

Human Capital and Upgrading of Industrial Structure: An Empirical Study Based on the Countries along the “Belt and Road”

Zhiyi Liu

School of Economics and Resource Management (SERM), Emerging Markets Institute (EMI), Beijing Normal University, Beijing, China

Email: 201431410006@mail.bnu.edu.cn

How to cite this paper: Liu, Z. Y. (2020). Human Capital and Upgrading of Industrial Structure: An Empirical Study Based on the Countries along the “Belt and Road”. *American Journal of Industrial and Business Management*, 10, 699-710.
<https://doi.org/10.4236/ajibm.2020.104047>

Received: March 16, 2020

Accepted: April 6, 2020

Published: April 9, 2020

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Abstract

Upgrading of industrial structure is a common pursuit of countries along the “Belt and Road”. Literature review and data analysis indicate that the structure of human capital determines the structure of industrial. Using panel data from 1995 to 2018, this paper confirms that in countries along the “Belt and Road”, the quantity of labor forces and the quality of labor forces have significant impacts on the upgrading of industrial structure. This means that in the process of promoting the “Belt and Road” initiative, the “Belt and Road” countries should actively promote the improvement of the quantity and quality of their human capital. While optimizing the age structure, they should focus on the promotion of education, especially middle and high-level education and training, so as to lay a solid foundation for the further transition of the industrial structure.

Keywords

Human Capital, Upgrading of Industrial Structure, The Belt and Road

1. Introduction

Since the International Financial Crisis in 2008, the economic rise of emerging market countries has become a trend. While leveraging their own endowment advantages to promote the rapid development of their economies, developing countries are also struggling to climb global value chains and optimize and upgrade their industrial structures. The failure of Latin American economies in the 1980s and the results of East Asian economies since the 1990s show that efforts to achieve industrial upgrading and avoid the “low-end lock-in” effect of the in-

dustry are of great significance for economic growth (Gereffi, 1999).

In the process of globalization, the quantity and quality of human capital determine the pace and rhythm of industrial upgrading to a certain extent. On the one hand, the amount of human capital determines the factor endowment, and emerging market countries have natural advantages in undertaking labor-intensive industries by virtue of their young labor structure. On the other hand, the quality of human capital also plays a pivotal role in attracting foreign investment and promoting technological absorption and conversion.

With the implementation of the “Belt and Road” (B & R) initiative, the countries along the “Belt and Road” as a group, while maintaining a relatively high economic growth rate, many beneficial changes have also occurred in the industrial structure. Therefore, examining the industrial upgrading status and problems of countries along the “Belt and Road” from the perspective of human capital can not only test the applicability of traditional theories, but also help the countries along the route to find the shortcomings in the process of industrial upgrading and promote the “Belt and Road” initiative.

2. Literature Review

The theory and historical experience show that the industrial structure is not static, but has its own general laws of development. Economists (Clark, 1957; Kuznets, 1985) have shown through a large number of statistical analyses that modern economic growth is not only a process of aggregate growth, but also involves structural changes.

The essence of upgrading the industrial structure is to reconfigure the production factors, which is an important means to reduce waste of resources and improve economic benefits. The better the industrial structure of a country, the higher the efficiency of its resource allocation. There are many factors affecting the upgrading of the industrial structure, such as technological progress, foreign investment levels, the degree of urbanization, and government policies in various regions. Since the new concept of human capital was proposed by Schultz, it is often used to study the relationship with the upgrading of industrial structure.

Schultz (1961) pointed out that human capital refers to the sum of education, vocational training and other expenditures on producers, which is expressed as the sum of various production knowledge, labor and management skills, and health qualities that are contained in humans. Through research on the influencing factors of American economic growth, he found that human capital growth has a significant role in promoting economic growth, and it is significantly greater than the contribution rate of factors such as physical capital and labor factors to economic growth.

The contribution of human capital to economic growth and social progress has reached consensus. Schultz (1961) systematically expounded the important role of education in economic growth and laid a theoretical foundation for subsequent research. Lucas (1988) also regarded human capital and physical capital

as the core factors determining economic growth, proving that education is an important driving force for industrial growth and structural adjustment. [Petrakis and Stamatakis \(2002\)](#) further compared the role of education in the economic growth of countries at different stages of development, and found that for developing countries, the role of primary and secondary education in promoting economic growth is more important.

At the same time, human capital also has a significant spillover effect, which can improve the skills and productivity of workers. Considering that the upgrading of the industrial structure is the process or trend of the transformation of the industrial structure from a low level to a high level, it is an upgrade of the economic growth mode, and it is also an optimization of the economic development model. In the process of industrial structure upgrading, the role of human capital is also crucial. From a certain perspective, the higher the level of human capital owned by a country, the stronger its ability to upgrade its industrial structure.

