Analysis of the Influence of High-speed Railway Engineering Construction Management on Enterprise Innovation Management Performance

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Abstract. The construction of high-speed rail engineering brings not only the convenience of lifestyle, but also accelerates the flow of talents, capital and other resource elements, thus promoting the improvement of corporate performance. This paper takes the four vertical and four horizontal high-speed railway lines constructed in 2009-2014 as a quasi-natural experiment, adopts the double difference model, and introduces enterprise innovation management as an intermediary variable to examine and evaluate the economic effects brought by high-speed rail engineering construction to enterprises from a microscopic point of view. The results show that the construction of high-speed rail projects mainly improves the management performance of enterprises by promoting the flow of talents and stimulating the innovation management of enterprises. The conclusions of this paper help to deepen the analysis of the economic effects of high-speed rail construction, and provide a reference for the country to further accelerate the construction of high-speed rail and promote the regional economic development with the help of high-speed rail construction.

1. Introduction
Since 2008, China has vigorously promoted the construction of transportation infrastructure, especially high-speed railways. By the end of 2018, China’s high-speed rail business mileage reached more than 29,000 kilometers, ranking first in the world. It is the country with the longest high-speed rail, the highest transportation density and the most complicated network operation scene. By 2020, China will build a modern high-speed railway network with the main channel of “eight vertical and eight horizontal” as the skeleton, the regional connection line and the intercity railway.

Space segregation is one of the main causes of poverty and marginalization in the region, and transportation has a significant role in promoting economic development. With the full development of China's railway infrastructure and the gradual improvement of the railway network, China's high-speed rail is gradually changing China's economic structure. The opening of high-speed rail can shorten the time of business negotiation between enterprises and reduce the cost of information communication, accelerate the flow of information between different enterprises, and accelerate the flow of production factors such as talents, capital, resources and technology, thus affecting the resource utilization efficiency of enterprises and the ultimate Performance level. Therefore, it is necessary to study the impact of high-speed rail opening on enterprises along the line.
2. Literature Review

Transportation infrastructure is an important factor in driving economic growth and driving local and nearby development (Aschauer, 1989) [1], especially infrastructure such as high-speed rail and highways. There are many studies on the economic effects of high-speed rail. The existing research on the economic effects of high-speed rail is mainly divided into the following aspects.

First, high-speed rail improves inter-regional accessibility, provides more location options, and aggregates cities into an open system that accelerates market integration (Kahn Matthew E, 2012) [2] and promotes inter-regional economic growth. As an important infrastructure investment, high-speed rail construction can effectively stimulate economic growth, and can also create employment effects by reducing labour transfer costs and improving market accessibility, and increase urban population and employment growth. Rate, and thus promote economic growth (Donaldson, 2013) [3]. The opening of the high-speed rail also promoted the flow of capital elements and optimized the allocation of capital elements among enterprises. (Li Xinze, Ji Xiaole, Zhou Lingling, 2017) [4].

Secondly, in addition to the economic growth effect, high-speed rail will also have a structural optimization effect on economic development and promote the change of regional economic spatial pattern. The opening of high-speed rails has provided direction for industrial changes along the line, thus forming a new industrial belt along the high-speed rail, driving regional economic growth and optimizing industrial structure (Xu Yuping, 2012) [5]. High-speed rail breaks the boundaries of geography, time and space, accelerates the flow of talent, information, technology and capital, and achieves the effective integration of various resources and elements. The development of high-speed rail brings high-end elements across regions, large flows, high-density, multi-frequency configurations and flows. Therefore, the opening of high-speed rail can significantly improve the level of innovation of enterprises (Zhu Taoxing, 2015) [6].

Through the above can be found, most existing literature from regional economic effect or the level of industrial structure to explore high-speed opened on regional economic growth, employment, population flow, the influence of the industrial structure, etc, and the study of micro enterprise less, although some research high-speed opening and the relationship between the enterprise innovation, but few people to open, enterprise innovation and enterprise performance, study along the high iron can open by promoting enterprise innovation and bring along the enterprise economic effect. Therefore, on the basis of the above literatures, this paper tries to make contributions in the following aspects: 1. Discussion is conducted from the micro level of high-speed railway opening, mainly using the double difference model to demonstrate the impact of high-speed railway opening on enterprise economic performance.2. This paper introduces the intermediary effect model to analyse the influence mechanism of the economic effect brought by the opening of high-speed railway on enterprises, so as to further analyse the positive role of high-speed railway construction.

