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Investment Efficiency of Chinese Enterprises Under 'Belt and Road' Initiatives:
What Information Do We Get From Studies?

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ABSTRACT

In recent years, the economic effects of the belt and road initiative have attracted much attention. However, few related studies have explored how this initiative affects the investment efficiency of enterprises. This article regards the 'belt and road' initiative as a quasi-natural experiment and investigates its effects on the investment efficiency of Chinese enterprises. The difference in difference model was used based on data on Chinese listed companies in 2011-2018. According to the findings of this study, the belt and road initiative significantly increased the investment efficiency of Chinese enterprises. On this basis, this paper explores the paths with which the belt and road initiative affects the investment efficiency of Chinese enterprises from the perspectives of both environmental uncertainty and tax incentives. The mediating effect of environmental uncertainty between the belt and road initiative and the investment efficiency of Chinese enterprises assumes a significant "masking effect," while the mediating effect of tax incentives between them is not obvious.

KEYWORDS

belt and road initiative, Environmental uncertainty, Investment efficiency, Tax incentive

INTRODUCTION

The past few years have witnessed a transition of China's economic development from a stage of rapid growth to the new normal of medium and high-speed growth. When analyzing the problems caused by the "scale expansion"-based developmental pattern, the top priority for the Chinese government is to overcome developmental bottlenecks. For this background, in 2013, President Xi introduced two initiatives in succession to build "the Silk Road Economic Belt" and the "21st Century

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Maritime Silk Road" (collectively referred to as the belt and road initiative). In March 2015, the National Development and Reform Commission, the Ministry of Foreign Affairs, and the Ministry of Commerce jointly issued the Vision and Actions on Jointly Building Silk Road Economic Belt and 21st Century Maritime Silk Road (hereinafter referred to as the "Vision and Actions"), which puts the belt and road initiative (BRI) as a top-level design into practical implementation. Focusing on the construction of relevant infrastructure, this initiative aims to strengthen the cooperation for production capacities and to align developmental strategies among the countries along the belt and road. According to statistics released by the Ministry of Commerce for 2013-2018, the total direct investment of Chinese enterprises in countries along the belt and road exceeded 90 billion USD in this time-frame, with an annual mean growth rate of 5.2%. Hence, this paper will focus on the investment efficiency of the investment triggered by the initiative.

Microeconomic entities constitute an important component of economic development. The economic output of micro-enterprises is a significant driving force for the development of the national economy (Jensen and Meckling, 1976) and contributes to the realization of macroeconomic policy goals. However, existing studies mainly focused on the macroeconomic conditions of the countries that are affected by the BRI (William, 2016), while rarely probing into their microeconomic entities with a quantitative approach. This paper conducts an empirical study on the paths with which the BRI affects the investment efficiency of Chinese enterprises, and has vital instructive significance for both the government for promoting macroeconomic growth and for micro-enterprises for continuously increasing their values.

The BRI can be considered as a quasi-natural experiment. With regard to China itself, the effects of the BRI vary from province to province. Based on the geographical positions and economic functions of different region[1], key regions that are affected by the BRI can be identified (Chen and Liu, 2018). This offers an opportunity for using the difference in difference (DID) model for this study. Relying on the quasi-natural experimental environment created by the BRI, this paper empirically investigates the effects of this initiative on the investment efficiency of Chinese enterprises, using the DID model, based on data of Chinese listed companies for 2011-2018. The results show that, relative to enterprises distributed in non-key regions, the investment efficiency of enterprises in the key regions is significantly increased by the BRI. On this basis, this paper explores the paths with which the BRI affects the investment efficiency of Chinese enterprises from the perspectives of both environmental uncertainty and tax incentive. As indicated by the results, the mediating effect of environmental uncertainty between the BRI and the investment efficiency of Chinese enterprises assumes a significant "masking effect" (i.e., environmental uncertainty weakens the positive effect of the BRI on investment efficiency), while the mediating effect of tax incentive between them is not obvious.

The main contributions of this paper can be summarized with the following four aspects: First, this paper contributes to quantitative analysis on the economic effects produced by the BRI and furnishes new empirical evidence on how this initiative affects micro-entities. To some extent, this opens the "black box" of the promoting effect of the BRI on macroeconomic growth and identifies the micro-paths with which it exerts its economic effects. Second, this paper enriches research on the influencing factors of corporate investment efficiency. Existing studies on corporate investment efficiency mainly focus on microscopic factors, such as financing cost (Jensen, 1986), ownership structure (Goergen and Renneboog, 2001), the quality of accounting information (Biddle et al., 2009), and internal governance (Jensen and Meckling, 1976). In contrast, this paper concentrates on the effects of the BRI as a macroscopic policy on corporate investment efficiency and furnishes new empirical evidence for studies in this field. Third, this paper probes into the mediating effect of environmental uncertainty from a psychological perspective. The existence of a "masking effect" between the BRI and the investment efficiency of enterprises is confirmed, while a more significant positive mechanism between them has not been considered. In this way, this paper offers a new direction for future studies on the BRI. Fourth, this paper considers the promulgation of the BRI

as a quasi-natural experiment, which can (to some extent) mitigate the interferences of endogeneity problems. It also adopts the ancient "Silk Road" as an instrumental variable, thus reducing endogeneity problems when selecting treatment groups.

Part II of this paper presents a literature review; Part III proposes the research hypotheses of this paper based on related theories; Part IV presents both the data source and research design; Part V provides empirical test results and their analysis, and Part VI offers conclusions and further insight.

LITERATURE REVIEW AND RESEARCH HYPOTHESES

The BRI is a national innovation strategy proposed by China to actively adapt to the transformation and development of the economy and promote the new pattern of opening-up. Based on the economic functions and roles of different regions, 18 key regions have been identified along the belt and road, including Xinjiang, Shaanxi, Gansu, Ningxia, Qinghai, and Inner Mongolia in Northwest China; Heilongjiang, Jilin, and Liaoning in Northeast China; Guangxi, Yunnan, and Tibet in Southwest China; Shanghai, Fujian, Guangdong, Zhejiang, and Hainan in coastal regions; and Chongqing in inland China.

