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The Impact of the "Belt and Road" Initiative on Industrial Structure Upgrading Along the Corridor

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Abstract: The "Belt and Road" initiative functions as a novel impetus for China's external economic development within the framework of the new normal of economic growth. By leveraging panel data from 30 provinces and regions across China for the period of 2010 to 2020, this research assesses the influence of the "Belt and Road" initiative on the enhancement of the industrial structure along its trajectory. The findings indicate that: the most notable influence on the rationalization and progress of the industrial structure is observed in the eastern region, with the central region following suit, whereas the western region has yet to exhibit a significant transformation. The analysis delves into the role of technological innovation, concluding that the initiative primarily catalyzes optimization and upgrading through the effect of technological advancement. The study advances several pertinent policy recommendations to support and enhance these developments.

Keywords: Belt and Road; Industrial structure advancement; Industrial structure rationalization

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1. Introduction

Currently, there is a dearth of studies on the comprehensive impact of the "Belt and Road" initiative on the industrial structure optimization of provinces and cities along the route. This paper will analyze the impact of the Belt and Road Initiative on the transformation and upgrading of China's industrial structure within the framework of market demand, factor endowment, technological innovation, and other influencing mechanisms, using 30 provinces in China as samples. The potential innovations of this paper are as follows: (1) From an overall macro perspective, this paper discusses the substantive impact of the high-quality development of the "Belt and Road" on the optimization of industrial structure and its mechanism; (2) Constructs a multi-dimensional structural optimization index for rationalization and advanced industrial structure, which can better reflect the effect of industrial structure optimization.

2. Literature review

Markusen and Venables [1] have highlighted that in the context of international trade, foreign-funded enterprises

can directly stimulate the emergence of new industrial sectors within host nations, driven by the demand from suppliers of intermediate goods. This, in turn, acts as a catalyst for the growth of local industries and subsequently fosters the upgrading of the industrial structure within these host countries. Ishikawa and Tarui [2] have noted the significant influence of endogenous transportation costs on trade, suggesting that import liberalization may positively affect countries engaged in open export trade due to cost-related issues, which include a critical impact on the industrial structure. Chang *et al*. [3] have discussed that the "Belt and Road" initiative not only spurs China to increase its R&D investment and elevate the level of technological innovation but also aids in overcoming the bottlenecks of industrial structure. It promotes the ecological optimization of the entire industrial structure and actively introduces sophisticated equipment, technology, and management along the route, thereby advancing industrial technological progress and enhancing the ecological level of the industrial structure. The study thus advances the following hypotheses: (1) The "Belt and Road" policy facilitates the upgrading and the rationalization of the industrial structure; (2) The "Belt and Road" initiative enhances the optimization and upgrading of the industrial structure through technological upgrading effects.

3. Model construction and baseline regression

3.1. Variable selection and indicator description

(1) Explained variables: (a) Industrial structure rationalization (ins1): measured by Theil index, as follows: $tl_{it} = \sum_{m=1}^{3} (\frac{Y_{itm}}{Y_{it}}) \ln (\frac{Y_{itm}}{L_{itm}} / \frac{Y_{it}}{L_{it}}), m = 1,2,3$, where Y_{it} indicates the total output value of region i in t years, L_{it} indicates the total employment number of region i in t years, Y_{itm} indicates the output value of m industries in region i in t years, and L_{itm} indicates the employment number of m industries in region i in t years; (b) The upgrading of industrial structure (ins2): the ratio of the added value of the tertiary industry and the secondary industry.

(2) Explanatory variable: The implementation effect of the "Belt and Road" policy is taken as the explanatory variable. The policy dummy variable (treat) has a value of 0 for the control group and 1 for the experimental group. The time dummy variable (p) takes the value of 1 from the implementation of the policy in 2014 and 0 from the years before the implementation. The interaction term of treat and p is the policy effect (did), and the value is 1 only when the policy effect exists.

(3) Mediating variables: For technological innovation, this paper measures the regional innovation capability index published in China's Regional Innovation Capability Evaluation Report, which includes 5 first-level indicators, 20 second-level indicators, 40 third-level indicators, and 138 fourth-level indicators.

(4) Control variables: (a) Urbanization rate (urban): the proportion of the urban population in total population at the end of the year; (b) Infrastructure construction (road): per capita urban road area; (c) Human capital (edu): The product of population and years of education per capita in each province represents human capital; (d) Technical level (tech): the annual amount of patent grants in each province measures the technical level of each province; (e) Export demand (ex): The annual export volume of each province indicates export demand; (f) Household consumption (rgdp): Per capita GDP reflects the consumption of residents in each province; (g) Government expenditure (gor): The fiscal expenditure of each province and local government is measured; (h) Foreign Direct Investment (fdi): Foreign direct investment by province indicates the situation of foreign direct investment.

3.2. Data sources and processing

This paper selected the panel data of 30 provinces in China (without Tibet) from 2010 to 2020, and took 17

provinces with policy priorities as the experimental group and the other provinces as the control group. The data are mainly from the China Statistical Yearbook of the corresponding year. The descriptive results of variables are shown in **Table 1**.

