

The Effect of Subway Station Layout on P2P Accommodation Price: The Moderating Effect of House Location

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Abstract. Due to the opening of subway, there are a mounting number of individual tourists and peer-to-peer accommodations (P2PA) has also become a new choice of accommodations for tourists. However, little is known about the influence of subway layout on P2PA price. As a result of it, based on the neighborhood effect theory, this paper studied the relationship between subway station and P2PA price as well as one moderator (location). In order to solve the above problems, this paper collected data from Meituan platform. The results showed that (1) the existence of subway station has a positive impact on P2PA price. (2) When P2PA is located in CBD, its price is higher than those in non-CBD districts. (3) The shapley value related to room and area is higher. This paper expanded the influencing factors of P2PA price and proposed relevant suggestions for the sustainable development of P2PA.

Keywords: P2P accommodation pricing, subway station layout, house location, size of house, individual tourist

1 Introduction

In recent years, the local governments have increased investment in subway infrastructure construction to continuously optimize subway lines, and implemented various preferential measures for passengers. The rapid development of subway affects the self-guided tour [1]. For example, the opening of the subway makes transportation more convenient, which allows individual tourists to decide their own routes, and their destinations are no longer limited to tourists' attractions prescribed by tour groups. This not only provides convenience for individual tourists, but also reduces transfer and saves transportation costs for them. It can be inferred that individual tourists benefit a lot from the development of subway.

Given the autonomy of individual tour, P2PA has thus become a new choice for individual tourists. Unlike hotels, P2PA prices fluctuate severely and is usually priced by individual landlords, and there is no unified pricing standard. Considering that accommodation costs have become an important factor in individual tour, it of great significance to explore the factors of P2PA prices. However, many of them neglected the influence of subway on P2PA price. Therefore, the first research question of this paper is to explore the relationship between subway stations and P2PA prices. Besides, this paper also explored a moderator (location).

To address the above problems, this paper collected data related to P2PAs in Guangzhou from the platform of Meituan, and established a regression model to analyze the impact of subway on P2PA price. Besides, our proposed moderator significantly affected the relationship between the subway and the price of P2PA. The analysis from machine learning demonstrates that the subway can well predict the fluctuation of P2PA price.

The rest of the paper is structured as follows. We introduce relevant literature in Section 2. We then establish hypotheses in Section 3. In Section 4, we discuss the data and variables. In Section 5, we adopt regression models to explain the relationship between subway station and P2PA price, and two moderators. In Section 6, we verify the prediction capacity using machine learning XGBoost algorithms. We conclude our paper in Section 7.

2 Literature review

2.1 The Impact of Public Transportation on Tourism

The development of tourism is inseparable from transportation. Therefore, the urban transportation plays a decisive role in the development of tourism. At present, numerous researchers have paid attention to the relationship between the development of urban public transport and tourism. However, The subway is the symbol of a modern city, which has many positive impacts on the development of tourism, such as shortening travel time, lowering cost, promoting the development of tourism economy, attracting individual tourists and so on.

With the continuous progress of modern communication, transportation and other technological means, the number of individual tourists is increasing [2], and the online P2PA platform has also been developed to some extent. Different from traditional hotels, the accommodation on the P2PA platform is operated by the landlords. Tenants can contact the landlords through the platform directly, and the mutual communication can enhance the trust between the landlords and the tenant [3]. Moreover, P2PAs are rented by local landlords using idle houses, and their decoration and style are characterized by local characteristics and they can enjoy a better local experience and have a better understanding of the local culture in P2PAs [4]. However, most of the previous studies focus on hotels and ignore P2PAs. Therefore, this paper takes P2PAs as the research object to explore the development of P2PAs.

2.2 Determinants of P2PA

P2PA, a booming industry, has received increasing attention in recent years [5]. At present, many researchers have paid attention to the influencing factors of P2PA price changes. For example, Cai et al. conducted a study on the housing information on Airbnb in Hong Kong, and the results showed that house type and service quality can significantly affect the price [6]. Chang et al. also collected the data on Airbnb for analysis, and the results indicated that the type of room, the distance to scenery spots and the number of facilities provided affect the price markedly [7]. Jorge et al. took housing resources on Airbnb in Spain to research, and the experiment showed that the location of the accommodations has a significant impact on the price [8]. Although many scholars have discussed the factors affecting P2PA price in the above studies, they ignore the impact of traffic on P2PA price, and the literature on the relationship between

traffic and P2PA price is limited at present. Therefore, this paper attempts to explore the relationship between subway and P2PA and to supplement the existing research.

