A Difference-in-Difference Study Evaluating the Effect of High-speed Rail Opening on Financing Constraints of Enterprises' Construction Projects

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ABSTRACT

Taking the opening of high-speed railway as an exogenous event, this paper uses the panel data of the opening information of high-speed railway and the formation of A-share listed companies in cities of Zhejiang Province from 2010 to 2019, in order to investigate the impact of the opening of high-speed rail on financing constraints of local enterprises' construction projects from a micro perspective. This paper adopts Differences-in-Differences as regression model, which is an appropriate method to evaluate policy effects. At the same time, referring to Kaplan and Zingales (1997), this paper uses mathematical model to construct KZ index as a measure index to measure financing constraints of enterprise construction projects. The study found that the opening of high-speed rail significantly reduced the degree of financing constraints for local companies. One of its mechanisms is that the opening of high-speed rail promotes information flow and alleviates information asymmetry between investors and enterprise management. To ensure the robustness of the empirical results, a placebo test was used. By assuming a one-year postponement, the correlation was tested again, eventually ruling out the effects of other potentially disruptive events. The conclusion of this paper may provide suggestions for supporting the economic benefits and planning of high-speed railway network.

Keywords: *Financing Constraints of Construction Projects, High-speed Rail Opening, Differences-in-Differences*

1. INTRODUCTION

China's economic development is inseparable from the construction of transportation infrastructure. In 2016, the National Development and Reform Commission, the Ministry of Transport and China Railway Corporation jointly issued the Medium and Long Term Railway Network Planning, clearly proposed to build "eight vertical and eight horizontal" high-speed railway main passage. This shows that the construction of high-speed rail is still an important part of China's future infrastructure construction.

The financial market has the problem of opaque and asymmetric information, so external investors will lower the purchase price of securities to compensate for its risks. Chinese enterprises, especially small and medium-sized enterprises, have the problem of "financing difficulty". Therefore, it is of reasonable significance to study the opening of high-speed railway to improve the information flow between the two sides of the market and relieve the financing constraints of enterprises' construction projects.

Taking A-share listed companies on Shanghai and Shenzhen stock exchanges from 2009 to 2017 as samples, this paper finds that the opening of high-speed railway can help alleviate financing constraints of enterprises' construction projects, because the opening of high-speed railway can alleviate information asymmetry and thus reduce financing constraints of enterprises' construction projects. Compared with the existing literature, the innovation of this paper lies in the following: First, the previous literature mainly studied the macroeconomic impact of the opening of high-speed railway, such as regional economic development, population and employment. This paper analyzed the impact of the opening of high-speed railway on the financing constraints of enterprises' construction projects, enriching the micro impact of the opening of high-speed railway. Second, the opening of high-speed railway can break the information barrier between capital suppliers

G. Vilas Bhau et al. (Eds.): MSEA 2022, ACSR 101, pp. 1438–1443, 2023.
https://doi.org/10.2991/978-94-6463-042-8_209

and provide empirical evidence for the study of the relationship between information asymmetry and corporate financing constraints.

2. LITERATURE REVIEW

2.1. Opening of High-Speed Railway Related Literature

So far, a large number of studies have demonstrated the impact of transportation infrastructure on economic growth from many aspects. Macro-level of the research is mainly on the traffic infrastructure construction to the total factor productivity, the influence of the population, employment and regional economy, such as Zhang X.L. (2012) by using Chinese provincial panel data of 1993-2009 and spatial econometric research methods, empirical analysis it is concluded that the infrastructure construction plays an important role in China's regional economic growth, Besides, the spatial spillover effect is very significant[1]. If the spatial spillover effect is not considered, the role of transportation infrastructure on regional economic growth will be overestimated. There are also literature studies that the opening of infrastructure will have a negative effect on the economy. For example, Based on PSM-DID, Zhang M.T. (2020) believes that high-speed railway significantly negatively affects the export of peripheral cities through capital outflow[2]. Li Y. (2021) adopted the multi-stage difference method and found that the opening of high-speed railway did not effectively drive labor agglomeration in shrinking cities, but caused the diffusion of capital factors, which was not conducive to the development of shrinking cities[3].

