Analysis of the role of the "Belt and Road" initiative on industrial upgrading

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Abstract. Based on the labor productivity index, this paper establishes a Difference in Difference model to study the impact of the Belt and Road initiative on China's industrial upgrading. Using the data at the municipal level from 2008 to 2019, quantitatively evaluate the net effect of the industrial structure upgrading of the “Belt and Road” initiative. On the basis and conclusion of the previous study, the level of economic growth is added to the did model as a new control variable to further confirm and test the impact of the "Belt and Road" initiative and the level of economic growth on China's industrial structure upgrading. The study found that the "Belt and Road" initiative has promoted the upgrading of regional industrial structure, but it is mainly reflected in the upgrading of industrial structure, and its role in promoting the rationalization of industrial structure is not significant. The upgrading of industrial structure will promote the quantitative economic growth, not the qualitative economic growth.

Keywords: the "Belt and Road" Initiative; Difference in Difference model; Economic growth level; upgrade industries; Labour productivity.

1. Introduction

From 2011 to 2013, China's economic growth showed an "L-shaped" trend, and China's economic development officially entered the new normal of medium and high-speed growth. Under the new normal, the drawbacks of China's previous "winning by quantity" have gradually emerged. Under the background of the further disintegration of the global value chain and the international division of labor, China has fallen into the dilemma of "low-end of high-end industries", which is difficult to promote the upgrading of industrial structure. How to upgrade the industrial structure and promote China's economic growth has become a key issue to be solved by the Chinese government[1].

The "Belt and Road" has not done much research on industrial development, mainly focusing on industrial carrying capacity, foreign direct investment and diversified demand. (Ren Xuemei et al；2019) tested the relationship between China's FDI level to countries along the belt and road and domestic industrial upgrading. The results show that China's direct investment in countries along the "Belt and Road" shows a negative correlation with China's industrial structure upgrading. At present, there is no clear evidence that it can promote China's industrial structure upgrading. However, also clearly affirmed that the "Belt and Road" initiative has brought impetus to China's industrial restructuring and foreign investment growth. At the same time, the initiative also provides new demands for the diversity of energy sources and paths[2].

By analyzing the above documents, it is found that scholars have done a lot of research on the impact of the “Belt and Road” initiative on countries along the route and the mechanism of the “Belt and Road” initiative on economic development.However,many scholars have studied from the trade and foreign direct investment of the “Belt and Road” and come up with some positive and controversial negative impacts.They gave the measurement method of industrial structure upgrading indicators, so far, few scholars have analyzed the effect of the initiative on the rationalization and upgrading of China's regional industrial structure from the perspective of the “Belt and Road” based on the indicators of labor productivity.

There is a close internal relationship between the “Belt and Road” initiative and industrial structure upgrading. On this basis, this paper raises the following questions. Firstly, there has the “Belt and Road” initiative a positive or negative impact on the optimization and upgrading of China's regional

industrial structure? How strong is this effect? Secondly, how does the mechanism between the the Belt and Road initiative and industrial structure upgrading reflect?

In order to solve the above problems, this paper plans to use the panel data of 285 cities from 2008 to 2019 as the research sample. As the “Belt and Road” initiative is a quasi-natural experiment, the difference in difference model can be used to analyze and test the net effect of the "Belt and Road" initiative on the upgrading of regional industrial structure and study the intensity of its effect. Further explain the relationship between the “Belt and Road” initiative and industrial upgrading through robust test and mechanism analysis.

2. Model Construction

2.1 The "Belt and Road" initiative based on labor productivity: a DID model of China's industrial structure upgrading

In this paper, China's implementation of the “Belt and Road” initiative is regarded as a "quasi natural experiment". Since China formally put forward the initiative document of the " Belt and Road" strategic cooperation in 2013. Therefore, this paper determines 2013 as the time node for policy impact, that is, before the implementation of the initiative from 2008 to 2013 and after the implementation of the initiative from 2014 to 2019, so we can compare the policy changes of the experimental group and the control group during these two time periods, and then evaluate the effectiveness of this initiative. This paper uses the difference in difference (DID) method to study the impact of the “Belt and Road” initiative on the upgrading of industrial structure. The research object of this paper is 285 cities in China. The research scope is from 2008 to 2019, including whether to participate in the construction of the “Belt and Road”. We choose according to two principles: (1) whether to open China Europe train before 2019; (2) Whether it is located in an important node city and hub of the “Belt and Road”. According to the collection of the National Bureau of statistics and the “Belt and Road” website, we have obtained 134 cities participating in the "Belt and Road" construction, and the remaining 151 cities are the control group.

