International Journal of Research in Business, Management & Accounting
ISSN (Online): 2455-6114
Volume 02 Issue 01 January 2016
Available on-line at: https://gnpublication.org/index.php/bma
DOI: *https://doi.org/10.53555/bma.v3i1.1705* Received: *02-Jan-2016* | Accepted: *12-Jan-2016*

An Empirical Analysis of the Impact of Subway on Housing Price-Take Hangzhou as an Example

Zhuo Gong
Nanjing Normal University, Nanjing, 210023, China E-mail: gongzhuonjnu@126.com

Abstract:

Housing price in medium and large cities in China has been rising for a long time and still remains at a high level. This paper studies the phenomenon and takes Hangzhou No.1 Subway as an example. By using Hedonic model, this paper analyzes factors affecting the housing price such as age of house, traffic, area, etc. Through empirical analysis, we draw conclusion that among these factors, transportation is the most important factor affecting the housing price. Therefore, the improvement of traffic such as subway can ease the housing pressure within urban areas and can also improve the housing price outside the urban effectively.

Keywords:

Housing price; subway; Hedonic model

*Correspondence Author:

Email: gongzhuonjnu@126.com (Zhuo Gong)

1.0 INTRODUCTION

Excessive housing price in urban areas is a common problem in China's major cities. Housing, as one of the rigid demand, whose prices, rent and changes of purchasing policy are the focuses of people. According to the relevant data in the statistical yearbook, China's housing price to income ratio is more than 7 in most of the large and medium-sized cities, and even more than 10 in megalopolis such as Beijing, Shanghai, Guangzhou, etc. The excessive housing price exerts heavy loan burden on people who have to buy house in urban areas of the city for reasons of school district or marriage. The down payment and repayment of the loan will inevitably inhibit the consumption of residents and this can have an adverse impact on the overall economic operation. On the other hand, due to the large stock of houses and the relative slack demand, housing price in small and medium-sized cities and metropolitan suburbs are low compared with that in the urban areas, and the difference is bigger with that in the city center. Taking Hangzhou subway as an example, this paper observes the influences of all factors on the housing price and explores the possibility to ease the housing pressure and stabilize the housing price in urban areas through the construction of rail transit such as subway.

2. Literature review

In China, excessive housing price has already brought negative impacts on the economic operation, especially the "house slave effect" due to sudden rising of the housing price caused by policy changes. Yan (2013) points out that buyers try their best to save money for the down payment and mortgage loans, which reduces their consumption in other areas, and this view is supported by Zhao (2013). The high saving rate caused by high housing price can hurt China's industrial structure optimization, since it may lead to idle capacity thereby affecting development. Many scholars in China have analyzed the reasons for the rise in housing price. Xu (2012) believes that the main reason for the rise in housing price is the change of population structure; according to this structure, housing price does not have the upward momentum after 2015. Zhou (2002) believes that in addition to land price, purchasing policy is also a major factor affecting the housing price. Liu (2014) states that housing supply in China lacks flexibility, and housing price fluctuates mainly with the changes of policy. His view has been proved by the rise in housing price after the issue of new mortgage policy in February, 2016. In addition, the reasons for the rise in housing price have been verified by Gao et al. (2012) in the perspective of labor force moving to large cities; the "congestion" caused by excessive housing price not only inhibits the inflow of population but also affects the development of large cities. This paper argues that housing price in large cities are higher because they provide more job opportunities and perfect facilities, which are the reasons why they can attract the inflow of people. Zhang (2014) summarizes the reasons affecting the housing price by taking Suzhou as an example, and conclusion is that the living environment and transportation etc. affect housing price by influencing housing supply and demand. Considering subway is one of the factors that affect the housing price, Su (2015) studies the southwest subway in Beijing through an empirical analysis. Result shows that subway has a greater impact on housing price in core and suburban areas of a city, while less influence on housing price in the middle region. However, housing price along the subway will tend to be equal and stable in the long term, so the subway also helps to stabilize price. Deng (2014) verifies that the price of houses around the subway will increase by analyzing the range and effectiveness of the influence of Wuhan subway on the housing price around. Li (2007) collects the housing price data before and after the completion of Nanjing subway and draws the conclusion that housing price within 1KM around the subway rises 7%. He also studies the influence range of subway stations taking 500 meters as an interval. Gu (2010) proves that the opening of the subway in Beijing has a greater influence on the housing price in the suburban areas than that in the city center along time dimension. The reason is that the urban traffic has already been developed, therefore the convenience brought by the subway in urban areas is not so great as that in the suburbs. Chinese scholars have a certain consensus on subway's effect on the housing price and believe that subway can increase the surrounding housing price and enhance land utilization rate.

