on the average speed and the travel time in the free flow by the GaodeMap. http://report.amap.com/download_city.do

### 5.3 Future Research

There are still controversies on the impact of RTI of the public transit on the ridership of the public transit. Although some papers argued that the real-time information promote the ridership of the public transit, some papers did not found a significant impact. And the impact of RTI on the ridership in cities of developing countries or regions still remains unknown. Further study should analyze the impact of RTI on ridership in cities of developing countries or regions.

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