Study on the impact of the Belt and Road Initiative on China's overseas infrastructure investment

-- Take the power station project as an example

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Abstract. Infrastructure construction is the core of the Belt and Road Initiative, especially at this stage, countries around the world are committed to improving the green level of infrastructure, so as to cope with the continuous deterioration of global climate, and the construction of China's overseas infrastructure investment projects has attracted much attention. Based on this, this paper constructs the mechanism of the impact of the "Belt and Road" Initiative on China's overseas power infrastructure construction, and according to the statistics of China's overseas investment inventory database(COFI), takes 338 power station projects invested and constructed by China in 70 countries along the "Belt and Road" from 2000 to 2020 as research samples, and constructs a set of balanced panel data. The mechanism was tested empirically by using the method of multi-stage difference-difference. The study confirms that the Belt and Road Initiative in general has significantly increased China's power plant infrastructure in countries along the route, particularly promoting clean power plants and high-quality projects in high-income countries.

Keywords: The Belt and Road Initiative; China's overseas power station infrastructure construction; Multiphase differential; International technical cooperation.

1 Introduction

The report of the Party's 20th National Congress pointed out that the Belt and Road Initiative is a popular international public good and a platform for international cooperation. Under the background of actively promoting the Belt and Road Initiative, China has completed a number of overseas infrastructure connectivity projects. However, China's overseas infrastructure construction is frequently questioned by some Western countries. It is believed that China provides high loans to countries along the "Belt and Road" that exceed their ability to repay, making these countries lose resources and even sovereignty, and pollution transfer and destruction of local ecological environment [1]are also one of the criticism points of Western countries. Therefore, whether the continuous advancement of the Belt and Road Initiative is conducive to China's investment

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in the construction of high-quality infrastructure projects in countries along the route urgently needs to be confirmed. Power infrastructure is powered by energy resources, and in the face of global climate problems, countries have put forward higher requirements on the choice and utilization of energy. For example, the Paris Agreement to "accelerate the global phase-out of coal power projects", the European Union announced a clean energy proposal, and China has actively taken a series of measures to deal with global climate change, starting from 2020 no longer to build coal-fired power plant projects.

Based on this, this paper takes China's overseas power station infrastructure investment projects as a representative, focusing on the following questions: Will the "Belt and Road" help China's investment in overseas power station infrastructure construction? Will it help accelerate the construction of high-quality projects represented by clean power plants? Is the "Five links" mechanism of the Belt and Road working? It is expected that the answers to the above questions can prove that the promotion of the "Belt and Road" initiative will help promote China's investment in high-quality infrastructure construction projects in countries along the route, thus providing an important basis for refuting the "debt trap theory" and "pollution threat theory" of Western countries.

2 Literature review

The literature on the Belt and Road Initiative and infrastructure connectivity mainly includes: Li Jianjun and Li Juncheng (2018) [2]concluded that the Belt and Road Initiative has significantly improved the infrastructure performance of countries along the route. Huang Liangxiong et al. (2018) [3]found that the infrastructure level of countries along the Belt and Road Initiative has improved, and the regional differences have been narrowing. Focusing on infrastructure construction in various fields, mainly involving transportation, network, construction and other aspects. King Kong and Shen Kunrong (2019) [4]and Pauline C (2018) et al. [5]concluded that the Belt and Road Initiative has increased the investment of Chinese enterprises in the transport infrastructure of countries along the route. Xu Jie and Zhang Lin (2021) [6]investigated the PSM-DID method and concluded that the "Belt and Road Initiative" has significantly improved the level of network infrastructure in South and Southeast Asian countries.

The Belt and Road Initiative has brought opportunities to cross-border power plant construction, especially clean technology cooperation such as wind power, hydropower, nuclear power and solar energy. Some scholars have begun to study the risk factors of China's overseas power plant project construction (Li Zheng, 2018[7]; Zeng Fenyu and Shi Guoping, 2019[8]). There are also some scholars concerned about the factors that affect the construction of China's overseas power station projects (Zhang Ying and Hua Bing, 2018[9]. Because of its large investment scale and long construction period, the power station infrastructure construction project has strong externality, which has a great impact on the local ecological environment. Therefore, China integrates the concept of ecological civilization construction into the "Belt and Road" initiative. While accelerating the construction of overseas power stations, China pays more attention to

addressing global climate change and the requirements of sustainable development of developing countries, and actively expands the construction of green power stations[10].