3. Analysis of current status of housing price

A comparative analysis of reasons for housing price differences

The huge difference in housing price should be analyzed from aspects of both supply and demand.

Modern view is that housing demand consists of three aspects: the indemnificatory demand, reasonable improvement demand and investment demand. From the perspective of buyers or second-hand house sellers, the price they are willing to pay is affected by factors such as residential units type, residential property management company and greening, surrounding environment, convenience of transportation, surrounding facilities, etc. However, from the perspective of real estate developers, selling price of the commercial house consists of land price, construction price and some financial costs. The difference of the housing price in urban and suburban are clearly not caused by apartment type or property management and environment, since greening rate are often higher and environment are often better in suburban areas, and there is no significant difference in the apartment type and property. Living in the city center means more convenient traffic and a shorter travel distance; this advantage is even more valuable under the case that the current construction of Hangzhou subway causes traffic congestion and the vehicles accessing the city is restricted. The houses in city center also means rich supporting facilities such as hospitals and large supermarkets, etc. What's more, price of the houses around the well-known primary and secondary schools are far beyond that of other districts; at present, nine key secondary schools in Hangzhou are in the main city of Hangzhou. Compared to other districts and counties, the center of Hangzhou has considerable competitive advantages in teaching resources and teaching quality. All of these advantages cannot be found in suburbs, and these advantages make houses in urban areas more valuable. Even if houses in suburban areas have better types and environment, few people would buy them if they fail to provide a low enough price.

From the supply aspect, China's slow urbanization speed, the limited urban area expansion rate, the high costs for removing old houses in urban areas and long construction time of new houses limit the urban housing supply. In suburbs, there is a lot of open space to build houses, but people need to go to the urban areas for related activities since there are few entertainment facilities in suburbs, and people living there need to travel a long distance to work. At present, traveling in suburbs are not convenient enough, for example, public transport is often uncertain and takes long time, and there is restriction on private cars. Such inconvenience widens the gap between housing price in urban and suburban areas.

Inspiration from comparative analysis - the important impact of traffic on housing price

If the traffic is convenient enough for residents in suburbs or remote areas, they can enjoy the city's rich public facilities as residents in the city center do, which is equivalent to increasing the value of the houses outside city. Therefore, the convenience of transport affects the housing price to a large extent. The convenience of traffic can reduce the advantages of houses in the urban areas in the aspect of traffic, which can not only enhance the welfare of suburban residents, but also help to reduce the excessive urban housing prices. If the traffic is convenient and reliable enough, house buyers can choose to live in the suburbs and go to the city for entertainment or work every day. Convenient transportation can transfer a certain amount of the purchase demand from urban areas to suburbs, which will reduce the urban housing shortage.

Taking Hangzhou as an example, urban road traffic is extremely easy to be congested, so enter into the city center by private cars or buses has great uncertainty. But subway running under the ground does not have this problem. Compared to other transportation, subway is more efficient and more environmentally friendly. Its capacity and punctuality rate is far above buses and does not cause traffic jam; also,

the accident rate is much lower than the car. It takes at least 100 minutes or more to travel from the west of the city to the city center even there is no traffic jam before the opening of the subway. After the open of the subway, it just takes 40 minutes to reach the destination. In real life, the advantage of traveling through subway is very obvious. Subway facilitates people living in the city periphery and working in the city center to a great extent.

It can be said that the subway shortens the distance along the subway to the city center in dimension of time and enables surrounding residents to enjoy the city's rich entertainment and work resources more conveniently, which are the direct reasons that subway can affect the surrounding land price and housing price. Subway can produce huge externalities, easing traffic congestion and increasing the utilization rate of public facilities, which produce social value. Therefore, if we build subway in the urban areas and suburbs reasonably and then connect the subway with the surrounding small town through the intercity train, the surrounding house price can be effectively increased, and the urban housing price can also be stabilized.

4. Model construction and empirical analysis

Taking the Hangzhou No.1 subway as an example, this section studies the changes of the second-hand housing price along the subway and uses the Hedonic model to simulate and analyze the influences of the distance to downtown and the distribution of subway stations on the second-hand housing price. It proves that the subway can indeed raise the housing price along the line. Conclusion of this analysis is that subway can alleviate the problem of excessive housing price in the city center thus bringing more benefits to the residents.