At the macroscopic level, existing studies mostly assume a general perspective to investigate the background in which the BRI was developed, and both its framework and development strategies (Feng and Huang, 2016). Further, focuses were the significance of the initiative for the countries along the belt and road and for global development (William, 2016), and the important role of infrastructure construction under multilateral relations (Kennedy and Parker, 2015), as well as the foreign direct investment trade (Liu and Dunford, 2016). . Gao (2017) empirically investigated how institutional differences would affect China's direct investment in the countries along the belt and road. With regard to its effects on corporate investment efficiency, a certain gap exists in existing studies. With regard to investment efficiency, existing studies mainly explored its influencing factors at the microscopic level, while paying little attention to the effects of macroscopic policies such as the BRI. Chen et al. (2011) pointed out that the effects of the government and its economic policies on the micro-behaviors of enterprises should not be ignored. Thus, when investigating the effects of the BRI, studies can focus on the investment efficiency of micro-entities, thus enriching the literature on both the BRI and investment efficiency. On this basis, further consideration can be given to the two paths with which the BRI exerts its effects, i.e., tax incentive (which is also representative of favorable policies in general) and environmental uncertainty, to further clarify their action mechanisms.

The BRI is a bold exploration that boosts worldwide economic growth and revitalizes the global economy (William, 2016); furthermore, it offers new opportunities and poses new challenges to Chinese enterprises(Lin et al., 2019). Macroeconomic policies are means of macroeconomic control, and affect the investment efficiency of micro-enterprises via specific paths. First, macroeconomic policies shape the overall judgments and expectations of enterprises about both the national economy and the industrial economy, and also enhance the spillover effect of industries (Rodrik, 1995). By formulating supporting industrial policies and relaxing financial regulations or allocating financial resources toward supported industries, the state increases the availability of equity refinancing opportunities for enterprises (Bernanke and Gertler, 1989). Relying on these supporting industrial policies, enterprises can not only seize additional opportunities, but also increase their investment efficiency (Rodrik, 1994; Stiglitz, 1996). A study by Ye and Li (2012) showed that, during the "11th Five-year Plan" period in China, companies that were supported by industrial policies experienced a significant increase of their value, and that managers' herding behavior in investment was also eased. Second, proactive fiscal policies increase the investment efficiency of enterprises by lowering the capital cost of enterprises and easing their financing constraints. From the perspective of monetary policies and faced with sluggish economic growth, a flexible money supply helps to increase corporate investment efficiency (Opler et al., 1997). Judging from tax policies, a low tax rate and tax burden and high tax preferences significantly increase the investment efficiency of enterprises (Gary et al., 2016).

Judging from bank-enterprise relationships, the entry of foreign banks effectively inhibits agency conflicts and eases financing constraints. Moreover, the information asymmetry between banks and enterprises also decreases with the cultivation of more intimate bank-enterprise relationships, which further greatly increases the corporate investment efficiency (Chen et al., 2013).

The BRI is a strategic choice for China in joining the process of internationalization, and it is of vital significance to encourage and support Chinese enterprises to participate in the industrial investment and infrastructure construction of countries along the belt and road (Kennedy and Parker, 2015). On the one hand, the BRI expands investment opportunities for enterprises in the key regions and provides more robust and valuable investment projects, such as investment in energy, building, and infrastructure construction in countries along the belt and road. This, to some degree, can inhibit enterprise managers' detrimental behavior of blind investment through the misappropriation of funds. On the other hand, based on fiscal and tax policies, a series of measures (such as the establishment of special funds and the application of a zero tax rate) is assumed under the BRI, so that enterprises can obtain financing, innovation, tax preference, and other support. This alleviates problems of financing constraints and under-investment enterprises face, and increase their investment efficiency. On this basis, this paper puts forward Hypothesis 1:

Hypothesis 1: The BRI significantly increases the investment efficiency of Chinese enterprises.

The BRI poses specific risks and uncertainties to enterprises. Many different types of risk exist along the belt and road, including both macro risks (such as political, religious, legal, environmental, social, and financial risks), and micro risks (such as project operation risk, management risk, and accounting risk). These risks combine with each other, as embodied not only in the intertwining of political, religious, and other macro risks, but also in the overlapping of macro and micro risks. Because of the environmental uncertainty these risks cause, the effects of the BRI on the investment efficiency of Chinese enterprises are also uncertain. First, environmental uncertainty raises the degree of information asymmetry, which decreases the accuracy of management assessments on the expected returns of investment projects (Baum et al., 2010) and may even lead to investment failures. Second, management may take advantage of such uncertainty and seek personal gains. A high level of environmental uncertainty increases the difficulty of shareholder supervision over management behaviors, thus making it possible for management to be idle on the job or engage in on-job consumption (Minton and Schrand, 1999), leading to a more prominent agency problem. According to a study by Julio et al. (2016), environmental uncertainty is positively correlated with the degree of investment deviation, and causes enterprises to deviate from their optimal investment scale, thus resulting in low investment efficiency.

On this basis, a negative correlation between environmental uncertainty and investment efficiency can be inferred. However, existing studies have shown that the BRI may significantly increase the investment efficiency of Chinese enterprises. Thus, if Hypothesis 1 were correct, the indirect path with which the BRI affects the investment efficiency of enterprises via environmental uncertainty would weaken the direct effect of the BRI on the investment efficiency of enterprises, which would ultimately manifest a "masking effect". Such a "masking effect" is a common phenomenon in mediation models (Mackinnon et al., 2000), suggesting the existence of a more significant intermediate variable between the independent variable and the dependent variable (Kenny, 2003; Mackinnon, 2008). This is represented in the opposite signs of the direct effect and the indirect effect, and in the masking of the total effect. Based on this observation, this paper assumes that the action mechanism of environmental uncertainty between the BRI and the investment efficiency of enterprises presents a "masking effect". Consequently, the indirect effect exerted by the BRI on the investment efficiency of Chinese enterprises via environmental uncertainty is negative, while the direct effect of the BRI on the investment efficiency of Chinese enterprises is positive. In addition, there is a more significant mediator variable between the BRI and the investment efficiency of Chinese enterprises that have not been incorporated into this study, and that should be explored in depth by follow-up research. Based on this, Hypothesis 2 is proposed.

