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Does the Belt and Road Initiative Reduce the R&D Investment of OFDI Enterprises? Evidence from China's A-Share Listed Companies

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Abstract: Existing studies on the Belt and Road Initiative (BRI) primarily explain its impact on foreign trade, foreign direct investment and economic development of the countries concerned, whereas its impact on the performance of outward foreign direct investment (OFDI) enterprises has rarely been examined. By considering the BRI as exogenous policy shock, this paper analyzes the mechanism and impact of the BRI on the research and development (R&D) investment of China's OFDI enterprises investing in countries along the Belt and Road. With propensity score matching and a difference-in-difference approach, it tackles the endogeneity problem caused by self-selecting into the BRI enterprise group. The estimates indicate that BRI has not effectively promoted the R&D investment of OFDI enterprises, but plays an inhibitory role in the short term, and the marginal effect increases firstly and then decreases. Further mechanism analysis shows that the BRI leads to the addition of overseas revenue and the reduction of return on assets, which are the main reasons for the decrease of the R&D investment. In addition, the ownership heterogeneity analysis finds a higher negative effect on the state-owned enterprises, while a smaller effect on non-state-owned enterprises.

Keywords: Belt and Road initiative; OFDI enterprise; R&D investment

1. Introduction

Implementing the Going Out Strategy is of great significance for China's enterprises to participate in overseas competition and cooperation, develop new markets, accelerate innovation, and realize the upgrading of industrial structure and sustainability development [1]. China's outward foreign direct investment (OFDI) has been growing rapidly since 2002 and now China has become the second largest OFDI country following the United States. In particular, the Belt and Road Initiative (BRI) has played an important role in deepening the Going Out Strategy and promoting OFDI, which was proposed by China in 2013. The total import and export volume between China and other countries included in BRI accounted for 36.2% of China's total trade in 2017, and among them, five sixths of the trade volume came from 71 countries other than China along the Belt and Road (hereinafter called the node countries, see Appendix A, Table A1). As an open and multi-national mechanism of regional cooperation, the BRI is essentially integrated with sustainable development, and the main objective of BRI is to raise the economic growth of the participating countries and contribute toward socioeconomic uplift by trading and cooperating. In addition, the BRI also requires the participating countries to strengthen project cooperation in the areas of infrastructure interconnection, industrial investment, new energy development, financial cooperation, humanities exchange, and ecological protection to promote common sustainable development. Particularly, the investments from China play an important role in helping the infrastructures construction of these emerging markets and developing

countries, promoting the sharing of resources, and strengthening international production capacity cooperation [2,3]. International trade is often mixed with technological innovation and transfer, and technological innovation is extremely important for the competition and sustainable development of the enterprise [4,5]. The implementation of the BRI requires the enterprise to strengthen scientific and technological cooperation with government or other enterprises, jointly build research centers, and promote the exchange of technological personnel to enhance technological innovation capabilities and achieve sustainable development. However, in the initial stage of BRI, most enterprises participate in the initiative mainly to export products, develop new markets and acquire natural resources, instead of seeking technological progress and innovation [6]. The question is whether these enterprises would increase the R&D investment to improve their technology.

For the general OFDI enterprises, a large number of studies have shown that OFDI would significantly promote their productivity, trade volume and revenue performance [7–9]. As part of the Going Out Strategy of China, the BRI has its own special OFDI features. Thereby, testing the effect of BRI on enterprises would provide more useful information to understand the OFDI and the BRI more objectively and comprehensively.

The existing studies on the BRI focus on discussing the economic, trade and investment benefits from the perspective of countries and regions [10–13]. There is little literature studying the impact of the BRI on enterprises. Liu et al. [14] establish a combined dataset and find firms invest more along the "Belt and Road" route after the BRI was launched. Yu [15] finds the BRI can facilitate the investment of enterprises, and Rafif and Yang [6] point out several factors that restrict the innovation of enterprises in BRI, and suggest China strengthen its emphasis on innovation in the implementation of BRI. The "Belt and Road" Science and Technology Innovation Action Plan, which was issued in May 2017, also points out that China and countries along the route should strengthen innovation cooperation and provide a good environment for enterprise' R&D innovation.

Our research focuses on the literature that studies the impact of OFDI on R&D innovation. There are mixed opinions about the impact. Some hold a positive view [16–18], while others have different opinions [19]. Chen et al. [20], using a panel dataset of 493 multinationals over the period 2000–2008, find evidence supporting the reverse spillover effect, and point out that the emerging market multinationals that have subsidiaries in host developed markets are richer in R&D investment and R&D employment. Li et al. [21] find that OFDI has a very significant impact on the domestic innovation of China. However, Luo and Tung [22] find that because of the lack of sufficient and robust legal systems and fierce competition, OFDI has the negative effect on innovation. Moreover, China' s OFDI has not brought about positive reverse technology spillovers. Huang [23] also points out that the R&D growth of enterprise is negatively related to the wage gap between the home and host country, especially when the latter is an undeveloped one.