Model building

Housing price is affected by various factors, such as the house type, orientation, environment, traffic condition, distance to the urban area mentioned above. The influencing degree of these different factors can be calculated by specifying the corresponding independent variables through the Hedonic model. Due to the boundary decreasing effect of the factors affecting the housing price such as the distance to downtown, the distance to bus stations, etc., and in order to classify and analyze the statistical data, a number of virtual variables are introduced into the model. The following analysis uses the semi-logarithmic Hedonic model for calculation, and
the model form is shown in Equation 1:

$$\mathrm{LnP} = \alpha_0 + \sum_{i=1}^{n} \alpha_i X_i + \varepsilon \qquad i = 1,2,3 \ldots . n \qquad (1)$$

The left side of the semi-logarithmic Hedonic model is the logarithm of the price, and the right side consists of various factors that affect the price, such as house age, house type, etc., and the coefficient αi of the factors. Through the analysis and screening of the variables, the preliminary conclusions can be obtained. Among the several reasons affecting housing price, the properties of the house itself, i.e., housing orientation, height, age, with or without the decoration, housing area, etc. has a large correlation. In the data collection and preliminary analysis, we found that the overall story height and the number of floors have little

impact on housing price, so it is not reflected in the model. In the analysis, only north-south orientation houses are selected in order to reduce the irrelevant variables. The housing age is selected as a variable, and the virtual variable is used to distinguish the house with and without decoration and the apartment size.

Data collection

The distance and time data are mainly obtained by calculating the walking distance and time from the building to the nearest subway station through map or actual calculation, and the running time of the subway between two adjacent stations is calculated using the subway operation table. Meanwhile, the surrounding facilities of the district are recorded. In the model, the reason why the distance to the subway and the time to the city center are set as two different variables is that they bring different degrees of convenience, and the two attributes provide completely different utility for people.

Take the subway is the most efficient way for travelling; under the case that the subway station is set to be the destination, the time of taking subway to the city center reflects the distance to the city center directly. If the model is applied to the houses along the subway lines, its accuracy will be better than the direct measurement of driving or walking distance to the downtown.

The price data in this paper was collected from March to June, 2015, and the data source is the major second-hand housing transaction websites and the average trading price of the houses for nearly half a year. The walking distance from the communities to the subway stations is collected through the map. In the data processing, the communities with less samples and incomplete information have been removed; transaction price and records of houses at the median price level of this community are collected among the communities with more transaction records. In the data collection, some extreme sample points have been removed.

Empirical analysis

In the statistics, a total of 119 units are recorded and a total of 576 sets of second - hand housing information are calculated. The SPSS 21 is used, and variables used in this paper are summarized in Table 1.

Table 1 Summary of variables

variables	variables name	variables description	Variables value	
independent variable	P	Housing prices	prices	yuan/㎡
dependent variable	Y	House age	year	/
	D_1	Walking distance to the subway ports	distance	Km
	D_2	Range of driving from the subway to the city center	time	minute
decoration	De	decoration	1	/
		With no decoration	0	/
house type	H_1	SOLO,<60 ㎡	1	0
	H_2	Middle-size houses, 60 ㎡~140 ㎡	0	0
	H_3	large-size house,> 140 ㎡	0	1

Thus, the regression equation function is:

$$LnP = \alpha_0 + \alpha_1 Y + \alpha_2 D_1 + \alpha_3 D_2 + \alpha_4 D_e + \alpha_5 H_1 + \alpha_6 H_3 + \varepsilon \qquad (2)$$

Taking LnP as a dependent variable for regression analysis, the results are shown in Table 2 and Table 3.

Table 2 The result of model fitness test

dependent variable	R	R^2	Modified R^2	D.W.	F value	Sig.
LnP	.813	.660	.655	.751	118	.000

Table 3 Regression analysis results

Independent variables	values	standard error	T value	Sig.	VIF	marks
constants	10.269	.066	156.125	.000	/	/
Time of the distance to the urban	-.021	.001	-20.598	.000	1.343	D_2
Distance to the subway stations	-.251	.025	-10.224	.000	1.030	D_1
decoration	.134	.053	2.534	.012	1.102	De
House age	-.015	.002	-8.594	.000	1.303	Y
Large-size houses	.151	.029	4.388	.000	1.098	H_3
SOLO	-.113	.034	-3.937	.000	1.050	H_1