3 Theory Background and Hypotheses Development

3.1 Theory Background

The neighborhood effect is an economic and social science concept that holds that neighborhood relationships can directly or indirectly influence individual behavior [9]. In current research, many scholars have applied the neighborhood effect to regional analysis, population mobility and tourism management. For example, Shian discussed how tourism triggered the neighborhood effect. They found that the closer the accommodation is to public facilities, the shorter the walking time is, and the more significant the neighborhood effect is [10]. In this study, we demonstrated that when the distance between the subway station and the P2PA is close, the accommodations' price will change. Moreover, it brings conveniences to the tourists, which further enhances the neighborhood effect.

3.2 Hypotheses Development

3.2.1 The Direct Impact of Subway

As a convenient means of transportation, subway has been popularized in different cities in recent years, and it has become one of the important choices of most individual tourists to travel [11]. According to the neighborhood effect [10], the development of subway makes the street busy and increases the number and scope of business circle. Hence, when landlords realize the environmental advantages of housing resources, their pricing power becomes larger, which leads to the rise of housing prices near subway stations and higher price of P2PAs. Hence, we have the following hypothesis:

H1: The existence of subway has a positive effect on the P2PA price.

3.2.2 The Moderating Impact of District

CBD, as the central part of the city, has developed transportation and perfect public facilities, which meet the traffic requirements of many people' s travel. Therefore, in this case, it is conducive to the enhancement of the neighborhood effect, the landlord has strong pricing power, and thus the price is higher.

In contrast, within non-CBD, there is low population density and fewer business areas and low playability. Compared with CBD, non-CBD has lower housing price, which weakens the neighborhood effect and pricing power of landlords. To sum up, we propose the following hypothesis:

H2: When the P2PA locates in the CBD area, the impact of subway on P2PA price will be accentuated; When the P2PA locates in the non-CBD area, the impact of subway on P2PA price will be attenuated.

4 Research Context

4.1 Data Collection and Preprocessing

The data set used in this paper was collected on August 20, 2022 from Meituan platform (www.zhenguo.com), a short-rent booking platform for P2PA. It has more than 150000 landlords and 720000 online listings, covering more than 350 cities in China.

This article obtained the data of 1795 P2PAs in Guangzhou, China through Meituan platform. Subsequently, the original dataset was preprocessed, such as the deletion of duplicate, incomplete and invalid data, and then the non-numerical data was converted into numerical data. After data processing, the remaining data was 1699.

4.2 Research Variables

In this paper, P2PA price was selected as the dependent variable. At present, some scholars take consumer satisfaction and consumers' comments as the measurement standard to investigate its influencing factors [12, 13]. However, for most tourists, price is an important factor for them to choose P2PAs. With the increase of price, consumers' willingness to choose P2PAs will weaken. Therefore, price is the factor that can most directly reflect consumers' choice.

We chose subway station as the independent variable, aiming to study the relationship between subway and P2PA price. In this paper, we selected 700 meters and 1,500 meters as fixed distances, which makes this study more comparable.

In Guangzhou, Tianhe District and Yuexiu District are generally recognized as CBD, while other districts are considered as suburbs or exurbs. Therefore, for the convenience of statistics and research, this paper divided the 11 administrative districts of Guangzhou into CBD and non-CBD.

In order to reduce omitted variable bias, this paper collected three types of variables related to accommodation's attributes. The first type is related to the facilities of the house. The second category is related to the location of the accommodations. The third category is related to the landlords.

Table 1 lists the variables mentioned above.

Table 1. Variable Description

Variables	Type	Explanations
Price	Dependent	Room rate for one night
Subway 700	Independent	House within 700 meters of subway station available or not (respective binary value 0, 1)
Subway 1500		House within 1500 meters of subway station available or not (respective binary value 0, 1)
District	Area-control	When the P2PA in the CBD is 0, otherwise 1
View 1000		House within 1000 meters of sight spot available or not (respective binary value 0, 1)

Star rating	Host-control	Consumers' average score rating
Review number		The number of listing reviews
Host response		Host response rate within 24 hours
Size	Room-control	Size of rooms (Square meter)
Type		Room type: Entire room=0; Private room=1
Elevator		Available or not (respective binary value 0, 1)
Television		Available or not (respective binary value 0, 1)
Air condition		Available or not (respective binary value 0, 1)
Network		Available or not (respective binary value 0, 1)
Safety		Available or not (respective binary value 0, 1)

5 Empirical Analysis

5.1 Direct Impact of Subway

5.1.1 Model

To test the feasibility of H1, we constructed a linear regression model to examine the impact of subway stations on P2PA prices, and the equation is as follows:

$$\ln \text{price}_i = a_0 + a \times \text{subway}_i + d \times \text{room}_i + g \times \text{host}_i + l \times \text{area}_i + e_i \quad (1)$$

Where, i represents the i -th P2PA. Among the equation, the a was used to test the impact of subway stations on P2PA prices; The vectors δ , γ , and λ represent the influence related to the P2PA room, landlord and location, respectively, and represents the random error term. The regression results are shown in Table 2.