This paper draws on previous research, taking the impact of BRI on the R&D investment of OFDI enterprise as a quasi-natural experiment, and uses propensity score matching (PSM) and a difference-in-difference (DID) approach to evaluate the impact. In addition, it investigates the impact mechanism, ownership heterogeneity and takes the robustness tests. The empirical results provide three important insights. Firstly, the effect of the BRI on the R&D investment of OFDI enterprises has been found to be negative in the short term. Secondly, the addition of overseas revenue and the reduction of return on assets caused by the BRI largely reduce the enterprises' R&D investment. Finally, the effect of BRI is heterogeneous in ownership, which means that there is a higher negative effect in the state-owned enterprises (SOEs).

The main contributions of this paper are as follows: (1) Unlike previous literatures focusing on countries, this paper studies the effect of BRI from a micro perspective, and investigates the impact of BRI on the R&D investment of OFDI enterprises; (2) Since the BRI is a flexible initiative and its implementation period is not long, there is rare direct data compiled now. Using the matching data from multiple channels (such as the matching data of China A-share listed companies and the Open

List of Overseas Investment Enterprises (Institutions) Filings), this work makes the empirical results more robust and enriches the corresponding study.

The rest of this paper is as follows: Section 2 elaborates the literature review and theory foundation, Section 3 introduces model and data, Section 4 provides the empirical findings and robustness tests, and Section 5 offers conclusions.

2. Literature Review and Theory Foundation

As the BRI has been proposed for a few years, relevant theoretical and empirical studies about the effect of BRI on the R&D innovation of OFDI enterprise are rarely found. This paper refers to the relevant theory of OFDI, and sorts out the impact mechanism of BRI on the R&D investment of an OFDI enterprise.

2.1. The Motivation of Enterprise to Participate in the Belt and Road Initiative (BRI)

International investment behavior can be classified as four different types: market seeking, natural resource seeking, technology seeking, and strategic resource seeking [24]. Generally speaking, Chinese enterprises invest in developed countries for strategic resource seeking and technology seeking [8], and invest in developing countries for market and resource seeking [25]. For example, China's investments in Africa are dominated by the state-owned enterprises (SOEs) and they invest the infrastructure that helps the economic development of African countries, but private enterprises mainly for market seeking, and most of the industries invested are low-end manufacturing and services [26]. As for the R&D and innovation of enterprises, a large number of studies have pointed out that Chinese enterprises significantly improve their R&D investment and innovation capabilities by investing in developed countries [18,21]. However, when the investment destinations are undeveloped countries, the promotion effect is weaker or uncertain [4]. As with the traditional OFDI that enterprises invest in the countries according to their own needs, the implementation of BRI makes the enterprises invest countries purposefully.

From the timing of the BRI, the global economy has been slowly recovering and China's economy has been in urgent need of upgrading. When viewing more broadly about the motives that China propose the initiative, foreign aid and profitability may simultaneously exist [27]. Moreover, the node countries are rich in resources and poor in growth performance. All of these explain why Chinese enterprises participating in BRI are more concerned about exporting products, developing new markets, and acquiring resources, while their passions for investing in R&D innovation are limited [6]. In addition, because they are allocating more resources overseas, the crowding out effect may also have a negative effect on the enterprises' R&D investment.

2.2. The Comparative Advantage of Investment in BRI

The marginal industry expansion theory believes that the home country should transfer its relatively disadvantaged industry to the host country with potential comparative advantages. In reality, the developed countries have shifted mature industries to developing countries, and there exists technical export in this process [28]. Dunning's international direct investment eclectic theory regards the broad market of the host country as an important factor in attracting foreign direct investor. In recent years, many labor-intensive manufacturing industries in China have mature technologies and excess capacity, and their domestic advantages are no longer maintained. But most node countries are low-income economies, and have a certain scale of untapped market and a large surplus of labor, which are the new destinations of both Chinese enterprises' investment and export [29]. As a result, China's main export to these node countries are the labor-intensive industries such as machinery, textiles and clothing. Furthermore, compared with the enterprises of the node countries, Chinese OFDI enterprises have technological advantages, face lower competitive pressure and less demand for advanced products from the node countries. The above would make the Chinese enterprises easily

enter the local market and mostly pursue short-term profits from product sales based on existing technologies, while ignoring the R&D innovation [21].

