

House Pricing and Subway Distance

— An Analysis of Wuhan Estate Market

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Abstract: Many real estate developers advertise residential properties as being located near the subway, which makes one wonder whether subway distance affects the unit price of commercial housing. In this paper, the data of more than 900 new houses in Wuhan were collected and analyzed by multiple regression using Hedonic method. Variables were divided into 3 categories: architecture, position and price to make a more detailed and complex analysis. The results show that subway distance is negatively correlated with housing price, and the closer the subway is, the more obvious this effect is. In other words, the closer the house is to the subway, the higher the unit price of the house. This has a unique guiding significance for real estate developers who have commercial housing construction plans in Wuhan. In addition, the study found that the distance of the house from the hospital can significantly affect the level of housing prices.

Keywords: Real estate, house pricing, urban construction, subway

1. Introduction

In daily life, people often see the "subway" factor in real estate advertisements. Real estate developers are happy to advertise the property's proximity to the subway and convenient transportation. The Sky Oasis, a high-end residential area jointly built by Vanke Group and Wuhan City Construction Group, points out that it is 50 meters from the subway is the first of its advertisement. So, is the proximity of the house to the subway a key factor affecting the price of the subway? Is it reasonable to say that the closer the house is to the subway, the more expensive it is?

The previous literature generally held two different views on this issue. The subway has an impact on housing prices, a conclusion that has been generally proven in previous studies. However, the scholars' conclusions are likely to be the opposite. In 2001, Bowes and Ihlanfeldt collected data from Atlanta, US and drew a conclusion that properties within 0.25 miles of a rail station sold for 19% less than those more than 3 miles away. This could be attributed to noise pollution and large number of people brought by transportation hubs. A more general conclusion is that housing prices are positively correlated with subway [1]. In the selection of research methods, most researchers will combine multiple variables that affect housing prices for simultaneous analysis. Because this can more comprehensively and comprehensively show the impact of several factors on the housing price.

However, most researchers focus on prices and data for second-hand homes or apartments, or on a particular subway line. If we could comprehensively study the housing price of new houses on sale and its distance from the subway, it would be more instructive for developers. Another deficiency is that the subway has a strong time effect on housing prices. If a house is not far from the subway, its price during subway construction would be obviously lower than price after or before construction [2]. After years of subway construction, many cities in China have formed a dense subway network. New houses are more likely to enjoy the dividends of the subway than to be forced to sell at a lower price because of subway construction.

The study collected partial new home price data from the beginning of August 2023 in the central Chinese city of Wuhan. The data includes the total price of the house, the unit price, the floor area ratio, the number of parking Spaces, the specific location, the distance from the subway, the distance from the hospital and the distance from the school. After that, the imperfect data were cleaned up, and the data more than 5000 meters away from the subway and the data missing any factor were deleted. Finally, multiple regression analysis is carried out on the data, taking the unit price of the house as the explained variable and other factors as the explanatory variable, and the regression line and result are obtained.

The main conclusions of this study are as follows: 1) The farther the house is from the subway, the lower the price per unit of square footage. Specifically, for every meter away from the subway station, the price of a house per square meter will be reduced by 0.67 yuan. 2) When the subway distance is less than or equal to 833 meters, the subway distance has a greater impact on the housing price than when the subway distance is greater than 833 meters.

2. Literature Review

The research based on data from Wuhan China has taken data from different dimensions.

The housing price and the distance from the subway have obvious spatial characteristics. Take Athens as example, Efthymiou and Antoniou found that the proximity to metro, tram and suburban railway stations had positive impacts on the values and rents of nearby properties [3]. Another study based on Spatial autoregressive (SAR) model and Nonspatial hedonic model found that local accessibility could better explain housing price variations, and that proximity to metro and rail lines had significant impacts on housing value. Compared with other means of transportation in the city, the subway has greater accessibility, reduces commuting time and travel cost. Compared with private cars or public buses, it can avoid traffic jams and parking problems. Compared with bicycles or electric bikes, it is safer and faster. Therefore, subway has a positive impact on the surrounding real estate prices [4]. But from a micro point of view, the impact of subway on housing prices is different in many ways. The impact of rail transit on housing prices in the suburban market could be much greater than that in the main urban market. Research made by Gu and Zheng proved this conclusion from house prices near Beijing Metro Line 13. In the downtown area, proximity to metro stations along Line 13 had no significant role on housing price increases. However, in the suburban area, houses within 1 km of the metro stations along this line were 20% more expensive than houses beyond this scope [5]. Whereas research conducted by Zhao F etc. found that Beijing Metro Line 5 had a significant impact on housing prices in the urban area, but the impact was largely eliminated in the suburbs [6]. Proximity to the light rail system had a positive effect on high-income neighborhoods, and a negative effect on low income neighborhoods.