Hypothesis 2: The mediating effect of environmental uncertainty between the BRI and the investment efficiency of Chinese enterprises manifests as a "masking effect."

The BRI creates new opportunities for Chinese enterprises to benefit from tax preferences. Since the BRI was introduced, the State Taxation Administration of the People's Republic of China has taken it as a priority to serve the belt and road construction, and has introduced 10 tax policies to serve the belt and road strategy from three aspects, i.e., "safeguarding rights and interests through tax agreement negotiation and signing, promoting development through service improvement, and seeking win-win through cooperation enhancement". Clarifying tax support policies, improving the system of export tax refunds, signing tax agreements with the countries along the belt and road, and introducing other relevant tax policies, has encouraged an increasing number of enterprises to develop economic and trade cooperation with countries along the belt and road. Taking the construction of the Silk Road Economic Belt as background, Yu and Han (2017) compared the changes of investment level and investment efficiency in Xinjiang before and after the construction of the Silk Road Economic Belt. They found that the construction of the Silk Road Economic Belt, as a policy measure, promoted the development of targeted preferential tax policies and increased the investment efficiency of enterprises in Xinjiang.

Tax policies increase the investment efficiency of enterprises mainly via the following three aspects. First, preferential tax policies divert funds to policy-supported regions and banks. In response to these policies and out of strong confidence in the development of these regions, these regions and banks are willing to offer more loans (Lu, 2020). Second, tax preferences decrease the payout of free cash flow and increase the surplus of internal funds. Third, preferential tax policies decrease information asymmetry, since these policies are open to both shareholders and managers. Enterprises that enjoy tax preferences are also under tax collection administration by tax authorities, which strengthens taxation regulation, increases the transparency of corporate information, inhibits opportunistic behaviors on the part of corporate management, and helps to increase the investment efficiency of enterprises (Guedhami and Pittman, 2008). Based on this, Hypothesis 3 is proposed.

Hypothesis 3: The BRI significantly increases the investment efficiency of Chinese enterprises through tax incentive policies.

RESEARCH DESIGN

Model Design and Variable Definitions

After its development by Ashenfelter (1985), the DID model has been applied extensively. It has been used to estimate the implementation effects of policies according to the following basic principle: A counterfactual framework is introduced to assess the changes of the observed factor y with and without the policy. Furthermore, considering the presence of time effect and inter group differences, the differences between the treatment group and the control group are analyzed to assess whether the policy is effective. For this reason, when using this model to estimate the effects of the BRI on the investment efficiency of enterprises, it is essential to identify the enterprises of the treatment group and the control group. The promulgation of the Vision and Actions in 2015 can be regarded as a quasi-natural experiment. With regard to China, the effects of the BRI on various regions are not identical. In this case, key regions affected by the "experiment" can be identified according to their geographical positions and economic functions. This offers the conditions to identify the enterprises of the treatment group and the control group. Specifically, referring to the practice of Chen and Liu (2018), 18 key regions affected by the BRI were allocated to the treatment group, and non-key regions affected by the initiative were allocated to the control group. Furthermore, it was noticed that the proposal of the BRI coincided with a reform of turnover tax (the policy of "replacing business tax with value-added tax"). As pointed out by Qian (2018), the policy of "replacing business tax with value-added tax", implemented by periods and regions, affects the investment efficiency behaviors of enterprises. Therefore, to acquire a cleaner sample, regions[2] that lead to the implementation of

the policy of "replacing business tax with value-added tax" were eliminated, and only those were retained that implemented this policy in the same period. In this way, even if the policy of "replacing business tax with value-added tax" would affect the investment efficiency behaviors of enterprises, the degrees of this effect on both the enterprises of the treatment group and the control group would be equal, since they can be eliminated through two differential operations using the DID model. See the specific model design below (Formula (1)):

$$Invest_{it} = \beta_0 + \beta_1 Treat_{it} + \beta_2 Policy_{it} + \beta_3 Treat_{it} * Policy_{it} + X_{it} + \varepsilon_{it} \quad (1)$$

where Invest represents the explained variable investment efficiency. At present, the main models used to measure the capital investment efficiency of a specific enterprise include the Wurgler model (1999), the Vogt model (1994), and the Richardson model (2006). Because of its ability to directly measure the investment efficiency of a specific enterprise in a given year, this paper uses the Richardson model (2006) to calculate the investment efficiency (Formula (2)).

The model to calculate the investment efficiency is designed as follows: After considering growth rate, asset-liability ratio, cash holding level, and other relevant factors influencing investment opportunities and investment expenditure, the optimal investment scale can be estimated. By subtracting the optimal investment scale from the real investment scale, the residual Ɛ can be obtained. That is, the absolute value of the residual Ɛ of Formula (2) is the explained variable Invest of Formula (1). A positive residual means that the real investment scale has exceeded the ideal level, and that over-investment exists; a negative residual means that there is under-investment. The higher the absolute value of residual Ɛ, the lower the investment efficiency.

$$\begin{aligned} Ainvt_{i,t} = {} & \beta_0 + \beta_1 Growth_{i,t-1} + \beta_2 Size_{i,t-1} + \beta_3 Lev_{i,t-1} + \beta_4 Cash_{i,t-1} + \\ & \beta_5 Age_{i,t-1} + \beta_6 R_{i,t-1} + \beta_7 Ainvt_{i,t-1} + \sum Industry + \sum Year + \varepsilon \end{aligned} \quad (2)$$