2.1.1 According to the application principle of double difference method, a specific benchmark model is constructed

$$\text{industry}_{i,t} = \alpha_0 + \alpha_1 did_{i,t} + \gamma x_{it} + \eta_t + \mu_i + \varepsilon_{i,t} \quad (1)$$

In the model, $\text{industry}_{i,t}$ is the explained variable, which is the upgrading level of industrial structure of city i in t year , measured from two aspects of rationalization and upgrading. $\text{did}_{i,t}$ is a dummy variable of the “Belt and Road” initiative, which is composed of the interactive term treated*period. The did value of the treat group during the experimental period is 1, and that of other cases is 0. The coefficient is α_1 is the core parameter of the model, which measures the net effect of the "Belt and Road" initiative on the optimization and upgrading of industrial structure. If the coefficient is positive, it indicates that the "Belt and Road" initiative is conducive to the optimization and upgrading of industrial structure. If the coefficient is negative, it indicates that the "Belt and Road" initiative has a negative inhibitory effect on the optimization and upgrading of industrial structure. x_{it} is another control variable that affects the industrial upgrading. η_t is the time fixed effect, μ_i is the individual fixed effect[3].

2.1.2 Definition of variables

In this model, we select the degree of rationalization and upgrading of industrial structure as the main explained variable. For the rationalization and upgrading of explained variables, we use labor productivity as the main measurement standard.

(1) Explained variable: the existing studies on industrial structure upgrading are mainly conducted from the two aspects of industrial structure upgrading and rationalization. Industrial structure upgrading refers to the process of industrial structure evolving from a low-level state to a high-level

state according to the law of economic development. It includes not only the transformation of industrial structure from labor-intensive and capital intensive to knowledge-based and technology intensive, or the upgrading from low value-added industries to high value-added industries, but also the upgrading of the overall technical level or added value of each industry at the level of the original industrial structure. This paper uses the industrial structure hierarchy coefficient to measure, and its formula is:

$$HL_1 = \sum_{m=1}^{3} m \times y_{i,m,t}, m = 1,2,3 \quad (2)$$

Where $y_{i,m,t}$ refers to the proportion of the gross domestic product of the m Industry in the regional gross domestic product of the City i in the period of t. the hierarchical coefficient of industrial structure mainly reflects the progressive evolution and development of the three industries. In order to study the upgrading of industrial structure more comprehensively, this paper uses the practices of Liu Wei and Cai Zhizhou for reference, and uses the product of the proportional relationship between labor productivity and industries to express the connotation of the upgrading of industrial structure, and further depicts the evolution process of industrial structure from an industry with lower labor productivity to an industry with higher labor productivity. The formula is:

$$HL_2 = \sum_{m=1}^{3} y_{i,m,t} \times \varphi_{i,m,t}, m = 1,2,3 \quad (3)$$

Of which, $\varphi_{i,m,t}$ is the labor productivity of city i in the period of m Industry t which is expressed by the ratio of the added value of city I in the period of M Industry t to the number of employed persons, and the dimension is eliminated by the averaging method. In the existing literature, the results of formula (2) and formula (3) are both used as the measurement indicators of industrial structure upgrading. However, in order to distinguish the meaning of the two, the results of formula (2) are called the industrial structure hierarchy coefficient, and the results of formula (3) are called the industrial structure upgrading indicators[4].

The rationalization of industrial structure refers to the realization of coordinated development and high correlation among industries on the basis of the existing economic foundation, consumption level and production factor allocation. The rationalization of industrial structure is of great significance for the rational and efficient utilization of resources in economic development and the rapid linkage development by improving the coupling degree of various industries. This paper uses the method of Gan Chunhui, etc. for reference, and uses the Theil index to express the rationalization level of industrial structure. The formula is:

$$GL = \sum_{m=1}^{n} \left(\frac{Y_{i,m,t}}{Y_{i,t}}\right) ln \left(\frac{\frac{Y_{i,m,t}}{L_{i,m,t}}}{\frac{Y_{i,t}}{L_{i,t}}}\right) \quad (4)$$

Where, Y represents output value and l represents labor force. If the economy is in equilibrium, then GL = 0. The greater the GL value, the more unreasonable the industrial structure.