Subway distance is not the only factor that affect housing price. Scholars have used Hedonic model which estimates various factors to compare how these factors affect housing price complicatedly. This model will consider architectural characteristics, location characteristics and neighborhood characteristics. Architectural characteristics refer to the physical properties of the building, including the building area, the green rate of the community, the floor area ratio, etc. Location characteristics

refer to the distance of the building from the nearest transportation station, generally considering subways and buses. Neighborhood characteristics are variables that reflect the living facilities near the building. It is generally divided into four categories: schools, hospitals, shopping centers and parks. Because this model could analyze multiple factors at the same time, it has been widely used in recent studies of property prices and subway distances in major Chinese cities. Lu gang analyzed housing price near Beijing subway line 9 and found that house prices within 600 meters of a metro station are not obviously affected by the distance [7]. Zhang Li, Liu Jia and Ye Liqiong applied this model to Xi 'an Metro Line 2 and found that within 1.2 km of the subway line, housing prices first rise and then fall as the distance from the nearest subway station increases. According to Zhang, living near subway station could be disturbed by traffic noise and pollution, which might cause decreasing of housing prices [8].

3. Data Analysis

This paper chose the characteristic price model to analyze data set. The characteristic price model is an econometric method to analyze the characteristic price of products. In this paper, it mainly analyzes the real estate. The contribution of various characteristics to real estate prices. This housing model believes that real estate is composed of multiple different characteristics, and the full utility that each feature brings to people determines the real estate price. Due to the different quantity and combination of each feature, the real estate price is different. The basic idea is to decompose the price factors of real estate, and then estimate the hidden features of each feature. In the end, it reflects the pure price change of a certain feature of real estate [9]. Its functional form is as follows:

$$P = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon$$

In this function, P is the real estate transaction price grid, and the single place is yuan/m; β_0 is the constant quantity, which refers to the sum of the influence of other variables on the housing price; β_n is the characteristic price of each characteristic variable. X_n is each characteristic variable; ε is a random error.

Table 1: Variables and Explanations

Feature classification	Feature Variable	Variable Meaning
Dependent Variable	P Unit Price	The unit price per suite (RMB/m)
Architecture Feature A	A1 Parking Number	Parking Place Number in the community
	A2 Total Number	Total Number of houses in the community
	A3 Area	Area of the suite
	A4 Plot Ratio	Plot ratio of the building
Position Feature P	P1 Subway Distance	Distance from community to subway
	P2 School Distance	Distance from community to school
	P3 Hospital Distance	Distance from community to hospital
Price Feature C	C1 Total Price	The total price per suite(RMB/set)

4. Result and Analysis

After deleting the missing variables or the data with unreasonable variables, regression analysis was carried out on the remaining 983 new house data in Wuhan. The results are as follows:

$$P = 13607.69 + 0.038A_1 + 0.013A_2 + 849.65A_3 - 0.3748A_4 - 0.6700P_1 + 0.4766P_2 - 91.0367P_3 + 53.2498C_1$$

4.1. Architecture Feature

Among the four architecture feature factors that affect the housing price, the coefficient of parking space and the number of households is small, and the influence on the housing price is not obvious. These two elements essentially reflect the size of the community.

However, the coefficient of floor area reached a staggering 849.65, that is, the larger the floor area, the higher the unit price of the house. We can give the following explanations for this problem. Tax increases could be a direct reason. According to the Deed Tax Law of the People's Republic of China, when purchasing a first home, the deed tax is 1% under 90 square meters, 1.5% between 90 and 144 square meters, and 3% above 144 square meters [10]. When the housing area is greater than 70 square meters, the price of the housing is positively correlated with the area, because the large unit has better living comfort, higher preservation ability, and is more suited to the needs of investors rather than residents [11].

Plot ratio which represents the ratio of living area to community building area also has a certain impact on housing prices. Xi Deli from Tongji University conducted an empirical analysis on the relationship between housing prices and floor area ratio in Shanghai in 2021, and found that in the new development sector, floor area ratio has a significant negative impact on housing prices [12].

