The Influence of Enterprise Location on Its Profit: Empirical Analysis Based on Commercial Data of Beijing Metro

Keqing Li
s17012923@sjajeju.kr

St. Johnsbury Academy Jeju

Daejeong-eup, Seogwipo-si, Jeju Special Self-Governing Province, 63644, Republic of Korea

Abstract: This paper analyzes the impact of the distance from the subway station on the profits of businesses around subways. Based on the data of commercial outlets around the Beijing subway, a multiple linear regression model is used for empirical analysis. It turns out that the distance from the subway station does impact the profits of businesses around the subway. The radiation effect of subway stations on surrounding enterprises is different due to the location factors of the subway itself. The operating characteristics of surrounding enterprises also affect the radiation effect of subway stations.

Keywords: Corporate location; Corporate profit; Beijing subway; Multiple linear regression model

1 INTRODUCTION

The development of the subway network is one of the signs of a modern city. The convenience determines that subways will be the primary travel mode of the future big cities, bringing together many passenger flows. The commercial layout of the future city is also likely to be developed around subways. Studying the influence of subways on the surrounding businesses and the way of influence is of great significance to a reasonable commercial layout, and it can also provide a reference for maximizing the profits of the business owner. Many scholars have paid attention to this and analyzed the development model of commerce around the subways from the respective commercial and social development, and most of them have used case analysis. This paper will analyze the issue from the perspective of economics, considering distance factors as factors affecting production, using quantitative analysis methods combined with data from Beijing. While confirming some of the existing research conclusions, from the perspective of empirical analysis, new conclusions that affect the operating profits of commercial outlets are also put forward.

2 LITERATURE REVIEW

Regarding the relationship between subways and the surrounding commercial development, scholars at home and abroad have conducted extensive and in-depth research, focusing on the following issues for discussion.

ICEMME 2022, November 18-20, Nanjing, People's Republic of China

DOI 10.4108/eai.18-11-2022.2327159

Scholars such as Wang Xianqing believe that we can learn from the experience of successful cases of international metro commercial development to promote the development of China's domestic metro commercial. Wang Xianqing (2012), in his paper "Research on Metro Commercial Development in the Context of Urban Expansion," studied the problems of commercial development models around the subway in the context of urban expansion in Guangzhou [3]. The author draws on the commercial development model around the subway from well-known cities at home and abroad and analyzes the factors that affect commercial development and the law of commercial development. The author believes that commercial positioning and business combination will affect the development of commerce around the subway. Emphasizing the development of underground space is the trend of commercial development around the subway. Therefore, the development near the Guangzhou Metro should ensure that the subway station's entrance and the surrounding environment, commercial positioning and business combination, urban planning, and market allocation are matched and combined. Zhang Wei and Liu Xing (2010) studied the design and planning of domestic subway commercial space in their paper [5] "Looking at the design and planning of domestic subway commercial space from the perspective of global subway commercial development." The author analyzes the advantages of the commercial development of subway stations, draws on the design of underground commercial space from well-known cities at home and abroad, and adopts the belief that domestic subways should adopt safety and comfort in commercial space. That is, to ensure a vast space and the introduction of natural scenery, obvious Road signs, and targeted design through in-depth market demand analysis. Hong Zenglin and Fan Sen (2010) studied the commercial development model around Xi'an subway in their paper "Study on the "Convergence and Three-Dimensional" Metro Commercial Economic Exhibition Mode, [6]" drawing on the commercial development model around the subway in well-known cities at home and abroad. Combined with the commercial practice experience of Lianhu District, Xi'an. The author believes that the development of Xi'an's subway business circle should follow the principle of "aggregation and three-dimensional," Under the premise of ensuring commercial diversity, the commercial space layout should be rationally allocated. Han Ningchun (2007) studied the commercial development of Beijing subway in his paper "Reference and Research on Commercial Development of International Urban Metro.[7]" The author draws on the main commercial development models of subways in well-known foreign cities and Hong Kong and suggests that Beijing should pay attention to commercial planning in the commercial development of subways, that is, the matching of commercial planning and subway construction; pay attention to the choice of developers and the combination of business types and formats; improve commerce Environment and quality to enhance business attractiveness.

Scholars such as Chen Zhongnuan believe that it is also possible to study the commercial development issues around the subway from the commercial structure and commercial development model. In 2013, he studied the relationship between urban rail transit and commercial agglomeration in their paper "Business Agglomeration Around Metro Stations and Its Influencing Factors."[1] The author uses the RK and nuclear density analysis method and field survey data of three stations in Guangzhou and believes that the common influencing factors that lead to the commercial agglomeration characteristics of subway stations are commercial attributes, business agglomeration benefits, and subway induction; leading to differences in commercial subway patterns The main reason is the difference in the development of the business district, the difference in the road system, and the difference in the effect of the subway.