As can be seen from Table 3, the regressive R2and the modified R2are larger, so the degree of fitting of the model is high and it has a certain ability to explain. Observing the F value, we can see that all variables of the model have a certain ability to explain. Checking the value of the D.W., we can get that the residual sequence of the model is positively correlated through the look-up table. In Table 3, we can observe that all the VIF values are smaller than 4, indicating that the model does not have significant collinearity. And all the independent variables have high significance level and the model can pass the econometric test. According to Table 3, the model equation can be written as:

$$LnP = 10.269 - 0.021D_2 - 0.251D_1 + 0.134De - 0.015Y + 0.151H_3 - 0.113H_1 \quad (3)$$

The equation indicates that the further the distance to the urban area is, the lower the price is, and the further the distance to the subway stations is, the lower the price is. The price of second-hand houses with decoration is higher. However, the impact of decoration on the housing price is not significant, which is contrary to our general belief that decoration has a huge impact on the housing price. This may because the value of the decoration has large instability and a certain degree of subjectivity, so the degree of decoration cannot be subdivided, which may lead to significant differences emerged. The price of old houses is lower; large units are more expensive than ordinary houses, and smaller units are cheaper, which are in line with our daily experience and can be explained economically. Therefore, the model has practical significance.

Finally, the data of a set of second - hand housing near a station (this sample is not included in the statistical calculation) is put into the model for inspection. The data of the house is: a large unit of 202 square meters, with decoration, aged 4 years, 0.82km away from the subway station, and 50min's distance to the city center by subway. Plugging these data into the model, the price is 10282 yuan / ㎡ after calculation. And after the verification, the quoted price of this second-hand house is 9850 yuan / ㎡ . The error is within 5%, thus the model is verified to be reliable.

From the regression equation and Table 3, it can be seen that the greatest influencing factor of the second - hand housing prices is the walking distance to the subway station. The price of the second-hand house 500m away from the subway station is 25% higher than the house 1.5 Km away from the station, ceteris paribus;

such difference in price may because the selected samples are all within 1.5 km from the subway station. In the past study, the scholars generally believed that the area within 1.5 km from the subway station is the area under strongest influence. In addition, the time to the urban areas is also a major factor affecting the price. After verification, operating speed of the Hangzhou No.1 subway is about 31km / h and it takes about 3 to 5 minutes to travel between the two adjacent stations. Passing each subway station means 1.5km to 2.5km further from the city center, and the housing price drops by 6 percent to 10 percent. In this sample, the price of second-hand house near the first station in the city can be three time of the price of the house near the last station. What's more, housing age is also one of the major impact factors of housing prices, and the annual depreciation can reach 1.5%.

Finally, the data in the analysis are used to mark the area. The area within 10 minutes from the West Lake Cultural Square Station are marked as X1, representing the center of the city; the area 10 to 30 minutes from the West Lake Cultural Square Station is marked as X2, representing the urban area; and the area 30 minutes or more from the West Lake Cultural Square Station is marked as X3 , representing the suburban area. Regression analysis of the three blocks is conducted and Table 4 can be obtained.

Table 4 Regression analysis Results of three blocks

Independent variables	Marks	values	Standard error	T value	Sig.	VIF	R^2
Distance to the subway stations	D_1	/	/	/	/	/	
/	X_1	-.221	.028	-7.942	.000	1.059	.557
/	X_2	-.271	.054	-5.022	.000	1.135	.537
/	X_3	-.492	.082	-6.012	.000	1.098	.698

From the coefficient we can see that the further the house away from the urban area, the greater the impact of the distance from subway station on the second-hand housing price is, and the second-hand housing price drops quicker when the house is away from the subway station in the suburbs.

5. A Further Analysis of the Impact of Subway on Housing Price

From the above empirical analysis, we can know that the price of second-hand house along the subway line will be higher than the price of the house far away from the subway, and the further the house is away from the city center, the greater the impact of the subway port on housing price is. This is in line with the logic in everyday life: if people live in the city center, advantages of bus and subway are not that big in traveling a short distance, and people can choose more flexible tools such as taxis and private cars. However, the demand of the subway will rise sharply in suburbs, since subway is the main traffic mode to access to urban areas, and this makes the land price around the subway increase correspondingly.