It is not very abundant to discuss the economic consequences of the opening of high-speed railway from the micro level, and relevant literatures are mainly carried out from the perspective of reducing the degree of information asymmetry caused by the opening of high-speed railway. Studies have shown that the distance between economic entities is an important indicator to measure the information asymmetry of enterprises, and the closer the distance between them is, the more likely they are to obtain valuable information (Ivkovi and Weisbenner, 2005)[4]. The opening of high-speed railway shortens the spatial distance between enterprises to a large extent, promotes the flow of people and information, breaks the barrier of information search between enterprises, and improves the information environment of enterprises (Wang Y.F. and Ni P.F., 2016)[5].

From the perspective of geographical location, Huang Z.K. (2016) found that the farther an enterprise is from the central city, the higher the IPO discount degree will be, and the opening of high-speed railway will help reduce information asymmetry and ease the IPO discount of enterprises[6]. For another example, Li H. and Tang L.M. (2015) used panel data of Chinese manufacturing enterprises from 1998 to 2007 to build a fixed effect model, and discussed the spatial spillover effect of provincial highway construction on enterprise inventory in China, providing micro-level evidence for the existence and causal impact of spatial spillover effect of transportation infrastructure in China[7].

2.2. Literature of Financing Constraints

Previous studies have pointed out that information asymmetry is one of the main reasons for financing constraints (Myers and Majluf, 1984)[8]. Due to the information asymmetry between external investors and enterprises, in order to reduce the risk, external investors will lower the purchase price of securities, thus increasing the external financing cost of enterprises. When enterprises take measures to reduce information asymmetry, the external financing cost of enterprises will be significantly reduced (Zhang J.X. and Wang Y., 2013; Qian M., 2016)[9][10].

For debt financing, the high-speed rail to cities to creditors field understand financing business situation provides the convenience of time and space, a lower degree of information asymmetry between enterprises and the creditors, alleviate the creditors concern about adverse selection and moral hazard problems, thereby alleviating the financing constraints. For equity financing, it needs the intermediary of capital market to play a role more. The opening of high-speed railway can enable external institutional investors to have a clearer understanding of the basic situation of enterprises, and provide convenient control for investors before, during and after the event.

In general, no matter debt financing or equity financing, information asymmetry is an important factor limiting the investment decisions of external investors. However, the opening of high-speed railway can reduce the information asymmetry between external institutional investors and enterprises, thus easing the degree of financing constraints of enterprises' construction projects. Therefore, this paper proposes the hypothesis:

H1: The opening of high-speed rail helps reduce the financing constraints of local enterprises.

3. RESEARCH AND DESIGN

3.1. Sample Source

The sample interval is from 2010 to 2019, and the registered address of 381 A-share listed companies in 11 prefecture-level cities of Zhejiang Province is located. At the same time, the financial industry, ST and SST and companies with missing values are excluded. The empirical data mainly include financial data of listed companies and high-speed railway information. Among them, the financial data came from CSMAR database,

and the high-speed railway traffic information was obtained from Baidu and the official website of The Ministry of Railways by the author through The Statistical Yearbook of China and the assistance of web crawler technology. In order to eliminate the influence of outliers, the data were indented at the 1% level.

3.2. Variable Design

3.2.1. Explained Variable

The explained variable is the degree of financing constraint of enterprises, and the KZ index is used as the measurement index of financing constraint (Kaplan and Zingales,1997)[11]. The specific calculation process of KZ index in this paper refers to Wei Z.H.(2014)[12].

Table 1 reports the results of ordinal logistic regression, which are similar to the conclusions of previous studies, indicating the applicability of KZ index.