Where Ainvtit represents the investment expenditure of company i in phase t, defined as the difference after subtracting the net cash received from disposal of subsidiaries and other business units from the sum of the net cash paid for purchase and construction of fixed assets, intangible assets, and other long-term assets and the net cash paid for purchase of subsidiaries and other business units in the cash flow statement (standardization performed using year-beginning total assets); Growthit represents the growth level of company i during phase t-1, defined as the growth rate of the main business income; Sizeit represents the scale of company i in phase t-1, defined as the natural logarithm of year-end total assets; Levi,t-1 represents the asset-liability ratio of company i in phase t-1, defined as year-end total liabilities divided by year-end total assets; Cashi,t-1 represents the cash holding level of company i in phase t-1, defined as the sum of monetary capital and short-term investment divided by year-end total assets; Agei,t-1 represents the listed years of company i in phase t-1, defined as the natural algorithm of [(current year - lasting year) + 1]; Ri,t-1 represents the annual abnormal return of company i in phase t-1, defined as the difference after subtracting the annual return on A-share market from the annual return on cash dividend reinvestment (value-weighted); Ainvti,t-1 represents the investment expenditure of company i in phase t-1. To eliminate the effects of year and industry factors, a group of dummy variables have been introduced into the model, i.e., Year and Industry.

The dummy variable Treat relates to the grouping of sample enterprises, where Treat = 1 denotes enterprises in key regions that are affected by the BRI (i.e., the treatment group), and Treat = 0 denotes enterprises in non-key regions (i.e., the control group); the dummy variable Policy denotes the time span of the effects of the BRI, where a value of 1 is assigned for the year the Vision and Actions were introduced and the years after that (2015-2018), and a value of 0 is assigned for the years before the Vision and Actions were introduced (2011-2014); Treat*Policy denotes the interaction term between

enterprise grouping and time grouping. This is because the higher the Invest value, the lower the investment efficiency. Thus, the coefficient β3 of Treat*Policy is a focus of this study, and should be significantly negative according to Hypothesis H1.

Xit represents the control variable group. The total assets growth rate, asset-liability ratio, cash holding level, enterprise age, and other characteristic variables at the enterprise level have been controlled. See variable definitions in Table 1.

Sample Selection and Data Source

This paper takes the four years before and the four years after the proposal of the BRI as the time window (2011-2018), and adopts the Chinese A-share listed companies of both the treatment and the control group as original samples. According to general practice, finance and insurance companies, Special treatment (ST) companies, and companies missing main variables were eliminated. Ultimately, 8,754 observed values of 1,095 listed companies were obtained. To (II) eliminate the effects of extreme values on estimation results; Winsorization was performed at the 1% level for the main continuous variables. In addition, to mitigate the interferences with estimation results by latent heteroskedasticity and series autocorrelation, robust standard errors were adopted to estimate all subsequent regressions, followed by clustering at the company level. The financial data on listed companies are all derived from the China Stock Market & Accounting Research Database (CSMAR).

DESCRIPTIVE STATISTICS OF MAIN VARIABLES

Table 2 provides the descriptive statistics of various variables. Seen from the sample as a whole, Invest has a minimum value of 0, which indicates that the real investment level has not deviated from the ideal investment level and that the investment efficiency is maximal. Invest has a maximum value of 98.5%, meaning that the real investment level has not deviated from the ideal investment level and that the investment efficiency is minimal. This suggests significant differences among sample enterprises with regard to their investment efficiency. Ownership concentration has a maximum value

Table 1. Variable definitions and descriptions

Variable type	Variable name	Calculation formula
Investment efficiency	Invest	Difference between the real investment scale and its ideal level, i.e., residual Ɛ
regions affected by the BRI	Treat	A value of 1 is assigned if the province where the enterprise is registered is a key province along the belt and road; otherwise, a value of 0 is assigned.
Time span of the effects of the BRI	Policy	A value of 1 is assigned for the year the *Vision and Actions* was introduced and the years after that (2015-2018), and a value of 0 is assigned for the years before the *Vision and Actions* was introduced (2011-2014)
Total assets growth rate	Growth	(Current-year assets - last-year assets) / (last-year assets) × 100%
Asset-liability ratio	Lev	Year-end total liabilities / total assets × 100%
Cash holding level	Cash	Balance of cash and cash equivalents / total assets
Enterprise age	Age	Listed years
Annual abnormal return	Return	Difference after subtracting the annual return on A-share market from the annual return on cash dividend reinvestment
Return on total assets	Roa	Earnings before interest and tax / mean total assets × 100%
Ownership concentration	Top	Shareholding ratio of the first majority shareholder

of 89.99 and a minimum value of 3.39. The large difference in ownership concentration may affect the investment efficiency of enterprises.

The mean values of the growth rate of total assets, asset-liability ratio, cash holding level, enterprise age, annual abnormal return, and return on total assets are 21.6%, 49.8%, 20.9%, 2.64, 5.7%, and 5.4%, respectively.

Table 3 shows the distribution characteristics of investment efficiency. In 2011-2017, the average corporate investment efficiency did not change much, and Invest had an average value of 3-5%. On the whole, most investment activities were inefficient, and to a larger degree suffered under-investment. This suggests that a majority of enterprises faced a lack of investment opportunities or funds.

EMPIRICAL TEST RESULTS AND ANALYSIS

Parallel Trend Test

In order to ensure the effectiveness of the DID model, the control group and the experimental group should have a parallel trend before the implementation of belt and road policy. Following Wang et al. (2020), we constructed the following model to test the parallel trend between the experimental group and the control group before and after the implementation of the Belt and Road policy.