2.3. The Small Reverse Technology Spillover Effect of Investment in BRI

Reverse technology spillover currently refers to phenomena that enterprises in home countries absorb advanced product and technology from the host country to enhance their own technology innovation ability [16,17]. Since the research on reverse technology spillover started from the discussion of OFDI in developed countries, there are some studies showing that the positive spillover effect does not always exist [19]. Especially when the host country is the undeveloped country, the effect may be weak, or even negative. For example, Haddad and Harrison find negative technology spillovers associated with direct investment in a study of Venezuelan firms [30]. Ye et al. point out that the reverse technology spillovers of China's OFDI enterprises would be affected by cultural distance. Enterprises investing in Europe and U.S. gain more technology spillovers, but no spillovers occur in the Middle East and Africa [31]. The reverse technology spillover effects gained by Chinese enterprises when investing in the node countries are rare, and consequently, these enterprises' enthusiasm for R&D investment has weakened and even been inhibited.

2.4. The Environment and Policy Supports for Investment in BRI

Most of the node countries are in the preliminary or intermediate stage of industrialization, with imperfect infrastructures, unsound legal systems, and unstable domestic investment environments. By contrast with investing in developed countries, Chinese enterprises investing in these node countries are more likely to encounter environmental and social problems and face greater risks of foreign investment [10,11,32]. These risks may increase the cost and difficult of R&D and lose the enthusiasm for R&D investment by the enterprises [33]. In addition, the lack of legal system in the ownership of the host country will increase the possibility of invasion of property rights for foreign investors, especially in technology-intensive sectors, which will inhibit the innovation of enterprises [22,34]. The property rights protection systems of the node countries are not perfect, and enforcement is insufficient, so the technical protection for foreign investors is also insufficient.

Government support plays a significant role in promoting the R&D innovation of enterprises [35]. Since proposing the BRI, the Chinese government has increased the tax subsidy and financial support for enterprises investing in the node countries. However, some recent studies have pointed out that the tax subsidy for export is only effective for the R&D of non-high-tech enterprises, but not for high-tech ones, because the latter normally already assume low tax rates [36]. In terms of promoting the technology innovative investments, some policies directly dealing with financing problems may be more effective than traditional tax subsidy [6]. But most of the domestic loans are used for infrastructure projects in node countries, while rarely for R&D innovation, causing an insufficient supply of R&D funds to some enterprises involved in BRI.

According to the aforementioned literature, current studies mostly discuss the impact of OFDI on the R&D investment of an enterprise from the aspects of investment motivation (such as market seeking, resource seeking, etc.), technology comparative advantage, technology spillover, environment and policy. Those studies point out that the impact of OFDI on the R&D investment of enterprises is uncertain and depends on the specific environment and policy. The BRI, as an emerging initiative, faces new environments and requirements. Therefore, based on previous research, this paper explores the effect mechanism and presumes that under the current implementation environment, the BRI would have a negative impact on the R&D investment of the OFDI enterprise in the short term.

3. Model and Data

There are mainly 71 node countries excluding China. Chinese OFDI enterprises, investing in the node countries, have some similar features, such as mature technologies, excess capacity, and lower domestic advantages [6]. So, we can infer that the OFDI enterprises involved in BRI are self-selected.

The sample selection problem leads to the biased estimation results. To get an unbiased estimation result, this paper will apply a difference in difference (DID) method combined with a matching technique, as suggested by Egger et al. [37].

3.1. Difference in Difference (DID)

The DID model can exclude some interference factors to effectively estimate the treatment effect of policy shock. The BRI is a good quasi-natural experiment for our study. Since the initiative was proposed in September 2013, and the actual implementation was in 2014, this paper sets 2014 as the year BRI began. The time period is selected as 2011–2017. We set $Post_t$ as the dummy variable indicating the year pre- and post-BRI, taking a value of 1 in 2014 and after. Considering that only those OFDI enterprises whose investment destination involves one of these node countries would be truly affected by BRI, this paper selects the A-share listed OFDI enterprises, who invest in the node countries, as the treatment group, and sets BRI_i as the dummy variable that is 1 when the OFDI enterprise belongs to the treatment group. The A-share listed OFDI enterprises, whose foreign investment destination does not involve any node countries, are selected as the control group.