2.1.3 Data Sources

Since 2008 is the turning point of the rapid change period of industrial structure upgrading, this paper selects the 2008 as node time, and uses the panel data of 285 cities in China from 2008 to 2019 to study the impact of the “Belt and Road” initiative on the optimization and upgrading of industrial structure. The data involved in the variables are all from the China urban statistical yearbook. During the study period, individual data are missing, which are supplemented by the moving average method. The rest of the data comes from the wind database. Due to the impact of the COVID-19 in 2020, the effectiveness of the results may be greatly affected, so only 2019 is considered here[5].

2.1.4 Calculation of variables and descriptive statistics

Table 1 The definition and calculation method of variables.

Category	Variable	Algorithm
Explained variable	Rationalization of industrial structure(lnHL)	Logarithm of previous data
	Advanced industrial structure(lnGL)	Logarithm of previous data
Core explanatory variables	"Belt and Road" initiative(did)	Virtual variable(0，1)
Control variables	Government expenditure scale(gov)	Ratio of government general budget expenditure to regional GDP
	Education level of residents(edu)	Ratio of the number of college students in the current period to the total population of the region at the end of the year
	Foreign direct investment level(inv)	Ratio of foreign direct investment to regional GDP
	Openness(open)	Ratio of total imports to regional GDP
	Independent research and development level(sci)	Ratio of technology market turnover to regional GDP
	Infrastructure construction level(intra)	Urban Road area per capita
	Informatization level(inf)	Ratio of regional total telecommunication services to regional GDP

Table 2 Descriptive statistics of variables

Variable	Sample size	Mean	standard deviation
HL	3420	10.82	26.43
GL	3420	1.12	0.58
did	3420	0.12	0.33
gov	3420	0.20	0.16
edu	3420	0.01	0.01
inv	3420	0.51	0.69
open	3420	0.23	1.06
sci	3420	0.02	0.02
intra	3420	12.01	8.3
inf	3420	0.05	0.02

3. Results

3.1 Did empirical results and analysis

This chapter adopts a two-factor fixed effects model to measure the net effect of the "Belt and Road" initiative on the optimization and upgrading of industrial structure from the perspectives of rationalization and upgrading. The results are shown in Table 3. Obviously, the "Belt and Road" initiative has no significant impact on the rationalization of regional industrial structure, but has a significant role in promoting the advanced regional industrial structure.

Table 3 Model estimation results of the "Belt and Road" initiative on the optimization and upgrading of regional industrial structure

	lnHL Model 1.1		lnGL Model 1.2	
Explanatory variable	Regression coefficient	Standard deviation	Regression coefficient	Standard deviation
did	0.007	0.91	0.088***	3.20
gov	-0.19***	-4.42	0.08***	5.25
edu	3.89***	5.62	3.67***	13.88
inv	0.03***	4.92	0.001	-0.58
open	0.18***	6.88	0.07***	4.73
sci	-0.45*	-1.38	0.43***	3.13
intra	0.035***	3.26	0.001*	1.88
inf	-1.54***	-6.23	0.19***	3.24
Time fixed effect	YES		YES	
Individual fixation effect	YES		YES	
Intercept term	2.28***	275.9	1.66***	423.40
N	3420		3420	
R2	0.35		0.77	

Note: *, **and*** respectively indicate that they are significant at 10%, 5% and 1% significance levels.

The comparison between the two models shows that the "Belt and Road" initiative has no significant impact on the rationalization of industrial structure, but has a significant role in promoting the upgrading of industrial structure, that is, the "Belt and Road" initiative has a significantly better effect on promoting the upgrading of industrial structure than the rationalization of industrial structure.