Scholars such as Zhang Weiyang believe that rail transit will also impact surrounding commercial real estate prices. In their paper "Research on the Impact of Urban Rail Transit on Residential Prices-Taking Beijing Metro Line 1 as an example [2]" (2012), the relationship between housing prices and the distance from subway stations, as well as the scope and extent of the impact of subway stations on housing prices. The author used GIS spatial analysis tools, added a spatial autoregressive model and Kriging interpolation method, and used housing price data around Metro Line 1. The analysis believes that urban rail transit has a significant impact on the housing price, the suburbs have a greater degree of impact, and the intensity of the impact decreases with increasing distance in a wave-like manner. Feng Changchun in 2011 studied the impact of rail transit on the price of commercial housing along the line in their paper "Analysis of the impact of rail transit on the price of commercial housing along the line: Taking Beijing Metro Line 5 as an example [4]". The author used a multiple linear regression analysis models, adopted the price data and geographic location of sample houses around Metro Line 5, and performed Spearman correlation analysis. The analysis shows that Beijing Metro Line 5 has a certain impact on the surrounding commercial housing, and the impact is inversely proportional to the distance from the subway station; as the distance from the subway is farther, the housing price is lower, and the price decreases exponentially as the distance increases.

3 METHODOLOGY AND DATA

This paper uses a multiple linear regression model to analyze the relationship between the distance between a company and a subway station and the company's profit. Multiple linear regression models are often used to analyze multivariate disturbance problems; that is, the explained variable in a problem is affected by changes in multiple explanatory variables. The problem of corporate profit is typical. Corporate profit is affected by many factors such as corporate location, passenger flow, fixed costs, and variable costs. So, it is essential to establish a multiple linear regression model through econometric methods and then accurately define the distance between the company and the subway station on business profits among the many influencing factors. The specific model form is shown in equation (1).

$$y_i = \beta_0 + \beta_1 x_i + \beta_2 z_i + u \quad (1)$$

In equation (1), the dependent variable $y_i$is the profit of the enterprise, and the independent variable x_i is the distance between the enterprise and the subway station. The coefficient β_1 represents the degree of influence of the distance between the enterprise and the subway station on the profit of the enterprise. In order to accurately understand the influence of the distance between the enterprise and the subway station on the profit of the enterprise, a series of control variables z_i are added to the equation (1), including passenger flow, fixed Costs and variable costs. In the estimation process of the model, this paper uses the least square method in the mathematical optimization technique to find the best function match of the parameters by minimizing the square sum of the error. The least squares method can be used to easily obtain the parameters to be estimated, and minimize the sum of squared errors between the obtained parameters and the actual parameters. According to the Gauss-Markov theorem, given the assumption of classical linear regression, the least squares estimator is a linear unbiased estimator with the smallest variance. Therefore, when the classical assumption holds, there is no need to look for other unbiased estimators, and none of them will be better than ordinary least squares estimators. That is to say, if there is a good linear unbiased estimator, the variance of this

estimator is at most as small as the variance of the ordinary least squares estimator, and will not be less than the variance of the ordinary least squares estimator.

This paper mainly uses the income data of residents in the China Comprehensive Social Survey (CGSS), combined with the data published by the official website of the Beijing Metro for analysis. CGSS adopted a stratified random sampling method to select commercial shops around the subway and selected 10 of the 18 existing rail transit lines in Beijing for investigation. Random sampling was used again in each route to identify 31 businesses for investigation. The survey content consists of two parts: the first part is the questionnaire, which mainly includes the fixed cost, variable cost, and profit of the company; the second part is the surveyor's observation, which mainly includes the distance between the company and the nearest subway station and the front of the company—issues such as passenger flow per hour. Regarding the sampling of the observation time of the enterprise's previous unit hour passenger flow, random sampling methods are also used to conduct investigations to ensure the data's authority and reliability while considering the investigation costs. The data variables included in the CGSS survey well cover the needs of the data in the research of this paper. At the same time, in considering the availability of data, this paper mainly uses the above-mentioned data for analysis. Regarding the opening times of the various subway lines and the basis for the division of suburban lines, this paper uses data from the official websites of Beijing Metro and Beijing-Hong Kong Metro.

4 RESULTS

This paper uses the commonly used measurement analysis software Stata to realize the model establishment and data processing. The output results of the multiple linear regression model are shown in Table 1.