The idea of DID in our study is to find the difference in the R&D investment of the treatment group between the two periods, which is:

$$E(RD_{i1} - RD_{i0}|BRI_i = 1) = E(RD_{it}|BRI_i = 1, Post_t = 1) - E(RD_{it}|BRI_i = 1, Post_t = 0) \quad (1)$$

where RD_{it} denotes the R&D investment of the OFDI enterprise i (i = 1, 2, ... 474) in period t (t = 2011–2017). Because there are many factors influencing the R&D investment of OFDI enterprises, we are supposed to control for the time effect. The change of the control group can be regarded as the time effect, which is:

$$E(RD_{it}|BRI_i = 0, Post_t = 1) - E(RD_{it}|BRI_i = 0, Postt_t = 0) \quad (2)$$

So, the treatment effect of the initiative (δ) can be obtained by Equation (3):

$$\begin{aligned} \delta = \quad & E(RD_{it}|BRI_i = 1, Post_t = 1) - E(RD_{it}|BRI_i = 1, Post_t = 0) - \\ & [E(RD_{it}|BRI_i = 0, Post_t = 1) - E(RD_{it}|BRI_i = 0, Post_t = 0)] \end{aligned} \quad (3)$$

According to the basic settings of DID, this study sets the empirical model as the follows:

$$RD_{it} = \beta_0 + \beta_1(BRI_i \times Post_t) + \partial_j \sum_{j=1}^{n} Control + \varepsilon_{it} \quad (4)$$

The vector *Control* includes all the control variables. The parameter β_1 captures the policy effect of BRI on the R&D investment of the OFDI enterprises, which is included in BRI. ε_{it} is random disturbance item. The identification requires the assumption that there is no other policy shock correlated with the effect of BRI on the OFDI enterprises. To our knowledge, there was no similar policy shock took place in that year for the OFDI enterprises included in BRI.

As the BRI has been a continuing implementation process since 2014, it is necessary to consider the dynamic effects of the initiative on the R&D investment of OFDI enterprise. This paper adds the dummy variables of the years 2014, 2015, 2016, and 2017, which is shown in Equation (5):

$$\begin{aligned} RD_{it} = \quad & \beta_0 + \beta_1(BRI_i \times Post_{2014}) + \beta_2(BRI_i \times Post_{2015}) + \beta_3(BRI_i \times Post_{2016}) \\ & + \beta_4(BRI_i \times Post_{2017}) + \partial_j \sum_{j=1}^{n} Control + \varepsilon_{it} \end{aligned} \quad (5)$$

where parameters β_1–β_4 captures the dynamic marginal effects of different years, other variables and symbols are the same as the above.

Considering that China's SOEs and non-state-owned enterprises (non-SOEs) are different in many ways, we also test whether BRI has different impacts on the R&D investment of the two type of enterprises. Based on Equation (4), this paper constructs a triple differential (DDD) method, and the setting refers to Cai et al. [38]:

$$RD_{it} = \beta_0 + \beta_1 Soe_i \times (BRI_i \times Post_t) + \partial_j \sum_{j=1}^{n} Control + \varepsilon_{it} \quad (6)$$

Among them, Soe_i is the dummy variables of the ownership of the enterprise (takes the value of '1' if the enterprise is state-owned), and the other variables are set in the same way as the model (4). If the significance test is passed, it means that the effects of BRI on R&D investment are significantly different among different ownership enterprises.

3.2. Propensity Score Matching (PSM)

The premise of using the DID method is that the treatment group and control group must satisfy the common trend hypothesis, that is, if there was no BRI, there would be no systematic difference in the trend of changes in R&D investment over time. However, the OFDI enterprises investing in the node countries and those not investing in the node countries usually differ considerably in size, productivity and profit. These factors influence an enterprise's competitive advantage and the decision to invest in the node countries. Using all the OFDI enterprises not investing in the node countries as the control group may generate a biased estimation result of the DID method.

The PSM method can effectively alleviate this problem and make DID meet the assumptions of common trends [39]. The basic idea is to construct a control group that is as close to the treatment group before the policy implementation as possible, and then match the enterprises in the treatment group with the control group, so that the matched pairs are different only by policy impact. In this paper, the PSM method addresses the selection problem by constructing a comparison group of enterprises from the OFDI enterprises not investing in the node countries, whose observable characteristics are similar to those of OFDI enterprises investing in the node countries, and the kernel matching method is adopted to determine the weight. The propensity score is estimated by the variables (total assets, total operating income, total liabilities, net profit, and overseas income), and obtained by a logit model. The estimated propensity score can be used to construct the control group with a similar probability of joining the BRI for the treatment group.

3.3. Data Source and Description

This paper uses enterprise-level, yearly panel data to examine the effects of BRI on the R&D investment of OFDI enterprises, and takes the OFDI enterprises among the A-share listed companies in China as the research objects. The financial data of the enterprises comes from the Wind information platform, and the foreign investment information matches the Open List of Overseas Investment Enterprises (Institutions) Filings, which is provided by the Ministry of Commerce of the People's Republic of China. The samples are simply screened and processed, and in the end, we get 474 OFDI enterprises. Among these sample enterprises, 166 are in the treatment group and 308 are in the control group. Our sample year (2011–2017) includes the ex-BRI period and post-BRI period, and we take 2014 as the year of exogenous policy shock.