Table 2. Descriptive statistics of variables

Variable	Mean	Std. Dev.	Min	Max
Invest	0.039	0.060	0.000	0.985
Growth	0.216	1.518	-0.895	79.603
Lev	0.498	0.212	0.007	8.612
Cash	0.209	0.345	0.002	15.924
Age	2.637	0.399	1.099	3.332
Return	0.057	0.429	-0.895	7.120
Roa	0.054	0.161	-0.564	7.249
Top	35.409	15.254	3.390	89.990

Table 3. Distribution characteristics of investment efficiency

Year	Invest mean	Number of companies in over-investment	Proportion of companies in over-investment	Number of companies in under-investment	Proportion of companies in under-investment
2011	0.048	355	32.42%	740	67.58%
2012	0.036	389	35.53%	706	64.47%
2013	0.033	450	41.10%	644	58.81%
2014	0.034	401	36.62%	694	63.38%
2015	0.045	294	26.85%	799	72.97%
2016	0.051	322	29.41%	763	69.68%
2017	0.037	452	41.28%	643	58.72%
2018	0.030	454	41.46%	641	58.54%

$$Invest_{it} = \beta_0 + \beta_1 Treat_{it} + \beta_2 Policy_{it} + \beta_3 Treat * Policy_{2014+k} + X_{it} + \varepsilon_{it} \quad (3)$$

Among them, Treat*Policy$_{2014+k}$ is the interaction term before or after the year, and other variables are consistent with the baseline regression model. As indicated in Table 4, the coefficient of Treat*Policy was insignificant before 2014, indicating that there was no significant difference between the control group and the experimental group before the implementation of belt and road policy. However, after the implementation of the belt and road policy in 2014, this coefficient gradually began to be positive and significant. It means that there was a significant difference in investment efficiency between the control group and the experimental group, which can be considered as the direct effect of the implementation of the policy. It is noteworthy that the coefficient of Treat*Policy became significant in 2016. The reason may be that the implementation and effect of relevant favorable policies need some time. In sum, the model satisfies the assumption of parallel trend.

DID TEST RESULTS AND ANALYSIS

Table 5 reports the regression results of the effect degree of the BRI on investment efficiency. In Column (1), industrial and annual fixed affects have been controlled. To eliminate the effects of unobservable factors at the company level on basic study results, corporate fixed effects have been further controlled in Column (2). The coefficient of the interaction term Treat*Post reflects the influence degree of the BRI on the investment efficiency of the companies in key regions relative to those in the non-key regions. A lower Invest value indicates a higher investment efficiency. According to the results, the regression coefficient of Treat*Post was significantly negative at the 5% level (coefficient in Column (1) = -0.006, t = -1.68; coefficient in Column (2) = -0.007, t = -2.02), suggesting that the BRI increased the investment efficiency of the listed companies in key regions relative to those in the non-key regions. Thus, statistically, it is impossible to reject Hypothesis 1, and the BRI has indeed increased the investment efficiency of enterprises in the key regions.

Endogeneity Problems: The Instrumental Variable Method

When estimating the causality between the BRI and corporate investment efficiency using the DID model, the most ideal scenario is one in which the treatment group is selected randomly. Consequently, the selection of the treatment group is not affected by other observable or unobservable factors that influence the response degree of corporate investment. In fact, the selection of key regions along the belt and road and the response degree of corporate investment to the BRI may have been determined simultaneously. For instance, regions with a higher response degree of corporate investment are more likely to be included in the list of key regions along the belt and road (since they are more likely to realize the goals of the initiative). Also, companies with a lower response degree of corporate

Table 4. Parallel Trend Test

	2011	2012	2013	2014	2015	2016	2017	2018
Invest$_{it}$	-0.113 (0.763)	-0.095 (0.528)	-0.263 (0.926)	0.120 (1.352)	0.179 (1.633)	0.382* (1.787)	0.399** (1.983)	0.417*** (2.621)
Year	Control							
Industry	Control							
Constant	Control							

Note: T-static value in parentheses, * p < 0.10, ** p < 0.05, *** p < 0.01.

Table 5. The BRI and corporate investment efficiency

Variable	Invest	
	(1)	(2)
Treat	0.006** (2.08)	
Policy	0.006*** (4.06)	0.009*** (4.86)
Treat*Policy	-0.006* (-1.68)	-0.007** (-2.02)
Growth	0.008*** (19.09)	0.007*** (17.81)
Lev	-0.019*** (-6.09)	-0.024*** (-6.30)
Cash	0.013*** (7.28)	0.012*** (6.55)
Age	-0.009*** (-5.09)	-0.019*** (-4.31)
Return	0.019*** (13.30)	0.018*** (12.27)
Roa	-0.010** (-2.45)	-0.006 (-1.54)
Top	0.001*** (-0.35)	0.001*** (4.16)
Constant	0.051*** (5.01)	0.093*** (8.19)
Firm and year		Control
Industry and year	control	
N	8754	8754
R^2	0.074	0.105
F	76.453	13.335

Note: T-static value in parentheses, * p < 0.10, ** p < 0.05, *** p < 0.01.

investment are more likely to be included in the list of key regions along the belt and road (for the sake of intensive monitoring). As a result, the selection of the treatment group may be influenced by endogeneity problems, thus affecting the estimation accuracy (Chen and Liu, 2018). On that account, this paper uses the instrumental variable method to solve the problem of potentially missing variables. Considering that interstate highway system plans, railways, and exploration lines were once used as instrumental variables in history (Duranton et al., 2014; Agrawal et al., 2017), the ancient "Silk Road" is adopted as an instrumental variable for key regions along the belt and road. Theoretically, this instrumental variable meets two conditions for effective instrumental variables: First, a high correlation exists between the selection of the key regions along the belt and road and the regions the ancient "Silk Road" passed. The BRI is based on the ancient "Silk Road", and one of its goals is to revive the ancient "Silk Road". Second, the ancient "Silk Road" as a variable is exogenous, since it does not directly affect the relationship between the BRI and corporate investment efficiency.