In general, although the existing literature focuses on the impact of the "Belt and Road" Initiative on infrastructure connectivity, few studies focus on the field of power infrastructure, especially the in-depth quantitative assessment of the "Belt and Road" policy effects and impact paths. Compared with the existing studies, this paper integrates the concept of ecological civilization construction into the "Belt and Road" power infrastructure construction and development, advocates the construction of "Belt and Road" green cooperation partnership, integrates climate governance, environmental improvement and high-quality development, and opens a new situation of South-South cooperation.

3 Mechanism analysis and hypothesis

Pei Changhong and Fan Ying (2010) [11]proposed that China's foreign investment behavior should be explained by specific national advantages. Under the active promotion of "specific national advantages", China increased its investment in power station infrastructure in countries along the "Belt and Road".

Under the Belt and Road Initiative, the Chinese government has taken various measures to encourage enterprises to actively engage in international investment. For example, the signing of bilateral investment agreements, through the provision of investment advisory and guidance services, to provide strategic planning guidance for enterprises to invest in overseas power station infrastructure, and to provide different degrees of tax relief and subsidy policies for enterprises investing in power station construction in countries along the "Belt and Road". The countries along the "Belt and Road" are rich in natural resources, which can provide energy for the construction of power station infrastructure. However, the power plant infrastructure needs a lot of financial support. The Belt and Road Initiative has provided new investment and financing channels for enterprises, and the Asian Infrastructure Investment Bank and the Silk Road Fund have eased the investment and financing pressure on enterprises and provided more bidding opportunities for enterprises investing abroad. Power station infrastructure construction requires high overall planning and coordinated development capabilities, and China's "Belt and Road" initiative has transformed global economic and trade activities from "center - periphery" to "double cycle" through the "new South-South cooperation" approach, expanding the breadth and depth of regional cooperation, and taking peace and cooperation, openness and inclusiveness, mutual benefit and win-win as the concept. It has strengthened investment in power station infrastructure construction in countries along the "Belt and Road", narrowed the gap in power station infrastructure between regions, and made significant contributions to helping realize coordinated regional development.

Therefore, combined with the theory of "country-specific advantages", this paper proposes:

Hypothesis 1: The Belt and Road Initiative promotes the construction of China's overseas power station infrastructure.

In order to cope with global climate change and the transformation and upgrading of energy structure, the primary goal of "Belt and Road" power station infrastructure cooperation is to improve energy efficiency and achieve low-carbon power development, which requires green power infrastructure construction to lead the countries along the "Belt and Road" to participate in the global industrial division of labor and integrate into the integrated development of the world economy.

According to the theory of "international technical cooperation", technological differences between countries are the premise of international technical cooperation[12]. With global climate change and the transformation of energy structure, green and low-carbon economy has become a global consensus, and countries along the Belt and Road attach great importance to the development of clean energy, and many countries have made plans for the development of clean energy. However, most of the countries along the "Belt and Road" are developing countries, and the shortage of funds and backward technology limit the development and utilization of clean energy, which is not enough to support the huge demand for electricity. As an advocate of the "One Belt, One Road" strategy, China has made major breakthroughs in clean energy technology, nuclear power technology, geothermal power generation technology, tidal power generation technology and other technologies continue to mature, and has accumulated rich experience in clean energy overseas investment. It can be seen that China and the countries along the "Belt and Road" have formed complementary advantages in the development of clean energy power, and there is great room for development of clean energy power cooperation with countries along the road. Therefore, this paper proposes:

Hypothesis 2: Compared with non-clean power plants, the "Belt and Road" initiative will promote the construction of clean power plants in China overseas.

4 Measurement model and variable design

4.1 Measurement model construction

This paper adopts the practice of Song Jie et al. (2022)[13], which takes the time when countries sign the "Belt and Road National Cooperation Agreement" with China as the policy implementation time, and the data comes from the results published on China's "Belt and Road" website. Based on this, the following model is constructed:

$$Y_{it} = \alpha_0 + \alpha_1 Treat_i \times Time_t + \alpha_i \sum Control_{it} + \eta_i + \lambda_t + \varepsilon_{it} \quad (1)$$

Among them, i and t represent the host country and the year respectively, Y_{it} represents the cumulative number of power plants built by China in host country i in t years, Treat represents the policy treatment variable, Time represents the policy time variable, $Treat_i \times Time_t$ is the core explanatory variable, Controlit represents the control variable and represents the individual fixed effect. Denotes time fixed effect, denotes random interference term.