The variable description has been presented in Table 1. We use the R&D investment intensity (the ratio of R&D investments to total assets) to express the dependent variable (RD). The ratio of R&D investments to total sales and the logarithm of the amount of R&D investments are used to conduct the robustness tests. The control variables should be the decision factors regarding R&D investment activities of the enterprises. We refer the existing research [40–42], and select the factors (foreign investment risk (Risk), proportion of overseas income (OI), return on assets (ROA), financial

leverage ratio (LEV), and market monopoly power (MP)) that can significantly influence the R&D investment activities of OFDI enterprises as the control variables.

Table 1. Variables' meaning and indicator.

Variable	Meaning	Indicator
RD	R&D investments intensity	The ratio of the R&D investments to total assets
Risk	Foreign investment risk	The fluctuation of the return on enterprise's total assets
OI	The proportion of overseas income	The ratio of the overseas income to main business income
ROA	Return on Assets	The ratio of the net profit to main business income
LEV	Financial leverage ratio	The asset liability ratio
MP	Market monopoly power	The ratio of the company's main business income to the industry's average main business income of the year
Soe_i	The ownership of enterprise i	Takes the value of '1' if enterprise i is state-owned

4. Empirical Results

4.1. Preliminary Results

In order to examine the impact of the BRI on the R&D investment of the OFDI enterprise, we refer to Kang et al. [13] and attempt to match each OFDI enterprise investing in the node countries with an OFDI enterprise not investing in the node countries that had the most similar propensity score. The balancing test results from the matching procedure are shown in Table 2. The standardized deviation of the observable variables after being matched is significantly smaller than that before, and the t-values cannot reject the null hypothesis that there is no systematic difference between the treatment group and control group, indicating that the matching technique is effective. Therefore, the PSM method has provided a more valid and reliable comparison group of the control group with the treatment group to estimate the impact of the BRI. The empirical results of this paper are obtained from Stata13.

Table 2. Balancing test for the matching process.

Variable	Types	Mean		bias %	Δ|bias| %	*t*-values	$p > \|t\|$
		Treated	Control				
Asset	Unmatched	22.383	22.113	19.9	69.3	5.01	0.000
	Matched	22.37	22.287	6.1		1.41	0.160
Income	Unmatched	21.809	21.502	20.1	68.4	5.03	0.000
	Matched	21.797	21.7	6.3		1.46	0.143
Debt	Unmatched	21.372	20.994	21.6	77.7	5.39	0.000
	Matched	21.359	21.275	4.8		1.13	0.258
Netprofit	Unmatched	19.059	18.812	16.0	63.1	3.99	0.000
	Matched	19.05	18.959	5.9		1.36	0.174
Overseas	Unmatched	19.726	19.314	20.1	75.7	5.00	0.000
	Matched	19.722	19.622	4.9		1.17	0.241

Note: The kernel matching method with a bandwidth of 0.06 is adopted.

The premise of using the DID method is that the treatment group and control group should satisfy the parallel time trend. We use the average value of R&D investment intensity to examine the parallel trend from 2012 to 2017. The results along with the 95% confidence intervals are shown in Figure 1. The coefficients for the years from 2012 to 2013 are smaller than the coefficients for years after 2013. It shows that the sample groups have a parallel trend before the BRI. After the BRI, the regression coefficients are negative and gradually decreased, which is consistent with the previous theoretical

analysis. But the coefficient of 2017 is higher than that of 2016, which indicates that the negative effects of the BRI on the R&D investment of the OFDI enterprises may be smaller in the long term.

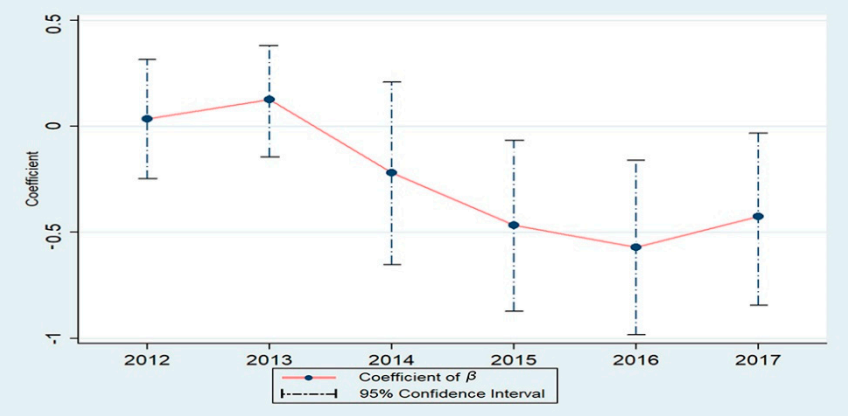

Figure 1. Parallel trend test.