4.2. Position Feature

P1 is the core variable studied in this paper, and its coefficient is negative 0.6700. This shows that the farther away from the subway, the lower the unit price, in line with people's general understanding. The subway is a convenient means of transportation that can reach most parts of the city and avoid traffic jams. Its core advantage is to reduce the cost of commuting time for city residents [13]. At the same time, it is more environmentally friendly than private cars, which meets people's demand for green travel. Therefore, people will be more inclined to buy houses near the subway, and the corresponding price will increase.

Take a closer look at this data. It can be obtained through the scatter plot, and most of the data are concentrated in the interval of 1000 meters from the subway. Through screening, 590 of the 982 data are less than 833 meters away, accounting for about 60.1% of the total data. The subway distance greater than 833 meters is divided into group A, and the subway distance less than or equal to 833 meters is divided into group B. The regression analysis of group A and group B was carried out in the same way, and the new coefficients P1 (A) and P1 (B) were -0.36165 and -1.40345, respectively. P1 (B) is approximately 3.88 times the size of P1 (A). This results in a new conclusion: when the subway distance is less than or equal to 833 meters, the subway distance has a greater impact on the housing price than when the subway distance is greater than 833 meters. If subway distance is too long to achieve by simple walking few minutes, people would choose not to take subway when travelling out. Since the subway network in Wuhan is dense in the central area and scattered in the suburbs, the houses far away from the subway are located in the suburbs, with small population density and traffic flow, and traffic jams are not easy to occur [14]. Residents do not need to use the subway to avoid traffic jams.

From another aspect, subway in Wuhan is especially designed to give citizens easier aspect to the city's attractions or commercial complexes. The Yellow Crane Tower, East Lake and other scenic spots can be easily reached by subway. The closer the residential area is to the scenic spot, the price will also increase accordingly [15]. Some subway stations close to commercial complexes have been integrated with shopping malls: consumers can enter the mall directly from the subway without leaving the station to the ground floor, and there are more convenience stores, cake shops, and small supermarkets in the subway stations. This gives these stations additional business value and the ability to serve the lives of citizens, which in turn increases housing prices.

P3(Hospital distance) is negatively correlated with housing price, and the absolute value of the coefficient is the largest. This phenomenon should be due to scarce hospital resources, and if acute diseases occur, shortening the distance to the hospital can greatly improve the survival rate [16]. According to the statistics of Wuhan Municipal Health Commission, in 2019, the elderly population above 65 in Wuhan has accounted for 14.74%, so the demand for medical resources is more vigorous. Their families will therefore focus on the distance to the hospital when purchasing a house.

The coefficient of variable P2(School Distance) is 0.4766, which is the only positive one in position variable. This ought to be attributed to China's characteristic enrollment system in Compulsory education stage. In May 2023, the General Office of the Ministry of Education issued a notice on the enrollment of primary and secondary schools, requiring schools across the country to select nearby communities for enrollment and guide students to enroll nearby. However, the level of education is different from school to school. Parents in major Chinese cities are willing to spend heavily on education and tend to buy properties near first-class primary and secondary schools to get their children into school, giving birth to the concept of "school district housing" [17]. Hence the housing price is directly related to the quality of schools that enroll students from its community but not simply school distance. High-quality school district housing will also have good investment value and preservation because of the pursuit of fanatical parents [18].

4.3. Price Feature

C1, the variable that represents the total price of a property, has a coefficient of a staggering 53. This means that the higher the total price of a property, the higher its unit price. The total price is determined by the area multiplied by the unit price. In the previous research, we have learned that the unit price of real estate is positively correlated with the area of real estate, so the total price of real estate is positively correlated with the unit price of real estate.

5. Conclusion

5.1. Hospital Concerning

For real estate developers who plan to develop residential buildings in Wuhan, they should give top priority to the quality and quantity of nearby hospitals when acquiring land. Among all the distance factors, the coefficient of hospital distance is the largest, which has the greatest impact on the housing price. If you cannot buy land near the hospital, you can also choose to buy land in administrative districts with more hospitals to build houses. According to the data of Wuhan Municipal Health Commission in 2020, the regions with more first-class hospitals are: Jiangnan District (18), Wuchang District (20), and Jiangnan District (16). Districts with Fewer hospitals are Wuhan Economic and Technological Development Zone (1), Wuhan East Lake New Technology Development Zone (2). Developers should also pay attention to the construction planning of new hospitals and be the first to arrange real estate in the vicinity.