Table 1 Multiple linear regression model results

VARIABLES	*(All lines)* *Profit*	*(Line 1)* *Profit*	*(Line 2)* *Profit*	*(Line 4)* *Profit*	*(Line 5)* *Profit*	*(Line 6)* *Profit*	*(Line 8)* *Profit*	*(Line 10)* *Profit*	*(Line 13)* *Profit*	*(Line 14)* *Profit*	*(Line 15)* *Profit*
Distance	2.191*	-14.87	0.312	-2.439	-13.47	-2.228	-10.03**	-7.283	-10.55**	-14.46**	-7.761
	(1.278)	(21.72)	(3.632)	(3.850)	(21.96)	(4.023)	(4.865)	(4.311)	(5.030)	(5.688)	(6.385)
PF	46.64***	58.82**	37.57***	36.94***	73.20**	31.26***	16.92**	17.50**	21.75***	14.49**	8.527
	(3.984)	(28.20)	(8.068)	(7.183)	(28.85)	(6.603)	(7.951)	(8.239)	(5.973)	(6.388)	(7.566)
FC	0.0731***	0.755***	1.161***	0.339***	0.286***	0.380***	0.414***	0.414***	0.369***	0.322***	0.270*
	(0.0107)	(0.254)	(0.151)	(0.0439)	(0.0499)	(0.0428)	(0.0719)	(0.0491)	(0.0731)	(0.0996)	(0.140)
VC	1.060***	0.510***	0.335***	-0.374**	-0.0731	-0.421***	-0.581**	-0.570***	-0.490	-0.206	0.422
	(0.0358)	(0.113)	(0.0871)	(0.156)	(0.182)	(0.141)	(0.271)	(0.183)	(0.289)	(0.384)	(0.544)
Constant	-6,076**	26,994	-2,349	3,511	24,924	3,201	18,389*	12,933	19,784*	27,580**	14,648
	(2,519)	(42,673)	(6,626)	(7,145)	(43,351)	(7,569)	(9,322)	(8,185)	(9,754)	(11,131)	(12,572)
N	310	31	31	31	31	31	31	31	31	31	31
R2	0.918	0.970	0.982	0.985	0.979	0.985	0.976	0.979	0.984	0.979	0.966

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In Table 1, the dependent variable is the business's profit, and the independent variables include the distance of a business from a subway station, passenger flow, fixed cost, and variable cost. The second column of the table is the regression results of the overall sample in the database, including ten subway lines in Beijing, with a total of 310 businesses; the third column of the table is the regression results of Metro Line 1, including the surrounding areas of Metro Line 1. 31 businesses; the fourth to twelfth columns of the table are Metro Line 2, Line 4, Line 5, Line 6, Line 8, Line 10, Line 13, Line 14, and the regression result of Line 15 represents the relationship between the profit of the surrounding enterprises of each line and its influencing factors. According to the data from the official website of the Beijing Metro, the urban lines in this sample include Line 1, Line 2, Line 4, Line 5, and Line 6; suburban lines include Line 8, Line 10, Line 13, and Line 14; the outer suburbs line includes Line 15.

From the overall regression results, the coefficient of the distance between the enterprise and the subway station is 2.191; the coefficient of passenger flow is 46.64, which is very significant; the coefficients of fixed cost and variable cost are very significant, which are 0.0731 and 1.060, respectively. The factor that becomes the cost is greater than the fixed cost. Judging from the regression coefficients of the five metro lines in the urban area, except for Metro Line 2, the distance coefficients from the companies on the other lines to the subway station are all negative, but the distance coefficients from the companies on the five lines to the subway station are not significant. The passenger flow coefficients of the five lines are all significantly positive, showing completely different characteristics from the distance coefficient of the enterprise from the subway station. The coefficients of fixed cost and variable cost, except for the variable cost coefficient of Line 5, are other coefficients. The significance is consistent with the regression results of the overall sample. The regression coefficient results of the four lines in the suburbs are quite different from the regression results of the urban lines. The distance coefficients of the four lines in the suburbs from the subway station are significantly negative except for Line 10, and the passenger flow coefficients are all significantly positive, but the average value of the coefficients is less than that of the five lines in the urban area. The variable cost coefficients and the overall situation, On the contrary, the coefficient is negative, and the coefficient of fixed cost is consistent with the overall regression. The distance coefficient between the enterprises on Line 15 and the subway station is negative and not significant, and the passenger flow coefficient is positive but not significant. The coefficients of fixed and variable costs are consistent with the overall situation, but the variable cost coefficient is not significant.

The multiple linear regression model results show that business profits are indeed affected by the distance from subway stations, but the direction and extent of the impact vary depending on the specific conditions of each line.