Many studies have shown that human capital has promoted the upgrading of China's industrial structure. [Jin \(2010\)](#) believes that human capital is the basis of industrial structure adjustment and has a decisive effect on the direction, speed and effect of industrial structure adjustment. The regional imbalance of human capital restricts the flow of labor between industries, thereby restricting technological innovation, affecting the development of capital-intensive industries, and leading to an imbalance in the industrial structure. [Zhang et al. \(2011\)](#) analyzed the effects of human capital on industrial structure through regional analysis and concluded that the impact of human capital on the industrial structure is regionally different. Human capital promotes the upgrading of the industrial structure in the eastern region, while the low level of labor quality causes the human capital to promote the central and western regions. And they also proposed that the improvement of human capital level is a strong driving force for the transformation and upgrading of industrial structure.

The two-way relationship between human capital and industrial upgrading is also the focus of research. [Chen & Li \(2017\)](#) studied the two-way relationship between human capital accumulation and industrial structure upgrade by using inter-provincial panel data from 1997 to 2014, and concluded that there is a two-way promotion effect between the two. However, there is heterogeneity in the relationship between the two. The eastern region is the accumulation of human capital to promote industrial transformation and upgrading, while the central and western regions are the opposite. [Huang \(2011\)](#) concluded that human capital accumulation is the Granger reason for industrial upgrading based on the VAR model. Industrial upgrading does not have a significant performance in the accumulation of human capital. At the same time, human capital demand factors, technological absorption and innovation promotion, and intelligence for industrial transformation Support and other aspects have studied its impact on industrial upgrading.

At present, the research on the relationship between human capital and industrial structure upgrade in the domestic academic circle is mainly focused on the practice in China. Generally, inter-provincial panel data are used for empirical research. So, are there similar laws in countries along the “Belt and Road” where there are large differences in systems and cultures and different levels of education? In these countries that are rapidly advancing industrialization and globalization, how to promote the continuous upgrading of their industrial structure from the perspective of cultivating human capital?

3. Human Capital and Industrial Structure of the Countries along B & R

Since the “Belt and Road” Initiative was launched in 2013, the number of responding countries has increased year by year. But in a general sense, there are mainly 65 countries¹ along the “Belt and Road”. The size of the labor force, the age structure of the labor force, and the cultural structure of these countries determine the competitiveness of these countries in participating in the global division of labor and the difficulty of upgrading the industrial structure.

Indicators for measuring human capital generally include labor density, labor cost, labor quantity, and labor quality. Among them, the quantity of labor and the quality of labor are the most important indicators for measuring the human capital situation of a country. The number of laborers is generally measured by the number of working-age laborers. The quality of the labor force is generally measured by the national education index released by the United Nations Development Programme, and the education index is a weighted average of the adult literacy rate (2/3 weight) and the primary, secondary, and university comprehensive enrollment rates (1/3 weight).

From the perspective of quantity, according to World Bank data, as of 2018, the total population of the countries along the “Belt and Road” has reached 3.32 billion, accounting for 44.1% of the global population. Among them, the working age population is 1.39 billion, accounting for 40% of the global workforce. From the perspective of the distribution of labor force, the labor force scale of 65 countries along the “Belt and Road” is relatively different. Among them, 6 are in over 50 million countries (including India, Indonesia, Pakistan, Russia, Bangladesh and Vietnam), and 14 are in the range of 10 to 50 million (including Philippines, Thailand, Turkey, Egypt, Iran, Myanmar, Ukraine, Pol-

¹For the comparability of the data caliber, a narrower caliber has been adopted in the research of this paper. According to the “Vision and Action for Promoting the Joint Development of the Silk Road Economic Belt and the 21st Century Maritime Silk Road” issued by the National Development and Reform Commission, the Ministry of Foreign Affairs and the Ministry of Commerce in 2015, these 65 Countries include: Albania, Afghanistan, UAE, Oman, Azerbaijan, Egypt, Estonia, Pakistan, Palestine, Bahrain, Belarus, Bulgaria, Bosnia and Herzegovina, Poland, Bhutan, East Timor, Russia, Philippines, Georgia, Kazakhstan, Montenegro, Kyrgyzstan, Cambodia, Czech, Qatar, Kuwait, Croatia, Latvia, Laos, Lebanon, Lithuania, Romania, Maldives, Malaysia, Macedonia, Mongolia, Bangladesh, Myanmar, Moldova, Nepal, Serbia, Saudi Arabia, Sri Lanka, Slovakia, Slovenia, Tajikistan, Thailand, Turkey, Turkmenistan, Brunei, Ukraine, Uzbekistan, Singapore, Hungary, Syria, Armenia, Yemen, Iraq, Iraq Ron, Israel, India, Indonesia, Jordan, Vietnam.

and, Nepal, Malaysia, Uzbekistan, Saudi Arabia, Afghanistan, Iraq), 6 countries between 5 million and 10 million, and 37 countries are less than 5 million.

The total size of the labor force not only determines the influence of countries in the regional labor market, but also means that the potential of the consumer market is different, which is of great significance for attracting FDI and promoting the development of labor-intensive industries. In the past 10 years, the average annual growth rate of the labor force of the countries along the “Belt and Road” has been about 0.7%, and it has been slowly decreasing. Among them, Afghanistan, Pakistan, and Kuwait have an average annual growth rate of more than 4%, which has grown rapidly; Malaysia, Uzbekistan, Egypt, Turkey, Cambodia, Vietnam, the Philippines and other countries have an average annual growth rate of 1% to 4%. The working-age population is growing faster than China’s (Figure 1). Therefore, some scholars have proposed that as China’s demographic dividend subsides, actively using the power resources of the “Belt and Road” countries to fill some labor-intensive service industries and manufacturing labor gaps has become an important policy choice (Wang, 2017).