In Model (1), Treat (the dummy variable for the key regions, occurs in both individual and interaction terms; therefore, the model contains two endogenous variables. In this paper, whether

a province is passed by the ancient "Silk Road" (IV) is adopted as the instrumental variable of Treat, and the interaction term (IV*Policy) is used as the instrumental variable of Treat*Policy. The corresponding Models 4 and 5 are given below:

$$Treat = \beta_0 + \beta_1 IV + \beta_2 Policy + \beta_3 IV * Policy + Controls + \varepsilon i_t \quad (4)$$

$$Treat * Policy = \beta_0 + \beta_1 IV + \beta_2 Policy + \beta_3 IV * Policy + Controls + \varepsilon i_t \quad (5)$$

where IV represents the dummy variable, to which a value of 1 will be assigned if the province where the enterprise is registered is passed through by the ancient "Silk Road"; otherwise, a value of 0 will be assigned. To estimate the response degree of corporate investment for the BRI, this paper re-estimates Model (1), using the instrumental variable method. This method uses two different sources of difference: The implementation of the BRI provides a difference in time series; the instrumental variable offers an exogenous difference in the selection of the treatment group on the cross-section. This helps to more reliably establish causality between the BRI and the response degree of corporate investment in this paper.

Columns (1)-(2) in Table 6 report the first-stage regression results of the relationship between the regions passed through by the ancient "Silk Road" and the selection of key regions along the belt and road. As indicated by the results, the coefficient of IV in Column (1) and the coefficient of IV*Policy in Column (2) were both highly significant at the 1% level, with an F value above 10. This suggests that, in the first-stage regression, the instrumental variable was highly correlated with the original endogenous variable, and there was no problem of unidentifiable or weak instrumental variables. Column (3) reports the second-stage regression results, which indicate that the regression coefficient of Treat*Post was significantly negative. This suggests that, after reducing endogeneity problems in the selection of the treatment group, the basic conclusions remain unchanged.

Table 6. Endogeneity problems: the instrumental variable method

Variable	First stage regression		First stage regression
	(1) Treat	(2) Treat*Policy	(3) Invest
IV	0.701*** (34.86)	-0.043*** (-2.9)	
IV*Policy	0.187*** (6.75)	0.968*** (47.31)	
Treat			0.005* (1.77)
Policy			0.007*** (4.66)
Treat*Policy			-0.006* (-1.71)
Constant	0.570** (-2.29)	-0.114*** (-6.64)	0.066*** (12.04)
Control	Control	Control	Control
Obs	8,754	8,754	8,754
R^2	0.322	0.334	0.077
F	461.349	486.330	70.505

Note: T-static value in parentheses, * p < 0.10, ** p < 0.05, *** p < 0.01.

Effects of the BRI on the Investment Efficiency of Chinese Enterprises

In the section that explores the theoretical mechanism, this paper indicates that the BRI can affect the investment efficiency of Chinese enterprises by promoting tax incentives and altering environmental uncertainty. This section further tests the mediating effect.

With regard to environmental uncertainty (EU), this paper adopts sales income and annual variable as the explained variable and the explanatory variable for OLS regression, respectively, to estimate the random disturbance term. Next, the disturbance term is assumed as abnormal sales income, and used to divide sales income to obtain the non-industry-adjusted corporate environmental uncertainty level. Finally, the non-industry-adjusted corporate environmental uncertainty level is divided by the median industrial environmental uncertainty level to obtain the mediator variable, i.e., corporate environmental uncertainty level. To avoid the effect of the dimensional problem on estimation results, z-score standardization of the corporate environmental uncertainty level has also been performed.

With regard to the tax incentive, this paper refers to the approach of Pan (2015), and uses the effective enterprise income tax preference Atax as a measure of tax incentive according to the following formula: Atax equals the statutory tax rate minus the effective tax rate. According to the Enterprise Income Tax Law of the People's Republic of China, the rate of enterprise income tax is 25%; therefore, the statutory tax rate in the above formula is set to 25%. The effective tax rate is the income tax expense divided by the total profit reported in the enterprise profit statement. Atax measures the level of all the income tax preferences enjoyed by an enterprise, including extra tax deductions for research and development costs, preferential tax rate, and tax credit.

Here, the model design referred to the mediating effect test procedure of Wen et al. (2004) to identify the mechanism of the effect of the BRI on the investment efficiency of Chinese enterprises. The test model is designed as follows:

$$Invest_{it} = \beta_0 + \beta_1 Treat_{it} + \beta_2 Policy_{it} + \beta_3 Treat_{it} * Policy_{it} + X_{it} + \varepsilon_{it} \quad (6)$$

$$EU_{it}(Atax_{it}) = \delta_0 + \delta_1 Treat_{it} + \delta_2 Policy_{it} + \delta_3 Treat_{it} * Policy_{it} + X_{it} + \mu_2 \quad (7)$$

$$\mathrm{Invest}_{it} = \gamma_0 + \gamma_1 Treat_{it} + \gamma_2 Policy_{it} + \gamma_3 Treat_{it} * Policy_{it} + \gamma_4 \mathrm{Atax}_{it}(EU_{it}) + X_{it} + \mu_3 \quad (8)$$

where EU and Atax represent the mediator variables of environmental uncertainty and tax incentive, respectively; μ represents the random disturbance term; the definitions of all other terms are the same as those in Model (1). According to the estimation results of Model (1) (see Table 2), coefficient β3 was -0.007, and significant at the 5% level. Thus, it can be assumed that the overall increasing effect of the BRI on the investment efficiency of Chinese enterprises is 0.007. The mediating effect test can be conducted for verification. According to the principle of the Sobel (1988) test, the mediating effect is measured by δ3 and γ4. If both δ3 and γ4 are significant, the mediating effect will be significant. In cases where at least one of them is non-significant, the Sobel test should be conducted to determine whether the mediating effect is non-significant. When testing the effect mechanism of the BRI on the investment efficiency of Chinese enterprises, annual fixed affects and corporate fixed effects have been controlled in all regressions at the same time.