The "Belt and Road" initiative focuses more on capital going out, which has little impact on the coordination between industries and the effective utilization of resources. On the contrary, it can promote the sequential evolution of industrial structure from low level to high level, from simple to complex. Therefore, the "the Belt and Road" initiative is an opportunity for all regions to transform and upgrade their industries, especially in areas where the proportion of industries is unreasonable. With the support of national policies, we should seize development opportunities, actively realize industrial transformation, and strive to improve the level of industrial structure advancing.

3.2 Parallel trend test

In order to further verify the effectiveness of the model, the parallel trend test will be conducted for the two indicators of upgrading and rationalization of industrial structure in this part. The results are as follows: the core explanatory variables of did in the following two figures are significantly positive. In Figure 1, the coefficient of dummy variable multiplied by the years before 2013 and the experimental group is positive and not significant. In Figure 2, the coefficient of dummy variable is not significant except for 2008 and 2009. Therefore, it can be basically proved that the model meets the parallel trend assumption[6].

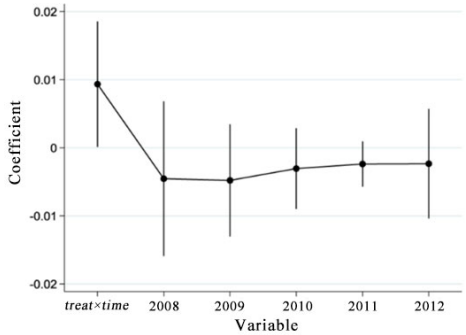


Figure 1 Parallel trend test of industrial structure rationalization indicators

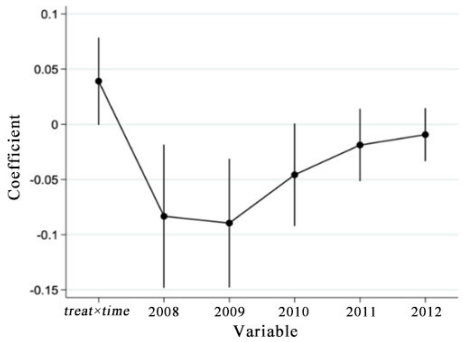


Figure 2 Parallel trend test of advanced indicators of industrial structure

3.3 Robustness test

3.3.1 PSM-DID test

The matching results show that 13 cities have not been matched to the appropriate control group. This paper further tests the matching results and finds that they meet the equilibrium conditions. Therefore, DID method can be used for regression, and the regression results are shown in Table 4. From the sign, size and significance of the regression coefficient, it can be seen that there is little difference between the regression results of PSM-DID and the benchmark regression results, so it can be determined that the model is robust.

Table 4 PSM-DID regression result

Explanatory variable	Advanced industrial structure	Rationalization of industrial structure
treat*time	0.051**(2.07)	0.008(0.86)
Control variable	YES	YES
Time fixed effect	YES	YES
Individual fixed effect	YES	YES
Intercept term	0.69**(-4.12)	0.23*** (38.82)
N	2420	2420
R2	2420	2420

3.3.2 Missing variable test

This paper examines the interaction between the “Belt and Road” initiative, industrial structure upgrading and economic growth at the national level. The estimated results are shown in Table5. Through analysis, it can be found that there is a functional relationship between the “Belt and Road” initiative, industrial structure upgrading and economic growth. In order to more accurately estimate the impact of the “Belt and Road” initiative on the upgrading of regional industrial structure, this paper selects a two-factor fixed effects model with economic growth level as the control variable for analysis. It can be seen from the table that the core explanatory variable did passed the significance test at the level of 1% and the coefficient symbol did not change fundamentally. In addition, the coefficient symbols of all control variables have not changed, indicating that there are no important variables omitted in this paper.

Table 5 DID regression results of the impact of the “Belt and Road” initiative on industrial structure upgrading

	lnGL	
Explanatory variable	Regression coefficients	Standard deviation
did	0.092***	3.25
GDP	-0.29***	0.04
gov	-0.17***	-4.42
edu	4.15***	7.62
inv	0.04***	5.13
open	0.16***	7.22
sci	-0.39*	-1.71
intra	0.004***	3.32
inf	-1.54***	-6.23
Time fixed effect	YES	
Individual fixed effect	YES	
Intercept term	1.66***	423.9
N	3420	
R2	0.36	

Note: *, **and*** respectively indicate that they are significant at 10%, 5% and 1% significance levels.