5.1.2 Results

As shown in Table 2, in Model 1, we tested the effect of subway stations on P2PA prices. For subway_700, the coefficient is statistically significant ($a = 9.065$, $p = 0.029$), while the coefficient of subway_1500 is less significant than that of subway_700 ($a = 8.265$, $p = 0.067$). It indicates that compared with accommodations with a subway station farther away, accommodations located closer to subway stations have a better pricing advantage. Therefore, the presence of subway stations will affect P2PA prices.

In Model 2, we examined the relationship between control variables and prices. In particular, the coefficient of the indoor facilities of P2PA is statistically significant and has a positive impact on the price no matter P2PA is 700 meters or 1500 meters away from the subway station. It shows that the indoor facilities of P2PAs are one of the important factors affecting the price.

Model 3 and Model 4 considered all variables, and the significance of the variables is consistent with that of Model 2 and Model 4, which confirms the robustness of the experiment. As shown

in Table 2, the difference between Model 3 and Model 4 is that Model 4 takes logarithm of the dependent variable-price, and Model 4 has the lowest AIC and BIC values. It indicates that Model 4 has the best effect in testing H1, much better than other models. In addition, Model 4 has the largest R^2 value, which means that Model 4 is more suitable than the other three models.

To sum up, in all the four models, it was found that subway stations have a positive impact on P2PA prices, which demonstrated the hypothesis H1.

Table 2. The regression results of the impact of subway on P2P price

Var- ia- bles	Model 1	Model 2	Model 3	Model 4	Var- ia- bles	Model 1	Model 2	Model 3	Model 4
	Price	Price	Price	ln price		Price	Price	Price	ln price
Subway 700	9.065**		12.63***	0.0705** *	Subway 1500	8.265*		8.471*	0.0347*
Type		-7.374	-7.394	- 0.120***	Type		-7.374	-7.054	- 0.122***
Star rating		52.61***	56.32***	0.272***	Star rating		52.61***	54.99***	0.270***
Review number		0.0216	0.0185	0.00005 82	Review number		0.0216	0.0183	0.00003 83
Host response		-0.711**	-0.661**	- 0.00264 **	Host response		-0.711**	-0.686**	- 0.00295 *
View 1000		-2.402	-4.774	-0.0209	View 1000		-2.402	-2.682	0.00075 9
Size		0.024**	0.060*	0.063**	Size		0.020*	0.059**	0.043**
Elevator		16.98***	16.90***	0.115***	Elevator		16.98***	16.33***	0.114***
Tele- vision		18.55***	19.13***	0.105***	Tele- vision		0.103***	18.55***	18.71***
Air con- di- tion		61.52***	59.93***	0.489***	Air con- di- tion		61.52** *	60.33** *	0.490** *
Net- work		35.12*	30.14	0.246***	Net- work		35.12*	30.80	0.260**
Safet- y		43.48**	42.77**	0.394***	Safet- y		43.48**	43.32**	0.412***

N	1699	1699	1699	1699	N	1699	1699	1699	1699
R ²	0.003	0.089	0.094	0.209	R ²	0.002	0.089	0.091	0.202
AIC	19945.1	19813.8	19806.6	1501.6	AIC	19946.5	19813.8	19812.5	1514.7
BIC	19955.9	19884.4	19882.7	1577.70	BIC	19957.3	19884.4	19888.5	1585.36
	77	67	31	5		69	67	82	2

* p < 0.10, ** p < 0.05, *** p < 0.01

5.2 Moderating Impacts

As shown in Table 3, we took the location of P2PA as one of the moderators, tested the influence of the location of P2PA on the price of P2PA in the presence of subway stations, and constructed the following regression model:

$$\ln price_i = a_0 + a_1 \times subway_i + a_2 \times district_i + a_3 \times subway_i \times district_i + d \times room_i + g \times host_i + l \times area_i + e_i \quad (2)$$

We discussed the presence or absence of a subway station within 700 and 1500 meters of the accommodation. According to the experimental results, Subway 700×District ($a_3 = 0.161$, $p = 0.002$) and Subway 1500×District ($a_3 = 0.294$, $p = 0.015$) have a significant effect on P2PA prices, which verifies the hypothesis H2.