Columns (1)-(2) of Table 7 report whether the BRI would affect the estimation results of the investment efficiency of Chinese enterprises through environmental uncertainty. Clearly, in the regression results of Model (6) in Column (1), the coefficient of interaction term Treat*Policy was positive and significant at the 5% level. This suggests that the BRI has indeed exerted a significant positive effect on the environmental uncertainty of Chinese enterprises. Moreover, in the regression results of Model (7) in Column (2), the coefficient of EU was 0.009 and significant at the 1% level. This suggests that environmental uncertainty exerts a significant inhibiting effect on the investment efficiency of enterprises. On the basis of the above test procedure, when coefficient β3 was significant, coefficients δ3 and γ4 were both significant; therefore, the Sobel test was not necessary. As a result, the mediating effect of environmental uncertainty was significant. However, the sign of the indirect effect (δ3*γ4 = 0.001) of

the BRI was opposite to that of its direct effect ($\gamma 3 = -0.008$). This suggests that the mediating effect of environmental uncertainty between the BRI and the investment efficiency of Chinese enterprises manifests as a "masking effect" (Wen and Ye, 2014), thus partially validating Hypothesis 2.

Moreover, Columns (3)-(4) of Table 6 report whether the BRI would affect the estimation results of the investment efficiency of Chinese enterprises through a tax incentives. It can be seen that both coefficients $\delta 3$ and $\gamma 4$ were non-significant. The Sobel test showed that the mediating effect was also non-significant. Hypothesis 3 is therefore not validated.

Robustness Checks

Excluding Supportive Policies Issued by Local Governments

As can indicate by the analysis presented in Table 5, statistically, it is impossible to reject Hypothesis 1. However, the following question still remains: Will other supporting policies introduced by the government interfere with the estimation results? First, support by functional policies at the national level does not modify the conclusions of this paper. This is because the results of the policies of a country, such as an infrastructure construction, scientific and technological input, and human capital development, usually unfold countrywide, and provide "inclusive" support for the entire market (Huang and Chen, 2003). Interferences with the treatment group and the control group by these means are equivalent. They can be eliminated through two differential operations using the DID model. However, it should be noted that the supporting policies introduced by local governments may exert different effects on the treatment group and the control group. In this case, the question remains whether it is possible that the investment efficiency of enterprises in the treatment group may have been increased by policy support from local governments after the BRI was launched. In other words, the increase in the investment efficiency of enterprises in the treatment group is not attributable to the BRI. In follow-up research, this question will be addressed.

Table 7. Action mechanism test: mediating effects of environmental uncertainty and tax incentive

Variable	Environmental uncertainty		Tax incentive	
	(1) EU	(2) Invest	(3) Atax	(4) Invest
Treat	-0.095 (-1.24)	0.002 (0.4)	-0.221 (-0.81)	0.001 (0.23)
Policy	-0.043 (-1.43)	0.010*** (5.23)	-0.017 (0.109)	0.009*** (4.98)
Treat*Policy	0.123** (2.17)	-0.008** (-2.29)	-0.216 (-1.06)	-0.007* (-1.95)
EU		0.009*** (12.33)		
Atax				0.000 (1.03)
Constant	-0.356* (-1.74)	0.076*** (6.12)	-1.145 (-1.55)	0.074*** (5.83)
Control	Control	Control	Control	Control
Obs	8,754	8,754	8,754	8,754
R^2	0.177	0.095	0.002	0.077
Sobel test	$\delta 3$ and $\gamma 4$ are both significant, so the Sobel test is unnecessary.		Z=-0.169,|Z|<0.97	
Mediating effect	Significant		Non-significant	

Note: T-static value in parentheses, * p < 0.10, ** p < 0.05, *** p < 0.01.

In general, China's local governments support local enterprises through fiscal subsidies. Thus, after the implementation of the BRI, if enterprises of the treatment group and the control group receive different levels of support, there will be obvious differences in the fiscal subsidies they receive. In contrast, if there is no significant difference in the fiscal subsidies received by them during the sample interval (2012-2017), it can be proved that the increase in the investment efficiency of enterprises in the treatment group is indeed caused by the BRI. Specifically, the DID model is still used for testing. See the model design below:

$$\mathrm{Sub}_{it} = \beta_0 + \beta_1 Treat_{it} + \beta_2 Policy_{it} + \beta_3 Treat_{it} * Policy_{it} + X_{it} + \varepsilon_{it} \quad (9)$$

Where Sub represents fiscal subsidies, expressed by the natural logarithm of the volume of fiscal subsidies received by an enterprise; X represents the control variable group, which has the same definition as that in Model (1).

Table 8 reports the regression results of fiscal subsidies based on the DID model. As indicated by the presented results, all interaction term coefficients of interest failed to reach the conventional significance level (10%). This indicates that, over the sample period, there was no significant difference

Table 8. Difference in difference (DID) test results and analysis

	Sub
Treat	-0.514 (-1.4)
Policy	-0.652*** (-4.46)
Treat*Policy	0.184 (0.67)
Growth	0.101*** (3.08)
Lev	0.367 (1.23)
Cash	0.147 (0.99)
Age	-1.301*** (-3.66)
Return	0.293** (2.57)
Roa	0.651* (1.73)
Top	0.009 (0.98)
Constant	18.121*** (18.31)
Firm and year	Control
Obs	8,754
R^2	0.021
F	16.678

Note: T-static value in parentheses, * p < 0.10, ** p < 0.05, *** p < 0.01.

in the policy support received by enterprises of the treatment group and the control group. On this basis, it can be assumed that the increase in the investment efficiency of enterprises in the treatment group is indeed caused by the BRI. Thus, the conclusions of this paper remain valid.

Alternative measure of investment efficiency

There are also some studies that measured enterprise growth in Richardson's (2006) model (corresponding to Model 2 in this paper) by market value (Tobin Q). We thus used this approach to re-estimate and then obtain the new residuals by using model (2) to measure enterprise investment efficiency (Ainvt). Model 2 in Table 9 shows the results. We can see that similar results were obtained for the alternative measures of investment efficiency.