3. Theoretical analysis and research hypothesis

According to the new economic geography theory, the far-reaching geographical distance will lead to an increase in the transaction cost, transportation cost, time cost and other costs, which will have a significant impact on the decision-making of the economic entity, and then determine the economic activities of the entity in the space. (KRUGMAN, 1994) [7]. In addition, cultural differences between different regions have deepened the information asymmetry of corporate stakeholders, which has limited corporate financing and talent flow, and ultimately limited the development of enterprises.

The opening of high-speed rail will break this restriction. On the one hand, the opening of high-speed rail will bring about the following three major effects: First, the industrial effect. The construction of high-speed railway will drive the development of required raw materials and related industries such as steel and cement. On the other hand, the opening of high-speed rail will bring huge passenger traffic, which will also drive the lodging industry, tourism and other tertiary industries relying on passenger traffic, thus driving the development of enterprises along the line.

Hypothesis 1: The opening of high-speed rail has a positive impact on corporate performance, that is, the opening of high-speed rail can bring economic effects to enterprises.
Secondly, the space compression effect and time saving effect brought by the opening of the high-speed rail can effectively alleviate the problem of information asymmetry, help to promote enterprises in high-speed railway cities to attract more venture capital and capital, and then promote the economic transformation and technological innovation of enterprises. Finally, the talent flow effect. First, the opening of the high-speed rail has reduced the transit time between different regions. The most significant change is the change of passenger flow, which facilitates the flow of entrepreneurs and high-tech talents. Second, the high-speed rail is opened. It promotes economic development along the region, while regional economic growth helps attract high-quality talent.

Hypothesis 2: The opening of high-speed rail can promote enterprise innovation.

High-quality talents are the key factor in innovation activities. The large number of talents attracted by the high-speed rail will greatly promote the innovation investment and output of enterprises. Innovation is the cornerstone of building a sustainable competitive advantage. Faced with diversified consumer demand and rapidly updated market environment, using technology innovation to achieve product differentiation to enhance corporate performance has become an inevitable choice for enterprises. Based on the above analysis, this paper proposes:

Hypothesis 3: The opening of the high-speed rail can strengthen the corporate economic effects enhanced by corporate innovation as a medium variable and improve corporate performance.

4. Research design

4.1. Model setting

The DID model refers to evaluating the effect of the new policy by comparing the results before and after the experiment with some kind of processing on the subject. Therefore, this paper uses the processing method of Long yu (2017) [8] for reference and adopts the DID model. If the place where the enterprise is registered is located in the area of the four vertical and four horizontal high-speed rail lines, the enterprises in the area are regarded as the experimental group in the high-speed railway enterprise, otherwise it is the control group. By examining the changes in the performance levels of the experimental group and the control group before and after the opening of the high-speed rail, revealing the economic effects of the opening of the high-speed rail on enterprises.

In order to verify that the opening of high-speed rail can promote enterprise innovation, and enterprise innovation plays a mediating role in the role of high-speed rail opening to promote the performance improvement of enterprises along the line, this paper draws on the practice of Judd and Kenny (1986) [9] to construct the following recursive equation test:

\[ \text{roa}_{it} = \alpha_0 + \alpha_1 \text{treat}_{afterit} + \alpha_2 X_{it} + \alpha_3 U_t + \alpha_4 \lambda_t + \epsilon_{it} \]  
(1)

\[ \text{rd}_{it} = \beta_0 + \beta_1 \text{treat}_{afterit} + \beta_2 X_{it} + \beta_3 U_t + \beta_4 \lambda_t + \epsilon_{it} \]  
(2)

\[ \text{roa}_{it} = \gamma_0 + \gamma_1 \text{treat}_{afterit} + \gamma_2 \text{rd}_{it} + \gamma_3 X_{it} + \gamma_4 U_t + \gamma_5 \lambda_t + \epsilon_{it} \]  
(3)

Where, subscript i represents the enterprise, t represents the year, roa represents the explained variable, treatafter represents the Core explanatory variables. The specific definition is shown in the variable interpretation section. X is the control variable; \( \lambda_t \) is the fixed time effect; \( U_t \) represents the fixed effect of individuals. rd refers indicates the level of innovation investment of the company as a mediator of the study.