Table 3. The regression results of the impact of moderator on P2P price

Variables	ln Price	ln Price
District	-0.103**	-0.281**
Subway 700	-0.0806*	
Subway 700×District	0.161***	
Subway 1500		-0.259**
Subway 1500×District		0.294**
Type	-0.140***	-0.145***
Star rating	0.173***	0.166***
Review number	-0.0000435	-0.0000453
Host response	-0.00318**	-0.00326**
View 1000	0.0139	0.0147
Size	0.000140**	0.000210***
Elevator	0.110***	0.111***
Television	0.117***	0.119***
Aircondition	0.460***	0.461***
Network	0.263***	0.267***
Safety	0.434***	0.445***

* p < 0.10, ** p < 0.05, *** p < 0.01

6 Prediction Analysis

The first half of this paper addresses how subway stations affect P2PA prices. In this section, we examined the predictive capacity of subway stations and other variables in P2PA pricing. However, due to the limited space of this paper, only the calculated results of XGBoost are

presented. Prior to the experiment, we used the median price of 200 as standard, and categorized it as low when it was less than or equal to 200, and high when it was more than 200. The results are shown in Figure 1.

Shapley value is a common index for fairly quantitative assessment of the marginal contribution of features. The higher the shapley value of a feature, the greater its impact on the price. The experimental results suggest that although the shapley value of the subway station is low, the room-related variables and area-related features are high, and their accuracy is as high as 98.24%. Therefore, these characteristic variables are still worthy of attention in the analysis of P2PA price.

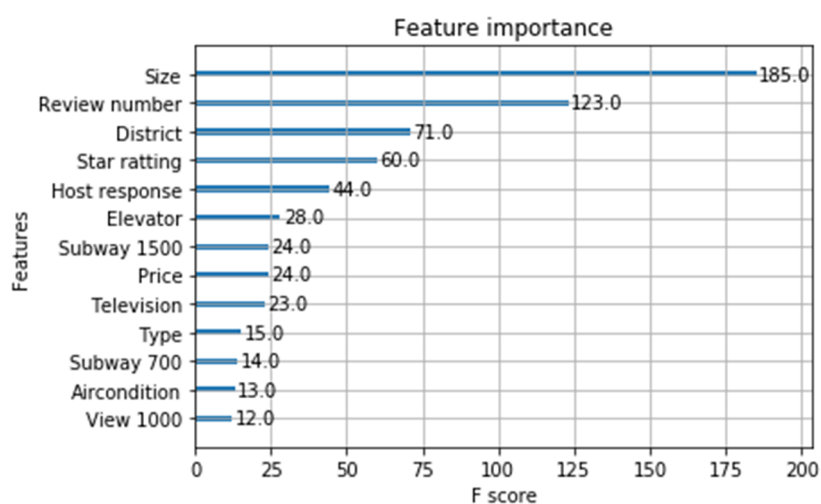


Fig. 1. The features 'Shapley value

7 Conclusion

7.1 Research Findings

Based on the P2PA data of Guangzhou on Meituan platform, we analyzed the factors that affect the price of P2PA. Based on the above analysis, we found that the subway station has a positive impact on the pricing of P2PA. Furthermore, when P2PAs are located in CBD, the price is higher than non-CBD. Finally, we use machine learning to verify the room-related and area-related variables are also important.

7.2 Recommendations

As for the landlords, the landlords should pay attention to the location, nearby traffic conditions and scenic spots, because tourists generally prefer accommodations with convenient living conditions. Moreover, this paper uses relatively new data, which can enable landlords and P2PA platforms to clearly understand which factors can effectively affect housing prices and help landlords timely update pricing strategies. For consumers, this paper provides a reference for consumers to book P2PAs. For example, the closer the accommodation is to the subway, the

higher the price will be. When consumers have a limited budget, they can live far away from the subway station to save money. For the platform, the platform should remind the landlords to reply users' questions repeatedly. This is because the quick reply of the landlords can make the accommodations quickly rented, improve the transaction rate of the landlords and attract more landlords to the platform, thus enhancing the competitiveness of the P2PA platform.

7.3 Limitation and Future Work

There are still some limitations in this paper. First of all, the sample data in this paper is limited. Due to the small amount of data collected in this paper, the lack of data may lead to poor representation of the results. In the future, if possible, the number of samples will be increased to make the conclusion more convincing. Secondly, this study is based on the P2PA data analysis in Guangzhou, China. Whether it is applicable in other regions and countries remains to be verified.

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