From the perspective of control variables, at present, China's economy is in a critical period of economic structure optimization and growth power transformation. The challenges brought by international market environmental risks to China's economic development, as well as the various pressures faced by the internal economic environment, such as the continuous rise of domestic factor costs and increasingly strict environmental constraints, have led to the slowdown of economic development and the lack of endogenous power for the upgrading of industrial structure.

3.4 Test results of the action mechanism of the "Belt and Road" initiative affecting industrial structure upgrading

According to the research results of the above model, we can see that the “Belt and Road” initiative can promote the advanced industrial structure, so we should further study the channels through which the “Belt and Road” initiative further realizes the upgrading of industrial structure. Therefore, this paper makes an empirical test around the two channels of unimpeded trade and connected facilities, so as to better understand the mechanism of the “Belt and Road” initiative affecting industrial structure upgrading, and provide a scientific basis for achieving a more reasonable industrial structure upgrading. The following results are shown in Table 6.

Table 6 Test results of the action mechanism of the "Belt and Road" initiative affecting industrial structure upgrading

	L1	L2	L3	L4
trade	0.17(7.26)***	0.082(5.15)**		
trade*did		0.034(2.06)**		
time*period		0.017(3.93)***		0.021(3.92)***
traff			0.004(3.32)*	0.001(3.82)*
traff*did				0.01(3.1)*
Intercept term	2.27(296.8)***	1.774(433.6)***	2.83(296.9)***	1.778(433.7)***
Control variable	YES	YES	YES	YES
Time effect	YES	YES	YES	YES
Individual effect	YES	YES	YES	YES
N	3420	3420	3420	3420
R2	0.726	0.729	0.725	0.728

In this section, through the above empirical analysis results, it is proved that the increase of infrastructure connectivity and trade exchanges can further promote the role of the “Belt and Road” initiative in promoting industrial structure upgrading, and provide a test for understanding the specific mechanism of the “Belt and Road” for industrial structure. Under the current COVID-19, we should still adhere to the construction of infrastructure, including the establishment of medical and health institutions, educational institutions, transportation facilities and CDC. In terms of trade, we should adhere to the smooth flow of trade, so as to ensure the stability and security of materials and energy in China and countries along the" Belt and Road".

4. Conclusions

The "bonus" brought by the “Belt and Road” initiative to the rationalization of the industrial structure of cities along “Belt and Road” is not significant, and it has a significant role in promoting the upgrading of the industrial structure of cities along “Belt and Road”, indicating that the implementation of the “Belt and Road” initiative can effectively improve the upgrading of the industrial structure of China. The industrial structure has different effects on economic growth with the improvement of the degree of change. At present, in the context of the “Belt and Road” initiative, the level of quantitative economic growth has slowed down, and the endogenous power of industrial structure upgrading is insufficient. The upgrading of industrial structure brought about by the “Belt and Road” initiative has mainly promoted quantitative economic growth, but this growth is still

relatively slow. From the empirical analysis of the mechanism, it shows that smooth trade and facility connectivity are important channels for the “Belt and Road” initiative to promote the upgrading of industrial structure, providing a scientific basis for further optimizing the path of industrial structure upgrading. These approaches are also more conducive to promoting China's economic growth.

Intensify efforts to promote the implementation of the “Belt and Road” initiative. The “Belt and Road” initiative conforms to the development trend of the times and is a powerful driving force for achieving sustainable economic development[7]. Adhere to the new development pattern of domestic and foreign double circulation. Based on the internal cycle of economic supply and demand, China should develop emerging industries to enable high-quality economic development and form more new growth points and poles. Accelerate independent innovation and form an innovative way of industrial structure change[8]. Innovation is the endogenous driving force to achieve high-quality economic growth and improve the labor productivity of the three industries[9]. China should accelerate the promotion of technological innovation and industrial innovation, turn to independent innovation, and achieve industrial technology transcendence in technology catch-up, so as to continuously improve social productivity. Accelerate the development of the tertiary industry and optimize the internal structure of the tertiary industry[10]. Pay attention to the role of the tertiary industry in promoting economic quality growth, realize the effective integration of service industry and manufacturing industry, take effective measures to gradually adjust the proportion structure of producer services and consumer services, and continuously improve the production efficiency of the tertiary industry.

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