First of all, from the overall point of view, the regression results of the sample show that the distance from the subway station has a positive impact on the profit of the business. However, what really affects a company's expected profit is the passenger flow per unit hour, and the distance from the subway station can affect the profit of the business because it can bring passenger flow to the business. Combined with the regression coefficient of the passenger flow per unit hour, this paper finds that the passenger flow will positively impact the business profit. Compared with fixed costs, variable costs have a more significant impact on business profits. Secondly, judging from the situation of the five lines in the urban area except Line 2, the distance from the subway station has a negative impact on business profits but is not significant. This is because most of the areas passed by the urban lines are relatively prosperous. The passenger flow

does not or rarely depend on the nearby subway stations, but the passenger flow has a greater impact on the profits of the business around the urban line. From the perspective of fixed costs, the impact of fixed costs on urban business profits is greater than the city's average. However, the impact of flow costs is relatively small and even has a negative impact on individual lines. Third, from the four lines in the suburbs, with the exception of Line 10, the distance from subway stations has a significantly negative impact on business profits, while the impact of passenger flow on business profits is positive but compared to the urban the coefficient is small. This shows that for businesses around suburban lines, the distance from the subway station is critical to their commercial profits, and the passenger flow is likely to be brought by the subway station. Finally, the outer suburbs lines represented by Line 15 show different characteristics. The distance from the subway station and the passenger flow does not significantly impact business profits, and the variable cost has a lesser impact than the fixed cost. This shows that the outer suburbs subway line The types of nearby commercial shops are quite different from those in the suburbs and urban areas. Without considering the representativeness of the sample, the commercial development near the outer suburban line may still have insufficient development due to the short opening time.

5 CONCLUSIONS AND FUTURE RESEARCH

Combining the results of empirical analysis, this paper finds that the profit of commercial outlets around the subway is significantly related to the distance between the commercial outlets and the subway station. However, the degree and direction of this connection are different due to the location factors and specific conditions of the subway line. Therefore, if business owners want to maximize their operating profits by being close to subway stations, they can refer to the following suggestions:

First, business owners should consider subway lines' location when setting up enterprises near the subway. Since the distance from the subway station does not significantly impact commercial profits in the outer suburbs and urban areas, people engaged in commercial activities in these two areas do not need to use this as a reference factor. On the contrary, those who do business in the suburbs need to consider the distance to the subway station. The closer to the subway station, the higher the expected profit.

Secondly, the business should conduct a passenger flow survey before selecting a store location. The distance from the subway station will not directly impact the business owner's profit because the distance factor is not a cost factor that constitutes the production function. Therefore, we determine how distance affects the business owner's profit by examining the passenger flow. The results found that regardless of the location of the subway, passenger flow has a positive impact on the income of businesses around the subway.

Finally, businesses around the subway should choose the closest subway line based on the type of operation. Since fixed costs and variable costs have varying degrees of impact on companies' income in different regions, companies with a large proportion of variable costs in costs can consider opening in the vicinity of metro stations in urban areas. In contrast, fixed costs account for a larger proportion Companies may consider opening commercial outlets around subway lines in the suburbs and outer suburbs.

Given the existing problems in the paper, the follow-up research of this paper will focus on the following points: First, improve the database, mainly for the data of businesses near the subway lines in the outer suburbs. Currently, there are only data on Line 15 in the database, and the Changping Line and Fangshan Line are missing. Secondly, the impact of distance to the subway station on the business's profit can be verified from other ways, mainly for analyzing the business owner's personal perspective. Alternatively, combine and analyze the production function and the operator's utility function and comprehensively consider the layout factors of commercial outlets around the subway.

REFERENCES

[1] Chen Zhongnuan, Feng Yue, Jiang Jin. Commercial agglomeration around subway stations and its influencing factors [J]. Journal of South China Normal University, 2013(6).

[2] Zhang Weiyang, Li Hui, Duan Xuejun. Research on the Impact of Urban Rail Transit on Housing Prices: Taking Beijing Metro Line 1 as an Example [J]. Economic Geography, 2012(2).

[3] Wang Xianqing. Research on Metro Commercial Development under the Background of Urban Expansion[J]. Urban Observation, 2012(5).

[4] Feng Changchun, Li Weixuan, Zhao Fanfan. Analysis of the impact of rail transit on the price of commercial housing along the line: Taking Beijing Metro Line 5 as an example [J]. Acta Geographica Sinica, 2011(8).

[5] Zhang Wei, Liu Xing. Looking at the design and planning of domestic subway commercial space from the world's subway commercial development [J]. Art and Design, 2010 (1).

[6] Hong Zenglin, Fan Sen. Research on the 'polymerization, three-dimensional' subway commercial economic exhibition model [J]. Economic aspect, 2010 (2).

[7] Han Ningchun. Reference and research on the commercial development of international urban subways [J]. Journal of Beijing Institute of Finance and Trade Management, 2007(4).