4.2. Baseline Empirical Results

This paper estimates the effect of BRI on the R&D investment of OFDI enterprises from Equation (4) based on the time fixed effect technique of panel data, and the clustering robust standard error used in the regression, can effectively capture the possible heterogeneous structure of the enterprises. The regression results are shown in Table 3. Column (1) and (3) reveal the basic results without the control variables, while others describe the regression results of the same equation after controlling the variables. The regression results show that when we use a DID method alone, the coefficients of $BRI_i \times Post_t$ have not passed the significance test. But when we apply the DID method combined with a matching technique to reduce the regression bias caused by the self-selection effect, the coefficients of the interaction term are negative and statistically significant in both columns (3) and (4). The results indicate that the implementation of BRI does not increase the R&D investment of OFDI enterprises in the implementation stage, but reduces and weakens the passion for the R&D of enterprise.

Table 3. The basic effect of the Belt and Road Initiative (BRI) on the research and development (R&D) investment of enterprises.

	DID		**DID Combined with the PSM**	
	(1)	**(2)**	**(3)**	**(4)**
$BRI_i \times Post_t$	−0.0414	0.00678	−0.473 ***	−0.507 ***
	(−0.38)	(0.06)	(−3.07)	(−3.35)
Risk		−0.702 **		−1.003 **
		(−2.10)		(−2.56)
OI		−1.219 **		−0.997 *
		(−2.17)		(−1.82)
LEV		−0.258		−0.185
		(−0.76)		(−0.44)
ROA		−0.608		4.509 ***
		(−0.90)		(2.64)
MP		0.717		0.611
		(0.44)		(0.27)
_cons	2.532 ***	2.512 ***	2.485 ***	2.273 ***
	(81.57)	(15.20)	(60.37)	(10.26)
Year FE	Yes	Yes	Yes	Yes
R^2_adj	0.00240	0.0197	0.0140	0.0452
N	3318	3318	2514	2514

Note: ***, ** and * respectively indicate that the regression coefficient is significant at the statistical level of 1%, 5% and 10%, with t-values in brackets.

The regression results also indicate that the higher return on assets significantly increases the R&D investment of enterprise, but the foreign investment risk is reversed. Notably, the ratio of overseas income is negatively correlated with the enterprise's R&D investment, which can be explained by the fact that the enterprises investing in the node countries are pursuing the short-term profits brought by the present product output, ignoring the long-term gains from technology innovation. The coefficients of other variables like LEV, MP do not show significance, meaning that the financial leverage ratio and market monopoly power of the enterprise have no significant impact on R&D investment.

4.3. The Dynamic Effect

Table 4 shows the dynamic marginal effect from 2014 to 2017 by estimating Equation (5). The results show that all of the coefficients of $BRI_i \times Post_t$ are significantly negative. The marginal effect increases firstly and then decreases, indicating that the impact of BRI on the R&D investment of the OFDI enterprises has a negative effect in the short term, but the negative effect would gradually decrease in the later stage. Since the execution time of BRI is short, it is not yet possible to estimate the dynamic effect over a longer period of time at the moment. Considering that there is a trend of weakening impact on the R&D investment of the OFDI enterprises from 2017, we predict that with the increasing competitive pressure for enterprises investing in node countries, the existing products cannot meet the market demand, and then the enterprises will realize the importance of technology innovation, and significantly increase the R&D investment.

Table 4. The dynamic marginal effect of the BRI on the R&D investment of enterprises.

	DID Combined with the PSM	
	(1)	**(2)**
$BRI_i \times Post_{2014}$	−0.307	−0.348 *
	(−1.65)	(−1.94)
$BRI_i \times Post_{2015}$	−0.427 ***	−0.478 ***
	(−2.69)	(−3.11)
$BRI_i \times Post_{2016}$	−0.575 ***	−0.605 ***
	(−3.33)	(−3.57)
$BRI_i \times Post_{2017}$	−0.590 ***	−0.600 ***
	(−3.22)	(−3.28)
Risk		−0.984 **
		(−2.51)
OI		−0.939 *
		(−1.71)
ROA		4.412 **
		(2.58)
MP		0.600
		(0.27)
LEV		−0.198
		(−0.47)
cons	2.485 ***	2.290 ***
	(60.26)	(10.27)
Year FE	Yes	Yes
R^2_adj	0.0207	0.0498
N	2514	2514

Note: ***, ** and * respectively indicate that the regression coefficient is significant at the statistical level of 1%, 5% and 10%, with t-values in brackets.