According to the testing method of intermediary effect, the first step is to carry out regression of formula (1) to test whether the opening of high-speed railway can bring economic effects to enterprises along the line. If \( \alpha_1 \) is significantly positive, it indicates that the opening of high-speed rail does have some positive effects on the economic performance of enterprises. Then the second step test was carried out to regression equation (2) to investigate the relationship between the opening of high-speed railway and enterprise innovation. If \( \beta_1 \) was significantly positive, the last step test was carried out. If both \( \gamma_1 \) and \( \gamma_2 \) were significantly positive, and the coefficient \( \gamma_3 \) decreased compared with \( \alpha_1 \), part of intermediary effect was indicated. If \( \gamma_1 \) is not significant but the coefficient of enterprise innovation is significant, enterprise innovation acts as a complete mediating effect.
4.2. Variable to explain
Explained variables: This paper refers to the practice of Huang Can (2019) [10], using the listed company's return on assets (roa) as the explanatory variable to measure the performance of the company. Explanatory variables: This article uses treatafter as the main explanatory variable, which is a dummy variable. When the registered place of the enterprise opens the high-speed rail and the time is opened after the high-speed railway, t takes 1, otherwise it is 0. Intermediary variables: This paper uses the ratio of R&D expenditure to total assets to measure the R&D investment intensity of the enterprise (rd). X is the control variable. The control variables selected in this paper are the company's listing period (age); the size of the enterprise, using the natural logarithm of the total assets at the end of the period; leverage factor (lev), expressed in terms of asset-liability ratio; Equity concentration (h5), using the proportion of shares held by the top 5 shareholders; Investment expenditure (inve), expressed as the ratio of the payment of cash to total assets by the construction of fixed assets, intangible assets, and other assets; Property attribute (soe), if it is a state-owned enterprise, soe=1, otherwise it is 0.

4.3. Sample selection and data sources
This paper selects the main target of the study as the four vertical and four horizontal high-speed rail lines opened in 2009-2014, and opens it as a quasi-natural experiment, taking all A-share listed companies in 2007-2017 as samples. Secondly, the samples are screened according to the following criteria: (1) Excluding the companies along the high-speed rail that have been opened since 2015 (2) Excluding financial and insurance companies; (3) Excluding ST and *ST companies; (4) Excluding existential variables Missing sample. In the end, this article received 12,895 processing group company annual data. The high-speed rail data used in this paper was manually downloaded from the website of the National Railway Administration and then compiled; other companies' financial data came from the CSMAR database.

5. Estimated results and analysis
5.1. descriptive statistical analysis
Table 1 is the descriptive statistical results of the main variables. In order to eliminate the influence of extreme values, this paper reduces the tail size of some continuous variables by 5% and 95%.

| Variable | Obs  | Mean | Std. Dev. | Min   | Max   |
|----------|------|------|-----------|-------|-------|
| roa      | 12,895 | 0.053 | 0.044     | -0.024 | 0.145 |
| treatafter | 12,895 | 0.586 | 0.493     | 0      | 1     |
| rd       | 12,895 | 0.020 | 0.015     | 0.001  | 0.055 |
| size     | 12,895 | 21.862 | 1.130    | 20.250 | 24.328 |
| age      | 12,895 | 7.461 | 6.633     | 0      | 27    |
| lev      | 12,895 | 0.380 | 0.194     | 0.083  | 0.739 |
| h5       | 12,895 | 55.265 | 13.772   | 29.990 | 77.256 |
| inve     | 12,895 | 0.053 | 0.043     | 0.005  | 0.157 |
| soe      | 12,895 | 0.301 | 0.459     | 0      | 1     |

5.2. Basic regression result
Table 2 reports the test results according to the economic effect brought by the opening of high-speed railway to enterprises and its impact mechanism. The first and second columns are the regression results of formula (1), the third and fourth columns are the regression results of formula (2), and the fifth and sixth columns are the regression results of formula (3). In addition, the first, third and fifth
columns only control the fixed effect of time and industry, while the second, fourth and sixth columns add related control variables on the basis of the previous column controlling the fixed effect.