Table 1. Descriptive statistics of variables

Abbreviation	Maximum	Minimum	Mean	Standard deviation
ins1	1.41	0.01	0.52	0.29
ins2	5.3	0.53	1.3	0.72
did	1	0	0.36	0.48
Innovate	62.14	15.78	28.89	10.53
urban	0.9	0.34	0.58	0.12
road	26.78	4.04	15.63	4.8
gor	14.37	10.93	12.92	0.62
fdi	14.49	7.76	11.17	1.38
tech	1.67	-0.64	0.17	0.39
ex	-0.11	-1.1	-0.57	0.21
edu	12.78	6.76	9.12	0.93
rgdp	16.49	1.31	5.44	2.73

3.3. Model construction

3.3.1. DID model

The formula for the DID model is:

$$industry_{it} = c_0 + \alpha_1 did_{i,t} + \alpha_2 treat_{i,t} + \alpha_3 p_{i,t} + \sum_{i=1}^{n} \mu_j \, control_{it} + \varepsilon_{it}$$

where $industry_{it}$ represents the industrial structure index, and α_2 and α_3 are regression coefficients of treat and p, respectively. The did_i represents the differential cross-multiplication term, α_1 represents the net effect brought by the policy implementation, i represents the province, t represents the year, $control_{it}$ is other control variables, coefficient P is the coefficient of the control variable, and ε_{it} is the random error term.

3.3.2. Intermediary effect model

The model is set as follows, where $medium_{it}$ represents the intermediate variable.

$$medium_{it} = \pi_1 + \lambda_1 did_{it} + \lambda_2 control_{it} + \gamma_t + \mu_i + \varepsilon_{it} \quad (1)$$

$$industry_{it} = \pi_0 + \beta_2 did_{it} + \beta_2 medium_{it} + \beta_3 control_{it} + \gamma_t + \mu_i + \varepsilon_{it} \quad (2)$$

4. Empirical analysis

4.1. Heterogeneity analysis

This paper divides the samples, and the results are shown in **Table 2**. Columns (1) and (2) represent the eastern region, columns (3) and (4) represent the central region, and columns (5) and (6) represent the western region. The industrial structure of the eastern region and the central region has significant policy effects, while that of the western region is not. This may be due to both the eastern region and the central region having better

overall economic scale and industrial development basis as compared to the western region. Production factors such as foreign capital inflow, technology spillover, and market demand expansion brought about by the "Belt and Road" policy can play a positive role more effectively and quickly under good infrastructure conditions in the east and central regions, promoting the proportion of local knowledge-intensive and capital-intensive industries, and promoting the optimization and upgrading of industrial structure. However, the economic development speed of the western region is relatively slow, and the industrial infrastructure is not complete, and the construction of these facilities often takes a long time, a large amount of capital, and there is a certain time lag. Secondly, the interaction coefficients of the industrial structure rationalization equation in the eastern and central regions are -0.041 and -0.024, respectively, and the interaction coefficients of the industrial structure upgrading equation are 0.086 and 0.032, respectively. In other words, the influence of the "Belt and Road" policy on the optimization of industrial structure in the eastern region is stronger than that in the central and western regions.

Table 2. Results of heterogeneity test

Variable	East		Central		West	
	ins1	Ins2	ins1	Ins2	Ins1	Ins2
did	-0.041***	0.086***	-0.024***	0.032***	-0.029	0.013
	(-2.76)	(-0.43)	(-2.76)	(-4.48)	(-1.14)	(1.02)
p	0.030*	-0.075	0.047	-0.046***	0.019	-0.018
	(1.86)	(-1.54)	(1.13)	(-2.91)	(0.69)	(-1.27)
treat	0.121***	-0.264***	0.231***	-0.035*	0.298***	0.010
	(2.61)	(-2.76)	(4.39)	(-1.75)	(13.64)	(0.93)
urban	1.423*	-7.630***	3.555	2.170**	5.870***	-1.443***
	(1.92)	(-3.52)	(1.26)	(2.01)	(7.42)	(-3.57)
road	0.005**	-0.032***	0.001	-0.005***	0.005***	0.001
	(2.16)	(-4.48)	(0.32)	(-2.92)	(2.65)	(1.17)
gor	-0.141***	-0.098	-0.240***	0.023	0.097***	0.003
	(-5.45)	(-1.59)	(-4.68)	(1.15)	(4.40)	(0.26)
fdi	-0.003	0.012	-0.012	0.008	0.002	0.012***
	(-0.54)	(0.62)	(-0.54)	(0.97)	(0.27)	(2.81)
tech	0.041	1.617***	0.033	1.028***	0.126***	1.114***
	(1.19)	(17.72)	(0.52)	(41.94)	(3.57)	(62.11)
ex	-1.743***	3.249**	-3.515**	-0.850	-4.573***	0.659***
	(-3.96)	(2.50)	(-2.42)	(-1.53)	(-12.94)	(3.65)
edu	0.003	0.174***	0.161***	-0.018	0.055***	0.005
	(0.19)	(3.47)	(3.63)	(-1.06)	(2.97)	(0.51)
rgdp	0.009**	0.061***	0.091***	-0.021***	-0.014	-0.006
	(2.36)	(5.45)	(6.05)	(-3.72)	(-1.13)	(-0.89)
intercept	0.224	7.282***	-2.281	-0.684	-7.405***	2.007***
	(0.28)	(3.11)	(-0.95)	(-0.75)	(-10.70)	(5.68)
FE	YES	YES	YES	YES	YES	YES
n	132	132	99	99	99	99