4.2 Variable setting and data description

The explained variable of this paper is the cumulative number of power plant projects (Y_{it}) built by China in the host country year *i*. The core explanatory variable is DID variable, $DID_{it}=Treat_i\times Time_t$, where Treatit indicates whether it is a "One Belt, One Road" country, Timeit indicates whether it is after signing the "One Belt, One Road" cooperation agreement with China. To rule out other factors interfering with the estimation of causal effects, This paper selects host country market size ($Pgdp_{it}$), host country labor resource (Rur_{it}), host country resource endowment (Nr_{it}), host country electricity rate (Ele_{it}), bilateral investment treaty (Bit_{it}), population density (Pop_{it}), employment rate (Emp_{it}), and degree of openness to the outside world ($Open_{it}$) as the control Variable. Data for the above variables are from the World Bank database and UNCTAD database unless otherwise specified.

5 Empirical analysis

5.1 Basic return

Table 1 reports the baseline regression results of China's overseas power station infrastructure construction under the Belt and Road Initiative. Model (1) is the result of regression without adding control variables, and the regression coefficient is 0.723, which is significant at the 5% level. Model (2) - (5) is the regression result of gradually adding control variables. We can find that when other interfering factors are controlled, the regression coefficient of core explanatory variables is more significant and gradually increases in general. This shows that the "Belt and Road" initiative has indeed increased China's power station infrastructure construction in countries along the route, and after controlling other interfering factors, this promotion role is more obvious. China's "Belt and Road" initiative meets the needs of countries along the route for power station infrastructure construction through regional cooperation, and hypothesis 1 is verified.

Table 1. Baseline regression result

Variable	(1)	(2)	(3)	(4)	(5)
	Y_{it}	Y_{it}	Y_{it}	Y_{it}	Y_{it}
$Treat_i\times Time_t$	0.723**	0.921***	0.966***	0.940***	0.995***
	(0.350)	(0.349)	(0.347)	(0.346)	(0.346)
$Pgdp_{it}$		-0.620***	-0.399*	-0.465*	-0.384
		(0.230)	(0.234)	(0.280)	(0.285)
Rur_{it}		-0.119***	-0.0756**	-0.0847**	-0.0920**
		(0.0347)	(0.0355)	(0.0355)	(0.0357)
Nr_{it}			-0.0423***	-0.0442***	-0.0466***
			(0.0156)	(0.0156)	(0.0156)
Ele_{it}			0.0457***	0.0436***	0.0427***
			(0.0105)	(0.0106)	(0.0105)
Bit_{it}				-1.139***	-1.213***

				(0.354)	(0.355)
Pop_{it}				0.000159	0.000204
				(0.000811)	(0.000820)
Emp_{it}					-0.0528*
					(0.0274)
$Open_{it}$					-0.0953**
					(0.0398)
Constant	0.00264	6.236***	1.271	2.709	6.912**
	(0.288)	(1.761)	(2.062)	(2.104)	(2.810)
Country FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	1,451	1,451	1,451	1,451	1,451
R2	0.335	0.347	0.359	0.364	0.368

Note: t value in parentheses; *, ** and *** are significant at the level of 10%, 5% and 1% respectively. The same below

Table 2 further distinguishes between clean and non-clean power stations for regression. The explained variable of models (1) and (2) is the cumulative number of clean power plants built. It can be found that when the fixed effect of country and fixed effect of time is controlled at the same time, the estimated coefficient of core explanatory variable $Treat_i \times Time_t$ is 0.558 and significant at 5% level when control variables are not added. After further adding control variables, the estimated coefficient of the core explanatory variable $Treat_i \times Time_t$ is 0.709 and is significant at 1% level, with a larger coefficient and stronger significance. This shows that after controlling other interfering factors, the "Belt and Road" initiative can better promote the construction of clean power station projects. The explained variable of models (3) and (4) is the cumulative number of dirty power plants established. It can be found that when the fixed effect of country and fixed effect of Time is controlled at the same time, the estimated coefficient of the core explanatory variable $Treat_i \times Time_t$, although positive, has not passed the significance test of at least 10%, regardless of whether the control variable is added. This result shows that while the "Belt and Road" Initiative promotes China to increase the construction of clean power stations in countries along the route, it does not increase the construction of dirty power stations in countries along the route, that is, it promotes China's investment in overseas high-quality power station projects. Hypothesis 2 is confirmed.