TABLE 1. RESULTS OF REGRESSION MODEL OF FINANCING CONSTRAINT DEGREE OF LISTED COMPANIES IN ZHEJIANG PROVINCE

	$CF_{i,t}/A_{i,t-1}$	$DIV_{i,t}/A_{i,t-1}$	$C_{i,t}/A_{i,t-1}$	$LEV_{i,t}$	$Q_{i,t}$	Pseudo R^2	N
KZ	-8.4402^{***} (-15.53)	-16.4855^{***} (-8.59)	-4.9444^{***} (-17.52)	4.6017^{***} (18.09)	0.6143^{***} (15.50)	0.2007	2,354

Note: ***, ** and * are significant at 1%, 5% and 10% levels respectively, and Z values are in parentheses

3.2.2. Core Explanatory Variables

The key explanatory variables of this paper are "whether to connect to high-speed rail" (HSR) and the interaction term of "before and After" (After) (AfterHSR). Where, HSR value is 1 if the company opens high-speed rail during the sample period; otherwise, HSR value is 0. If the enterprise is located in the prefecture-level city in the year when the high-speed railway is inaugurated and in subsequent years, After is set to 1; otherwise, After is set to 0. AfterHSR is always 0 for listed companies that have not opened high-speed railway in their cities during the sample period. For listed companies that opened high-speed railway during the sample period, AfterHSR is 0 before and 1 after opening.

The annual data of the sample companies were constructed as dummy variables by operating net cash flow/total assets of the previous period($CF_{i,t}/A_{i,t-1}$), cash dividends/total assets of the previous period($DIV_{i,t}/A_{i,t-1}$), cash holdings/total assets of the previous period($C_{i,t}/A_{i,t-1}$), asset-liability ratio($LEV_{i,t}$) and Tobin's Q($Q_{i,t}$).

3.2.3. Control Variables

Based on existing studies, CFO (net cash flow from operating activities), Growth (net cash flow from operating activities), ROA (return on total assets), EPS (earnings per share), Managers_share (shareholding ratio of senior executives), and Independent (proportion of Independent directors) are selected as control variables[13][14]. Specific variable definitions and calculation methods are shown in Table 2.

TABLE 2. VARIABLE DEFINITION AND DESCRIPTION METHOD

Variable	Variable	Variable description
symbol	name	
KZ	Financing constraint index	Refer to Kaplan and Zingales(1997)
AfterHSR	High-speed opening	During the sample period, companies without high-speed rail connection is always 0; companies with high-speed railway is 0 before the opening of high-speed railway, and 1 in the year and after the opening of high-speed railway.
CFO	Net cash flow from operating activities	Net cash flow from operating activities/Ending total assets
Growth	Sales revenue growth rate	(Current sales revenue - previous sales revenue)/previous sales revenue
ROA	Return on total assets	Net profit/total assets in the previous period
EPS	Earnings per share	Net profit/number of shares outstanding
Manager_share	Executive shareholding ratio	Shares held by management/Total shares
Independent	Proportion of independent directors	Number of independent directors/number of directors

3.3. Research Model

In order to measure the change of enterprises' financing constraints after the opening of high-speed railway in cities of Zhejiang Province, this paper uses a multi-period dual difference model to measure the impact of the exogenous event of high-speed railway opening, and controls the fixed effect of time and fixed effect of company. Based on the KZ index method to measure corporate financing constraints, this paper constructed the following regression model:

$$KZ_{i,t} = \beta_0 + \beta_1 AfterHSR_{i,t} + \gamma Controls_{i,t} + \delta_t + \theta_i + \varepsilon_{i,t} \quad (1)$$

See Table 2 for specific variable definitions. Interaction coefficient β_1 is used to represent the alleviating effect of the opening of high-speed railway on financing constraints of enterprises' construction projects. According to the hypothesis, β_1 is expected to be significantly negative in statistical results.

4. RESULTS

4.1. Descriptive Statistical Results

TABLE 3. DECRIPTIVE STATISTICS

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	mean	sd	min	max
KZ	1,898	0.264	1.790	-6.519	5.379
AfterHSR	1,898	0.923	0.267	0	1
CFO	1,898	0.182	0.121	0.0387	0.556
Growth	1,898	0.184	0.256	-0.213	1.058
ROA	1,898	0.0981	0.0581	0.00892	0.253
EPS	1,898	0.981	1.029	0.0339	4.671
Manager_share	1,877	0.0907	0.144	0	0.578
Independent	1,897	0.364	0.0414	0.333	0.444
Number of stkcd	381	381	381	381	381