The impact of subway station on housing price is the representation of the impact on housing supply and demand. The supply of real estate is strictly limited by

the land; under normal circumstances, the supply of land and its derivatives have less elasticity, and increase in demand has great influence on the housing price in the case where the supply is less flexible. According to the results of the empirical analysis, the increase in demand is mainly due to more convenient traffic. After the completion of the subway, people's demand on the houses near the subway increases as travelling becomes more convenient.

The housing demand sources along the subway line are then divided into two categories. One category is the buyers who already have the first set of housing; these people can be further divided into people who have the original house far away from the subway and choose to buy a new house near the subway for

improvement demand in order to enjoy the convenience of the subway, and who believe that the houses near subway have appreciation space and choose to buy the houses near the subway station for investment. These two needs together promote the increase of housing price along the subway line.

The second type of demand is mainly from buyers who have not yet purchased a real estate but have the need to purchase, such as young people who have just worked, or young or middle-aged people who have a certain economic base and need matrimonial home and originally planned to buy a house or rent in the urban area. However, the commuting time becomes small enough to live in the suburbs after the subway changing the commuting time. When the transport cost are less than the price difference between the houses in the urban area and the suburban area, these people may choose to buy house near the subway station in the suburbs and work and entertain in the city via rail transit. Figure 1 shows the impact of the second type demand on housing price.

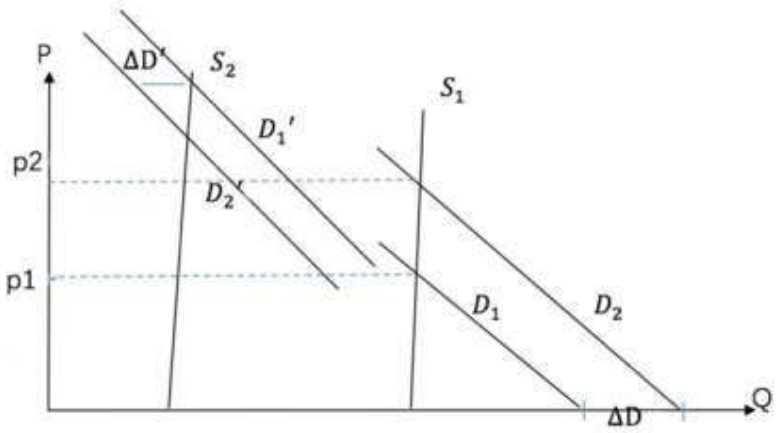

Figure 1 The impact of the second type demand on housing price

As can be seen in Figure 1, S_1 shows the housing supply along the suburban subway line and S_2 shows the housing supply in the urban area. The demand of houses in the suburbs moves from D_1 to D_2 after the completion of the subway and

ΔD shows the increasing demand of the houses near the subway station of the suburbs. ΔD contains the demand transfers from the city center, i.e., ΔD′. ΔD′ makes the house demand in the city center reduce to D_1' from D_2', so the construction of the subway will decrease the house demand in the urban area. In this aspect, the construction of the subway can affect the excessive prices in the urban area to a certain extent. In addition to the subway, the inter-city rail transit, such as light rails, can connect large cities and small cities around more closely. And the most important thing for the light rail is that it can be transferred in the same station with the subway, which can further expand the impact of the traffic on the housing price in the model to the surrounding cities.

6. Conclusion

At present, China's control and trading policies on housing price are being continuously improved, and China has introduced the policy to reduce the down payment ratio in the purchase of the houses, which then causes the an upsurge of purchase, making the housing price increase sharply. Compared with the stable housing price in developed countries such as Germany whose housing price and income ratio is just about 2, China's housing price and income ratio is much higher. In Munich which has the highest housing price, the average price per square meter just reaches 3600 euros (2016 data), even less than that in China's first-tier cities. The difference between housing price in large cities and price in rural areas are little. As the economic center of Germany, the housing prices in Frankfurt are just one time higher than it in the ordinary small town

200 km outside it. In addition to the large amount of real estate transactions tax and strict law which restrict the speculative demand for real estate, sound rail transport through the Germany is an important factor affecting the housing price. Taking Berlin as an example, there is a subway station every 800 meters and there are a total of 170 subway stations in the whole city; transfer between subway - tram - train is also achieved. People can enter into the subway station in any place in the urban area easily and then arrive at the surrounding town through the rail transit. The tickets can be universally used in the same province. The convenient transportation has enhanced the housing price in the suburbs and the small towns, and people can work in the city center, live in the suburbs and have rest in entertainment city. This is the reason why the price difference between German cities is not big.