*$P < 0.1$; **$P < 0.05$; ***$P < 0.01$

4.2. Robustness test

This paper selects the first three years and the last seven years (2010–2020) of the "Belt and Road" Initiative to investigate the dynamic changes of regression coefficients of interaction terms between time node dummy variables and policy dummy variables. The test results are shown in **Figure 1**.

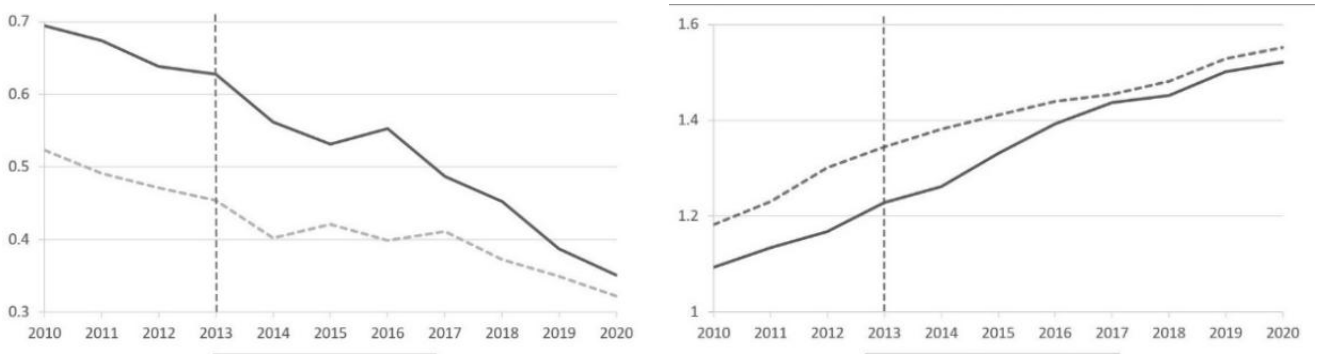

Figure 1. Parallel trend test of rationalization

As can be seen from **Figure 1**, the rationalization and upgrading of the industrial structure of the treatment group and the control group passed the parallel trend hypothesis test, and after the "Belt and Road" initiative was put forward, the change trends of both the control group and the control group showed significant differences. It can be considered that the "Belt and Road" initiative has a positive promoting effect on the upgrading of industrial structures along the routes.

5. Results of intermediary effects

Table 3 shows the test results of the technology enhancement effect. Models (1) and (2) are tests of **Equation (1)**, the explained variable is the level of technological innovation, with model (1) not adding control variables and model (2) adding control variables. Models (3) and (4) are regression results of **Equation (2)**, and the explained variables are ins1 and ins2, respectively. The results show that the "Belt and Road" initiative has significantly improved the level of technological innovation, and the level of technological innovation has significantly improved the upgrading of industrial structure.

Table 3. Test results of a technological innovation effect

	(1)	(2)	(3)	(4)
	innovate	**innovate**	**ins1**	**Ins2**
did	0.818**	0.802**	0.015**	0.025
	(1.821)	(1.873)	(2.149)	(1.322)
innovate			-0.004**	0.010
			(-2.430)	(0.997)
control	NO	YES	YES	YES
Individual	YES	YES	YES	YSE
Year	YES	YES	YES	YES
_cons	-102.729***	-96.637***	-0.459	3.749***
	(-4.784)	(-4.026)	(-0.658)	(3.698)
R2	0.062	0.271	0.697	0.029

*$P < 0.1$; **$P < 0.05$; ***$P < 0.01$

6. Conclusion and enlightenment

Based on panel data from 30 provinces and regions in China from 2010 to 2020, this paper empirically explores the impact of the Belt and Road Initiative on the upgrading of the industrial structure along its routes. The promotional effect of the Belt and Road policy on the optimization and upgrading of the industrial structure is most significant in the eastern region, followed by the central region, with a notable difference in the western region. The intermediary effect model reveals that the Belt and Road policy primarily promotes the optimization and upgrading of the industrial structure along the route through technological advancement. The following policy recommendations are suggested:

(1) Accelerate the deep integration of resources, talent, and other elements along the route to achieve the optimization and upgrading of the industrial structure.

(2) Provide appropriate tax incentives and financial subsidies to enterprises participating in the Belt and Road initiative to foster the development of high-tech industries.

(3) Tailor the advancement of the Belt and Road Initiative to local conditions.

Disclosure statement

The author declares no conflict of interest.

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