Table 3 reports the descriptive statistical results for the main variables in this paper. The analysis results show that the average risk of KZ index is 0.264, and the maximum and minimum values are 5.379 and -6.519 respectively, which are not very different from previous studies. It can be seen that there are great differences in the degree of direct financing constraints of various enterprises. AfterHSR has an average value of 0.923, indicating that most enterprises in Zhejiang province have already operated HSR from 2010 to 2019. In terms of control variables, the mean value of total return on assets (ROA) is 9.81%, indicating that most enterprises have good profitability. The average EPS per share was 0.981, and the standard deviation was 1.029, indicating that most enterprises had stable business conditions. The descriptive statistical results of other control variables are basically consistent with existing literature.

4.2. Analysis of Regression Results

In order to verify the impact of the opening of high-speed railway on the financing constraints of local listed companies, this paper constructed a multi-period differential model for analysis. According to the information asymmetry theory, it is expected that the financing constraints of enterprise construction projects will decrease with the opening of high-speed railway, which is manifested as the negative correlation between KZ index and AfterHSR.

TABLE 4. REGRESSION RESULTS OF HSR OPENING AND FINANCING CONSTRAINTS

KZ	(1) coefficient	(2) Tvalue
AfterHSR	-0.202**	-2.05
CFO	-8.370***	-31.37
Growth	-0.074	-0.75
ROA	-1.883***	-3.09
EPS	-0.377***	-10.99
Manager_share	-0.131	-0.52
Independent	0.268	0.32
Cons	2.415***	7.35
Observations	1,876	
Number of stkcd	381	

*** p<0.01, ** p<0.05, * p<0.1

Table 4 reports the regression results of the impact of the opening of high-speed railway on the financing constraints of enterprises' construction projects. As can be seen from the table, when the KZ index is used to measure the financing constraints of enterprises' construction projects, the regression results show that the coefficient of AfterHSR is -0.202 and significant at the 5% level, that is, the opening of high-speed railway reduces the degree of financing constraints of enterprises' construction projects, supporting the hypothesis of this paper.

4.3. Robustness Test

In order to eliminate the systematic error caused by the possible omission of unobservable variables, this paper uses placebo test for regression. In this part of the test, the paper assumes that the opening time of HSR is one year later than the actual opening time. AfterHSR_2, the dummy variable of "dummy high-speed railway opening", was constructed and put into regression analysis. The regression model is as follows:

$$KZ_{i,t} = \beta_0 + \beta_1 AfterHSR_{i,t} + \gamma Controls_{i,t} + \delta_t + \theta_i + \varepsilon_{i,t} \quad (2)$$

TABLE 5. ROBUSTNESS TEST

KZ	(1)	(2)
	系数	T值
AfterHSR_2	-0.130	-1.32
growth	-0.246**	-2.40
independent	-0.411	-0.38
manager_share	0.412	1.17
eps	-0.289***	-7.15
cfo	-8.682***	-28.13
var28	-1.542**	-2.33
Cons	2.545***	6.22
Observations	1,876	
Number of stkcd	381	
R-squared	0.452	

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The regression results are shown in Table 5. The coefficient of AfterHSR_2, the cross-product term in the regression results, is -0.130, and the T value is -1.32, which is not significant, indicating that there is no unobservable systematic error interference estimation results.

5. CONCLUSIONS

In this paper, a-share listed companies in Zhejiang Province from 2010 to 2019, excluding financial and ST, are selected as the research samples. By using the exogenous event of high-speed railway opening and the multi-period differential difference model, the impact of the exogenous impact of high-speed railway opening on financing constraints of local listed companies is studied, and the robustness test is conducted to ensure its robustness.

The study found that the financing constraint degree of local A-share listed companies in Zhejiang province significantly decreased after the opening of high-speed railway, which was specifically manifested as the opening of high-speed railway significantly reduced the corporate financing constraint index KZ index. From the theoretical analysis, this paper believes that the main reason for this result is that the opening of high-speed railway improves the flow of information elements and the enterprise information environment, and reduces the information asymmetry between external investors and the company.

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