However, the current inter-city train in China is not universal at present, and it is not convenient enough to get in and out of the train station. Tickets buying and checking process is complex and the train cannot dock with the subway seamlessly. In China, dilemma is that the shortest distance takes the most time in the middle-distance public transit. It often takes longer time to arrive at the train and subway station than in the high-speed rail and subway. Also, the ticket checking and queuing time cannot be ignored. However, in real life, all of these will be considered into the commuting time by residents. Since the time consumption in this aspect is very difficult to calculate, the model in this paper has ignored this aspect, which leads to a certain difference with the actual value. Fortunately, this "transit" time is often proportional to population intensity, that is, the distance from the urban area has been endogenized in the model and does not cause great influence on the whole conclusion of the model. But this is a problem worth to be thought about: the development degree of rail transit and the convenience degree of such vehicles are both impact factors of housing price.

References

[1]Yan Se. (2013). House slaves effect or wealth effect? A theoretical analysis of the impact of rising housing prices on national consumption. Management World, (3): 34-47.
[2]Shao Ting. (2012). Experience and Enlightenment of Germany's housing prices rising maintaining at a low level for a long time. China Economic Times, (1): 1-3.

[3]Zhang Suodi, Zhao Huaping & Libin. (2014). The relationship between real estate price and rent under the effect of macro-control: empirical evidence from thirty-five large and medium scale cities of China. Journal of Applied Statistics and Management, 33 (2): 305-316.
[4] Xu Jianwei, Xu Qiyuan & He Fan. (2012). Population structure factor behind rising house prices: interntional experience and Chinese evidence. World Economy, (1): 24-42.
[5] Duan Zhongdong. (2014). Threshold measurement of the impact of house price change on residents' consumption - an empirical study based on 35 Large and medium cities in China. Economic Science, (4): 27-38.
[6] Li Yongyou. (2014). Demand driving and ripple effect of housing prices rising: on strategies to deal with the problems of housing price. China Economic Quarterly, 13 (2): 443-464
[7] Zhao Xiliang, Liang Wenquan & Li Shi. (2013). Can growing house prices explain high household saving rates in urban China? An empirical analysis using CHIPs data. China Economic Quarterly, 13 (1): 81-102
[8] Su Yayi, Zhu Daolin, Zheng Yuzhong, Wang Xing & Chen Geng. (2015). The effects of subways on housing price gradients between urban area and suburb in southwest Beijing.
Resources Science, 37 (1): 125-132

[9] Gao Bo, Chen Jian & Zou Linhua. (2012). Housing price regional differences, labor mobility and industrial upgrading. Economic Research Journal, (1): 66-79.
[10] Baifu Zhou. (2009). A research on the factor of the rising of housing price. Hangzhou: Zhejiang University of Technology.
[11] Deng Yi. (2014). Study on the influences of subways on the housing price fluctuations along

subway lines and the strategy research. Nanchang: Nanchang University.

[12] Pan Yawen. (2010). The housing price model based on the speculative demand and research.

Hangzhou: Zhejiang University.

[13] Xue Zhiyong. (2012). Analysis of the impact of macro policies to real estate market base on expectation theory. Beijing: University of Science and Technology of China.
[14] Zhang Jing. (2014). Analysis about the factors which influence the housing price in Suzhou and the prediction. Suzhou: Suzhou University.
[15] Binshuo Liu. (2012). Analysis of the impact of consumer cognition on the property of real estate investment and speculation. Journal of Theoretical Studies, (6): 43-45.
[16] Gao Bo, Wang Wenli & Li Xiang. (2013). Expectation, income inequality and the puzzle of city's housing price to rent scissors in China. Economic Research Journal, (6): 100-126
[17] Kuang Weida. (2010). Expectation, speculation and urban housing price volatility in China.

Economic Research Journal, (9): 67-78.

[18] Liu Xueliang. (2014). Housing supply elasticity, determinant factors and housing price performance of urban China. Finance and Trade Economics, (4): 125-137.
[19] Xie Jieyu, Wu Binzhen, Li Hongshan & Zheng Siqi. (2012). China's urban housing prices and household consumption. Journal of Financial research, (6): 13-27.
[20] Wang De, Huang Wanshu. (2005). Hedonic house pricing and its application in urban studies.City planning review,03: 62-71.
[21] He Jianhua. (2004). Research on the effects of metro line 13 in Beijing on house prices under Hedonic model. Beijing, Tsinghua University.