Triple Difference (DDD) Model

Triple difference (DDD) is a variation of DID, which not only controls the time and group effects, but also adds a new set of sources of differences. In order to further analyze the heterogeneity of Chinese enterprises in various industries before and after the belt and road initiative, this paper adds a new control group (i.e., whether it is the energy industry) to analyze the investment effect of the energy industry. Then we established the following triple differential econometric model:

$$Invest_{it} = \beta_0 + \beta_1 Treat_{it} + \beta_2 Policy_{it} + \beta_3 Treat_{it} * Policy_{it} + \beta_4 Treat_{it} * Policy_{it} * \text{Energy}_{it} + X_{it} + \varepsilon_{it} \quad (10)$$

In this model, we introduced Energy as a dummy variable. It was coded 1 if the enterprise belongs to energy industry and 0 otherwise.

Table 10 shows the results. In the first column, the estimate of Treat*Policy*Energy is significantly positive ($\beta = 0.174$, $p < 0.01$). This indicates that the belt and road initiative has indeed promoted the improvement of investment efficiency of Chinese enterprises in the energy industry, and its energy investment effect on countries along the line is greater than non Belt and Road countries. We think that this may be attributed to the improvement of policies, facilities, trade, capital and popular sentiment. Since the belt and road initiative was put forward, China has continuously strengthened

Table 9. The BRI and investment efficiency that measured by Tobin Q

Vairable	Invest	
	(1)	(2)
Treat	0.012** (1.76)	
Policy	0.016*** (2.76)	0.029*** (2.59)
Treat*Policy	-0.016* (1.68)	-0.021** (1.98)
Constant	0.021 (0.99)	0.223*** (4.66)
Firm and year		Control
Industry and year	control	
N	8754	8754
R^2	0.114	0.115
F	86.458	15.535

Note: T-static value in parentheses, * p < 0.10, ** p < 0.05, *** p < 0.01.

policy communication with the countries along the Belt and Road. The construction of major energy and transport infrastructure projects, such as the China Myanmar oil and gas pipeline, the Central Asia gas pipeline, and the China Europe train, has increased the foreign investments of Chinese enterprises. At the same time, facility connectivity has reduced the transportation costs of enterprises.

CONCLUSION AND LIMITATIONS

Conclusion

This paper investigates the causality between the BRI and corporate investment efficiency in China based on data on Chinese listed companies for 2011-2018. Moreover, the effects of the BRI on the investment efficiency of enterprises are empirically studied using the DID model. According to the findings of this study, relative to the investment efficiency of enterprises distributed in non-key regions, that of enterprises in key regions is significantly increased by the BRI. This conclusion has passed a series of robustness tests. On this basis, this paper explores the paths with which the BRI affects the investment efficiency of Chinese enterprises from the perspectives of environmental uncertainty and tax incentive. The mediating effect of environmental uncertainty between the BRI and the investment efficiency of Chinese enterprises presents a significant "masking effect", while the mediating effect of tax incentive between them is not obvious.

To increase the investment efficiency of Chinese enterprises in the countries along the belt and road and to promote the successful implementation of the BRI, this paper proposes the following policy suggestions: First, considering the essential role of microeconomic entities for economic development, it is necessary to fully mobilize microeconomic entities, and, in particular, fully utilize the initiatives of listed companies during the implementation of the BRI, to thus promote the transformation and development of the local economy. Second, under the BRI, the tax incentive is not a significant factor that influences the investment efficiency of Chinese enterprises, and the mediating effect of tax incentives is non-significant. For this reason, when formulating relevant policies, both the central

Table 10. The BRI and corporate investment efficiency (DDD model)

Variable	Invest	
	(1)	(2)
Treat*Policy	0.013** (1.99)	
Treat*Energy	0.086*** (3.23)	
Energy*Policy	0.006* (1.61)	
Treat*Policy*Energy	0.174*** (3.335)	0.139*** (2.985)
Constant	0.024*** (3.02)	0.025*** (2.99)
Year	Control	
Industry and year		Control
N	8754	8754
R^2	0.026	0.108
F	78.953	15.842

Note: T-static value in parentheses, * p < 0.10, ** p < 0.05, *** p < 0.01.

government and local governments should fully consider how to guide companies to increase their investment efficiency and how to decrease unnecessary government subsidies. The implementation effects of relevant policies should be assessed in stages to timely rectify the phenomenon of unhealthy industrial competition caused by related policies. Third, Chinese enterprises should perfect their investment strategies, and rationally assess investment opportunities created by supporting industrial policies; to avoid over-investment, they should refrain from blindly pursuing large-scale investment projects. Fourth, the mediating effect of environmental uncertainty between the BRI and the investment efficiency of Chinese enterprises manifests as a "masking effect"; therefore, efforts should be made to perfect the external investment promotion system of the Chinese government, support Chinese enterprises in safeguarding their rights and interests abroad according to applicable law, and reduce the risks they face. Chinese enterprises should strengthen their surveys and understanding of the national conditions of the countries along the belt and road, and strive to avoid political, legal, and project operation risks, to achieve a more rational and scientific investment.

Limitations and Future Research

Our study is with limitations. First, enterprises may invest in multiple countries at the same time, which may or may not be countries along the belt and road. However, given that it is difficult to fully obtain the relevant data at present, we cannot able to separate the specific data from the total amount of investments. We would encourage future studies to use other method, such as data mining, to obtain more detail data. Second, we only consider the control group by region, but different industries are affected differently by the belt and road. Future studies may extend our research to consider industry region time by using the DDD model. Third, although we considered to exclude supportive policies issued by local governments in the robustness test, there are still some macro policies or international relations may affect enterprise investment. Future research could consider to exclude some other important concurrent events to make the results more robust, such as the establishment of the AIIB and the Regional Comprehensive Economic Partnership.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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ENDNOTES

[1] "Region" stands for provinces, cities and autonomous regions
[2] These regions include Shanghai, Beijing, Jiangsu, Anhui, Fujian, Guangdong, Tianjin, Hubei, and Zhejiang.

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