Table 2 basic regression results

| Variable | (1) | (2) | (3) | (4) | (5) | (6) |
|----------|-----|-----|-----|-----|-----|-----|
| roa      | 0.0042*** | 0.0041*** | 0.0011*** | 0.0009*** | 0.0038*** | 0.0037*** |
|          | (3.2871) | (3.3529) | (3.5262) | (3.0535) | (2.9918) | (3.0836) |
| roa      |    |    | 0.0007 |    | 0.0088*** |    |
|          |    |    | (8.5762) |    | (10.4344) |    |
| rd       | 0.3517*** | 0.3721*** |    |    |    |    |
|          | (8.7522) | (9.3834) |    |    |    |    |
| size     | 0.0071*** | -0.0046*** |    |    |    |    |
|          | (22.6658) | (8.8305) |    |    |    |    |
| age      | -0.0033*** | 0.0010*** |    |    |    |    |
|          | (-10.5604) | (13.0784) |    |    |    |    |
| lev      | -0.0720*** | 0.0007 |    |    |    |    |
|          | (-22.6658) | (8.8305) |    |    |    |    |
| h5       | 0.0006*** | 0.0000 |    |    |    |    |
|          | (13.2171) | (1.3077) |    |    |    |    |
| inve     | 0.0379*** | 0.0158*** |    |    |    |    |
|          | (4.4942) | (7.5514) |    |    |    |    |
| soe      | -0.0160*** | -0.0001 |    |    |    |    |
|          | (-4.3808) | (-0.1215) |    |    |    |    |
| Constant | 0.0445* | -0.1086*** | 0.0222*** | 0.1172*** | 0.0367 | -0.1522*** |
|          | (1.9483) | (-3.8800) | (3.9656) | (16.8192) | (1.6105) | (-5.3859) |
| Year Effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry Effect | Yes | Yes | Yes | Yes | Yes | Yes |
| R-squared | 0.1296 | 0.1982 | 0.0415 | 0.0940 | 0.1361 | 0.2051 |
| N | 12,895 | 12,895 | 12,895 | 12,895 | 12,895 | 12,895 |

***, **, and * indicate significant at 1%, 5%, and 10% respectively, and t-stats in parentheses

First of all, we can find from the first two columns that the coefficient of the explanatory variable `treatafter` is significantly positive at the level of 1%. It can be seen that without considering the innovation of the enterprise, the opening of the high-speed railway will bring positive enterprises to the enterprises along the line. That is, the opening of high-speed rail will indeed bring economic benefits to enterprises along the line. And the coefficients of other control variables are also passed the significance test. Moreover, if the enterprise scale is larger, the listing time is shorter, the asset-liability ratio is lower, the ownership concentration degree is higher, and the investment expenditure is higher, then the economic effect brought by the high-speed railway to the enterprise will be stronger. Therefore, the hypothesis 1 of this paper is verified. The first step of the mediation effect has also been verified.

The third and fourth columns are tests for the relationship between the opening of high-speed rail and corporate innovation investment. As can be seen from the above table, the coefficient of the explanatory variable `treatafter` is also significantly positive at the level of 1%. It can be seen that the opening of the high-speed rail can significantly promote the innovation investment of enterprises. Therefore, the hypothesis 2 is verified, that is, the second step of the mediation effect is verified.

The fifth and sixth columns are the last step to test the mediating effect. It can be found from the above table that, firstly, the coefficients of `treatafter` and `rd` of explanatory variable are both greater than 0, and both pass the significance test at the level of 1%. In addition, the explanatory variable
coefficients in the fifth and sixth columns are smaller than those in the first and second columns respectively. Therefore, the third step of the mediation effect is empirically demonstrated. In the role of high-speed rail opening to promote corporate performance, corporate innovation does play a mediating role and acts as a partial intermediary. Hypothesis 3 of this paper has also been verified.

6. Robustness test
for the sake of space, the regression results of the robustness test are not placed in this paper: Replace explained variables: In the previous regression estimation, the return on assets roa is used as a measure of the explanatory variable. Here, Tobin q is used as the explanatory variable for regression, and the result is consistent with the previous one.

Parallel trend test: The DID model requires that the asset-liability ratios of the experimental and control companies maintain a substantially parallel time trend before the high-speed rail opens. To this end, the paper introduces the grouping variable and the parallel trend test of the cross terms of the dummy variables in the first 2 years and the first 3 years before the opening of the high-speed rail. The results show that the paper meets the parallel trend hypothesis of the double difference method.

7. Conclusions and implications
This paper studies the impact of the opening of high-speed railways on the performance of enterprises along the line from the microscopic perspective of enterprises. The research shows that: The opening of high-speed railways has significantly improved the economic performance of enterprises along the high-speed railway, and innovative investment in enterprises It plays a part in mediating role.

Through the above research, the following revelation can be drawn. (1) We need to fully affirm the positive role of high-speed rail construction, further develop and optimize China's high-speed railway network. (2) In the planning and construction of future high-speed railway, investment in high-speed railway should be increased in areas with high and new technology industries, so as to give full play to the optimized role of high-speed railway in improving enterprise productivity.

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