Table 2. Distinguish the regression results of clean and dirty power plants

variable	(1)	(2)	(3)	(4)
	Y_{it}	Y_{it}	Y_{it}	Y_{it}
$Treat_i \times Time_t$	0.558**	0.709***	0.0339	0.751
	(0.278)	(0.268)	(0.610)	(0.542)
Control	No	Yes	No	Yes
Constant	0.0142	-1.731	-0	24.09***
	(0.225)	(2.169)	(0.500)	(5.981)

Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	1,299	1,299	483	483
R^2	0.383	0.438	0.238	0.432

5.2 Robustness test

5.2.1. Parallel trend test.

In order to prove that the promoting effect of the "Belt and Road" Initiative on the construction of power station infrastructure in host countries along the route is real, and not caused by the time trend of China's foreign investment favoring power station infrastructure, this paper conducts a parallel trend test on the year-by-year change trend of China's power station investment in "Belt and Road" countries and non-" Belt and Road "countries. Figure 1 reports the results of the parallel trend test, where the dotted line represents a 95% confidence interval. It can be found that before the "Belt and Road" initiative was proposed, the policy effect was negative and failed to pass the significance test. After the "Belt and Road" initiative was proposed, the policy effect was positive and generally increased year by year, and passed the significance test. This result shows that the parallel trend hypothesis in this paper is satisfied.

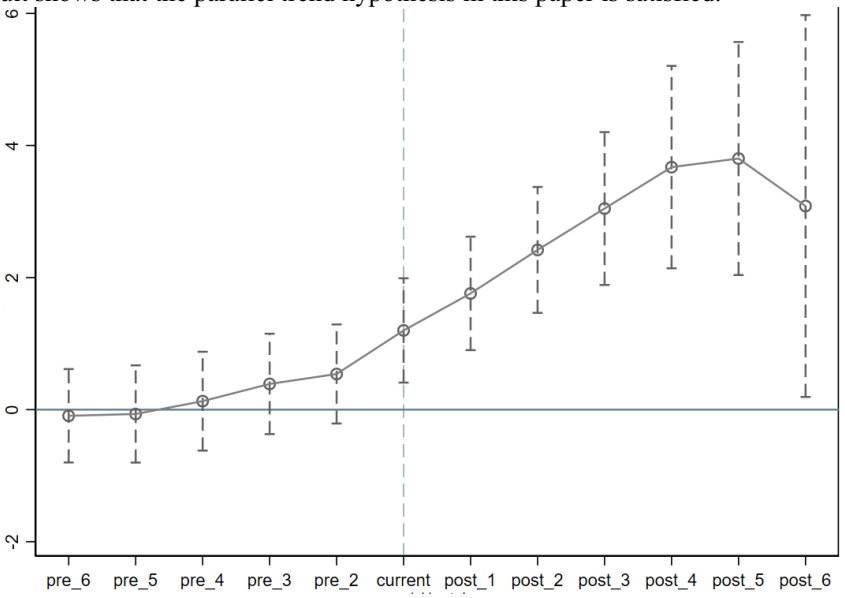

Fig. 1. Parallel trend chart

5.2.2. Placebo test.

In order to further exclude the existence of missing variables that may bias the experimental results, this paper draws on the practice of Ferrara E L (2008)[14] and randomly selects countries along the "Belt and Road" to conduct placebo test. Figure 2

reports estimated coefficients and probability densities for 500 experimental reports. Among them, the vertical line represents the baseline regression result, which is the core explanatory variable coefficient of 0.995 for the model (5) in Table 1 and 0.709 for the model (2) in Table 2. The estimated coefficient of the benchmark regression result is significantly different from that of the experimental group and the control group randomly selected 500 times, indicating that the influence of the "Belt and Road" Initiative on the construction of China's overseas power plants, especially clean power plants, is not affected by missing variables and other unobservable factors.

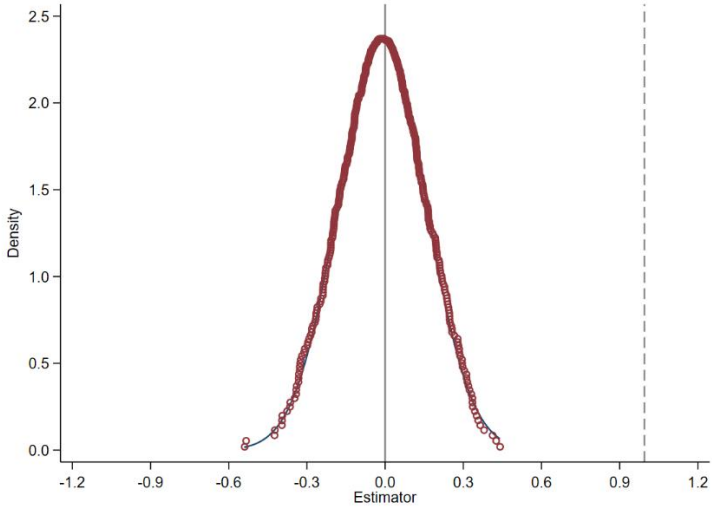

Fig. 2. Placebo test

5.2.3. Mechanism inspection.

The "Five Links" is an innovative cooperation model for building the Silk Road Economic Belt. It aims to strengthen policy coordination, financial integration, unimpeded trade, infrastructure connectivity and people-to-people ties, and gradually form a broad pattern of regional cooperation from point to point and from line to piece. According to the theoretical mechanism analysis above, this paper selects "five links" as the intermediary variable to explore the mechanism route of "Belt and Road" initiative to promote China's power station infrastructure construction in countries along the route through the effect of "five links". The following model is constructed:

$$\{Policy_{it}, Capital_{it},, Trade_{it},\} = \beta_0 + \beta_1 Treat_i \times Time_t + \beta_i \sum Control_{it} + \eta_i + \lambda_t + \varepsilon_{it} \quad (2)$$

$$Y_{it} = \chi_0 + \chi_1 Treat_i \times Time_t + \chi_2 \{Policy_{it}, Capital_{it}, Trade_{it}\} + \chi_i \sum Control_{it} + \eta_i + \lambda_t + \varepsilon_{it} \quad (3)$$

Selection of "Five links" variables: The number of mutual visits of bilateral senior officials between China and countries along the Belt and Road was selected as the proxy variable of Policy communication ($Policy_{it}$), and the data were collected according to the website of the Ministry of Foreign Affairs[15]; Whether China has signed bilateral

currency swap agreements with countries along the Belt and Road is selected as the proxy variable of capital financing ($Capital_{it}$), and the data come from RMB Internationalization Report. Bilateral trade volume, bilateral investment agreement, freedom of transnational trade and terms of trade were selected[16]. Principal component analysis was used to reduce multidimensional variables to one-dimensional evaluation index as the proxy variable of ($Trade_{it}$). Data from the International Monetary Fund, UNCTAD, the Economic Freedom of the World-FraserInstitute, the World Bank and others[17].

According to the above selected intermediary variables, we get the following regression results: As shown in Table 3, models (1) and (2) report the regression result of Capitalit as an intermediary variable, and the test result of model (1) shows that the coefficient of Treati×Timet is significantly positive at 1% level. This shows that the "Belt and Road" initiative has indeed promoted the financial interoperability between China and countries along the "Belt and Road" to a certain extent. Models (3) and (4) report the regression results of policy communication (Policyit) as an intermediary variable, showing that all its coefficients are significantly positive, indicating that policy communication (Policyit) has a partial intermediary effect. Under the "Belt and Road" initiative, the good political foundation among countries, the support of policies and laws to promote regional exchanges and cooperation, uphold the principle of seeking common ground while reserving differences, strengthen communication and exchange, to promote China's "Belt and Road" along the region power plant infrastructure construction has played a part in promoting. Models (5) and (6) report the regression result of Tradeit as an intermediary variable. The test result of model (5) shows that the coefficient of Treati×Timet is significantly positive at the 5% level. This shows that the "Belt and Road" initiative has indeed improved the level of unimpeded trade between China and countries along the "Belt and Road" to a certain extent.

Table 3. Regression result of "five links" intermediary effect

variable	(1)	(2)	(3)	(4)	(5)	(6)
	$Capital_{it}$	Y_{it}	$Policy_{it}$	Y_{it}	$Trade_{it}$	Y_{it}
$Capital_{it}$, $Policy_{it}$, $Trade_{it}$,		1.977*** (0.278)		0.218*** (0.0505)		2.224*** (0.611)
$Treat_i \times Time_t$	0.321*** (0.0332)	0.361 (0.351)	0.558*** (0.196)	0.834** (0.338)	0.0409** (0.0180)	0.555 (0.359)
Constant	0.998*** (0.270)	4.939* (2.773)	-2.906 (1.878)	7.002** (3.221)	-2.360*** (0.173)	17.08*** (3.738)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,451	1,451	1,246	1,246	1,157	1,157
R^2	0.408	0.391	0.223	0.360	0.868	0.354

6 Conclusions

Based on the China Overseas Investment Inventory Database (COFI), this paper constructs the country-year two-dimensional panel data of China's foreign power plant project construction from 2000 to 2020, and uses the multi-period differential method to identify the causal relationship between the "Belt and Road" and China's overseas power plant investment. The results show that the "Belt and Road" initiative has significantly promoted the construction of China's overseas power plant projects. In particular, it has promoted high-quality projects represented by clean power plant projects and power plant projects built in countries with higher levels of economic development. This conclusion holds true after a series of robustness tests.

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