4.4. The Mechanism Test

To explain the above regression results, we test some factors that may affect the R&D investment of the OFDI enterprises, and the results are shown in Table 5.

Table 5. The mechanism test of BRI on the R&D investment of enterprises.

	Risk	**OI**	**ROA**	**MP**	**LEV**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
$BRI_i \times Post_t$	−0.0723 ***	0.0253 **	−0.0442 ***	−0.0110 ***	−0.00275 *
	(−5.20)	(2.23)	(−3.10)	(−2.89)	(−1.70)
_cons	0.146 ***	0.159 ***	0.380 ***	0.0571 ***	0.00857 ***
	(40.72)	(50.36)	(95.63)	(57.29)	(18.59)
Control variables	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
R^2*_adj*	0.114	0.0101	0.0418	0.0245	0.00427
N	2514	2514	2514	2514	2514

Note: ***, ** and * respectively indicate that the regression coefficient is significant at the statistical level of 1%, 5% and 10%, with t-values in brackets.

The coefficients of $BRI_i \times Post_t$ from column (1) to (5), show that the implementation of the BRI has significantly increased the proportion of overseas income, diminished the risk of foreign investment, and eased the financing constraints. But the initiative has reduced the return on assets and the market monopoly power of enterprises. Among them, the positive effect on the proportion of overseas income is consistent with the empirical test of some existing studies [43]. Considering the regression results mentioned in Table 3, we find that although the BRI indirectly promotes the R&D investment of the OFDI enterprises by reducing the risk of foreign investment, it significantly promotes the proportion of overseas income of enterprises, which has increased the amount of product output but squeezed the R&D investment. Moreover, since the BRI has not improved the return on assets of the OFDI enterprises in the short term, it has also weakened the enthusiasm of R&D. To sum up, because the crowding effect is bigger than the promotion effect, there is a negative effect of BRI on the R&D investment of the OFDI enterprises, resulting in a reduction of R&D investment in the short term.

4.5. The Ownership Heterogeneity Effect of BRI on Research and Development (R&D) Investment

Equation (6) estimates the ownership heterogeneity effect of the BRI. The results are shown in Table 6. The coefficients of $BRI_i \times Post_t$ in column (1) to (4) are all significantly negative regardless of whether the control variables are added or not, which is consistent with the results in Table 3, indicating that the BRI has undeniably reduced the R&D investment of the OFDI enterprises. Compared with the non-SOEs, the absolute value and significance of the coefficients of the SOEs are clearly higher, indicating that the implementation of BRI has a greater negative impact on the R&D investment of the SOEs. The coefficient of $BRI_i \times Post_t$ in DDD, which is −0.449 significant at a 5% confidence level, also confirms the result.

We explain the above results as follows: on the one hand, in the current context of the urgent need for "De-Capacity, Destocking, and Restructuring" in China, a large number of SOEs get involved in the BRI. These SOEs mainly focus on undertaking economic and technological assistance, participating in infrastructure construction, increasing the overseas direct investment [43], but ignoring their R&D innovation. Infrastructure construction occupies capitals, which seriously crowd out the R&D funds [6]. So, the BRI has a larger impact on the SOEs. On the other hand, although non-SOEs face the same problems, most of them have stronger profitability compared with the SOEs. They invest in the markets of the node countries based on their own needs, and the decision making of R&D investment belongs to market behavior. Thus, the negative effects on the R&D investment of these non-SOEs are smaller. In short, the BRI's effect on the R&D investment of OFDI enterprise is heterogeneous in the ownership.

Table 6. The impact of BRI on the R&D investment of different ownership enterprises.

	State-Owned Enterprises (SOEs)		Non-SOEs		DDD
	(1)	(2)	(3)	(4)	(5)
$BRI_i \times Post_t$	−1.269 ***	−1.336 ***	−0.357 *	−0.393 **	
	(−4.64)	(−4.78)	(−1.82)	(−2.04)	
$Soe_i \times BRI_i \times Post_t$					−0.449 **
					(−2.45)
Risk		0.0649		−1.125 **	−1.022 ***
		(0.06)		(−2.29)	(−2.65)
OI		−1.115		−0.667	−1.009 *
		(−1.34)		(−1.03)	(−1.80)
ROA		−0.206		−0.607	4.239 ***
		(−0.21)		(−1.15)	(2.62)
MP		5.069		4.080 **	0.244
		(1.58)		(2.35)	(0.10)
LEV		−7.892 **		−2.613	−0.149
		(−2.28)		(−0.99)	(−0.32)
_cons	2.498 ***	2.435 ***	2.540 ***	2.568 ***	2.291 ***
	(31.57)	(4.15)	(49.45)	(10.41)	(10.90)
Year FE	Yes	Yes	Yes	Yes	Yes
R^2_adj	0.121	0.146	0.007	0.033	0.033
N	530	530	1972	1972	2514

Note: ***, ** and * respectively indicate that the regression coefficient is significant at the statistical level of 1%, 5% and 10%, with t-values in brackets.