5.2. Subway Distance

If the community is in the core urban area, it is close to the subway (subway distance is less than 833 meters). Then developers should try their utmost to make the building close to the subway station. At the same time, the path to the subway station is planned and protected (such as prohibiting the occupation of the road, adding the entrance of the community in the direction of the subway station), so that people can go to the subway station without obstruction.

If the community is built in the suburbs far from the subway, it is difficult for the subway to cover the residents of the community. Therefore, developers should pay more attention to the construction

of hospitals, schools and other supporting facilities, rather than looking for locations close to the subway. In order to make it more convenient for residents to travel, developers can also cooperate with local bus companies to extend bus routes. If the developer can connect the neighborhood to the subway station by bus, residents will also have access to public transportation services to the city center.

References

- [1] Bowes, D. R., & Ihlanfeldt, K. R. (2001). *Identifying the impacts of rail transit stations on residential property values*. *Journal of Urban Economics*, 50(1), 1–25.
- [2] Song Dan. (2016). *An empirical study on the impact of Wuhan Metro Line 2 on the surrounding housing price*. *Modern business trade industry* (01),208-210. doi:10.19311/j.cnki.1672-3198.2016.01.110.
- [3] Efthymiou, D., & Antoniou, C. (2013). *How do transport infrastructure and policies affect house prices and rents? Evidence from Athens, Greece*. *Transportation Research Part A-policy and Practice*, 52, 1–22.
- [4] Zhou Xiang & Wang Liya. (2019). *The Influence of Traffic Convenience on Urban Housing Price——Based on panel data analysis of 14 new first-tier cities*. *Price:Theory & Practice* (10),48-51.
- [5] Zheng, S. (2010). *The impacts of rail transit on property values and land development intensity: the case of No.13 line in Beijing*. *Acta Geographica Sinica*.
- [6] Zhao, F. (2011). *Influence of rail transit on nearby commodity housing prices: A case study of Beijing Subway Line Five*. *Acta Geographica Sinica*.
- [7] Lu Gang. (2013). *Research on the influence of rail transit on regional housing price based on Hedonic model: A case study of Fengtai South Road Station of Beijing Metro Line 9*. *China Journal of Commerce* (33),157-158+162.
- [8] Zhang Li, Liu Jia & Ye Liqiong.(2014). *Impact of urban rail transit on Housing prices based on Hedonic model: A case study of Xi 'an Metro Line 2*. *City* (03),34-37.
- [9] Du Qinjun & Wang Weixiu (2019). *Analysis on the Influence of Urban Metro Construction Housing Price along the Line*, *Science and Technology Management of Land Resources* (04),93-103.
- [10] *Deed Tax Law of the People's Republic of China* npc.gov.cn, n.d. (n.d.).
- [11] Zhang pei, Lin jian, Li xiaotang(2016), *Impact of the unit size on the housing price: A Case study of Shenzhen, China*, Department of Urban and Regional Planning, Peking University, Beijing, China,100871
- [12] Xi Deli. (2021). *The impact of floor area ratio on housing prices with case studies*. *China's real estate* (06), 14 and 20. Doi: 10.13562 / j.carol carroll hina. Real estate 2021.06.004.
- [13] Li, S., Chen, L., & Zhao, P. (2017). *The impact of metro services on housing prices: a case study from Beijing*. *Transportation*, 46(4), 1291–1317.
- [14] Wuhan Municipal Health Commission. *List of secondary and tertiary hospitals in Wuhan*. (n.d.).
a) *Wuhan Rail Transit Network Planning Revision. (2014-2049)-Wuhan Municipal Bureau of Natural Resources and Planning*. (n.d.).
- [15] Cai Yuzhi. (2022).*Research on Spatial Differentiation and Influencing Factors of Rooms in Huai'an City Based on POI Big Data*. Yangzhou University.
- [16] Fumei Lin, Qingqin Chen, Minxia Lin, Aihui He, HuaJuan Chen, Ying Chen, Hua Chen, Wenchen He, Yuanzhen Hu, Jie Wang, Xuehong Lin, Xiaomei Wang, "Clinical Effect of Nursing Based on the Kano Model in Emergency Multiple Injuries", *Evidence-Based Complementary and Alternative Medicine*, vol. 2022, Article ID 3586290, 7 pages, 2022.
- [17] Zhao X. (2015). *Research on Evaluation Method of School District Housing Based on Characteristic Price Model* (Master's Thesis, Yunnan University of Finance and Economics).
- [18] Wang X Z. (2022). *A New Study on the Overheating and Premium of School District Housing from a Multi.Dimensional Perspective*. *Economic Research Guide* (04),84-87.