4.6. Robustness Test

Firstly, we use the time placebo test method to move the time node to 2013. The results are mentioned in column (1) and (2) of Appendix A, Table A2. The regression results are not significant, indicating that the advanced time node is invalid. Secondly, some studies define the R&D investment intensity as the ratio of R&D investments to total sales, and others also use the absolute value of R&D investment as the dependent variable. Thus, we examine the dependent variables of these two different forms. The results, shown respectively in column (3) and (4), are consistent with the previous results.

5. Conclusions

The BRI provides a new platform for enterprises to participate in international cooperation and competition, which has been designed to encourage the economic growth of the participators. The international cooperation and competition can bring technological transfer and progress. By treating the BRI as a quasi-natural experiment, this paper uses the PSM-DID technique to estimate the impact of the BRI on R&D investment of enterprises, investing in the node countries. The empirical results show that the BRI has a negative impact on the R&D investment of the OFDI enterprises in the short term, and this effect has the marginal tendency of rising firstly and then falling. Further analysis shows that the BRI increases the proportion of overseas income of enterprises, but reduces the return on assets, which both reduce the R&D investment of the OFDI enterprises. Moreover, we have tested the ownership heterogeneity of the BRI's effect and found that the negative effects on R&D investment of the SOEs are greater than that of the non-SOEs.

This study provides another angle to look at the impact of the BRI which has been relatively neglected. The OFDI enterprises as the main participants of BRI would gain a lot from the initiative. Taking these enterprises as the object of the study would help to understand the effects of BRI more comprehensively. Our research may have some limitations to be addressed in future research. Firstly, we focus on enterprise characteristics as the main control variable, so our model does not account for other possible factors. Secondly, this paper uses the matching data from multiple data sources, and maybe some direct data will be compiled in the future. This research may be extended by

considering the other effects of the BRI on enterprise, and the detailed ways that enterprises participate in the BRI.

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Appendix A

Table A1. Classifications of countries and regions along the Belt and Road.

Area	Country
Asia and Oceania (14 countries)	Mongolia, South Korea, New Zealand, East Timor, Singapore, Malaysia, Thailand, Indonesia, Philippines, Brunei, Cambodia, Myanmar, Laos, Vietnam
Central Asia (5 countries)	Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan, Kyrgyzstan
West Asia (18 countries)	Armenia, Georgia, Azerbaijan, Turkey, Iran, Syria, Iraq, United Arab Emirates, Saudi Arabia, Qatar, Bahrain, Kuwait, Oman, Yemen, Jordan, Lebanon, Israel, Palestine
South Asia (8 countries)	India, Pakistan, Bangladesh, Afghanistan, Nepal, Bhutan, Sri Lanka, Maldives
Eastern Europe (20 countries)	Serbia, Montenegro, Bosnia and Herzegovina, Albania, Belarus, Moldova, Russia, Ukraine, Poland, Lithuania, Estonia, Latvia, Czech Republic, Slovakia, Hungary, Slovenia, Croatia, Romania, Bulgaria, Macedonia
Africa and Latin America (6 countries)	South Africa, Morocco, Ethiopia, Madagascar, Panama, Egypt

Note: The data is organized from the "One Belt, One Road" Big Data Center of the National Information Center of China in 2017.

Table A2. The robustness tests.

	Time Placebo Test		Dependent Variable	
			Ratio of the R&D Investments to Total Sales	Logarithm of R&D Investments
	(1)	(2)	(3)	(4)
$BRI_i \times Post_t$ -p	−0.133	−0.148		
	(−0.93)	(−1.03)		
$BRI_i \times Post_t$			−0.390 *	−2.717 ***
			(−1.87)	(−9.77)
_cons	2.522 ***	2.313 ***	3.461 ***	17.35 ***
	(36.46)	(9.71)	(10.01)	(38.38)
Control variables	No	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2_adj	0.000905	0.0302	0.121	0.128
N	2514	2514	2514	2514

Note: *** and * respectively indicate that the regression coefficient is significant at the statistical level of 1% and 10%, with t-values in brackets.

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