From the perspective of the age structure of the labor force, the average age of the labor force in countries along the “Belt and Road” has an upward trend. Among them, the countries of Central and Eastern Europe and the CIS countries have a relatively high degree of aging, and Central Asia and West Asia have lower levels. However, overall, about 44% of the total labor force means that the “Belt and Road” countries still enjoy ample demographic dividends, including Vietnam, Thailand, Indonesia and other Southeast Asian countries and Belarus and Russia and other Commonwealth of Independent States (CIS) countries Still high, which means that these countries will enjoy demographic dividends, driving economic growth and industrial upgrading (Figure 2). In addition, countries in South and West Asia, such as India, Egypt, and Iran, have higher birth rates, so the short-term dependency ratio of young children is relatively high, and the demographic dividend is not obvious. But as time goes on and age matures, it can also be expected to enter the period of demographic dividend.

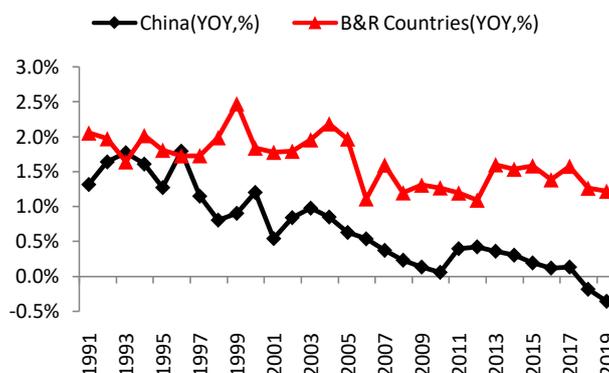


Figure 1. Labor growth rates in China and countries along the Belt and Road (1991-2019). Source: *World Bank Data*.

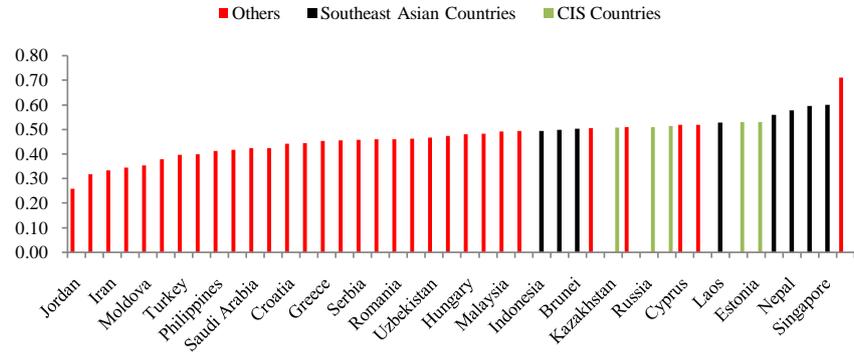


Figure 2. Proportion of working-age population in countries along the Belt and Road in 2018. Source: *World Bank Data*.

From the perspective of quality, the education status and technological innovation capacity of labor forces in countries along the “Belt and Road” are clearly hierarchical. The first echelon countries represented by Singapore and Israel have comparative advantages in terms of education level and quality, skills and R & D capabilities. The second echelon countries represented by Russia, Lithuania, and Slovenia have the education level and occupation of the labor force. Skills are at the leading level; the labor force of industrialized countries in Central and Eastern Europe represented by Poland and the Czech Republic and the oil and gas industrial nations of Western Asia represented by the UAE and Saudi Arabia also have higher education and skill levels; emerging labor resources represented by India. In large countries, there are some bright spots in the improvement of labor quality, but they also face many challenges and need to be resolved urgently; while East Asia and South Asia countries represented by Vietnam, Laos and Bangladesh are rich in labor resources, but the proportion of low-education and low-skill labor is higher, which needs to be improved.

In addition, this paper further observes the upgrading of industrial structure in these countries. Many scholars use the ratio of a certain output value to the total industrial output value or another output value to measure the industrial structure upgrade. The limitation of this approach is that it does not take into account the essential characteristics of the industrial structure upgrade. It only focuses on the upgrade of a certain output value and cannot be comprehensive, while the contribution of each output value to the upgrading of the industrial structure cannot be fully considered. The upgrading of the industrial structure is characterized by the increasing proportion of the tertiary industry and the smaller and smaller primary industry. Therefore, advanced indicators of the industrial structure² are adopted to measure the upgrading of the industrial structure.

²The specific calculation formula is: $Y = \sum i * X_i = 1 * X_1 + 2 * X_2 + 3 * X_3$. Among them, Y is the advanced index of industrial structure, and X_i represents the proportion of the output value of the i -th industry to the total output value. When Y approaches 1, it proves that the industrial structure of the region is slowly upgrading. When Y approaches 3, the industrial structure of the region is rapidly upgrading.

From the perspective of trends, the proportion of the secondary industries in the countries along the “Belt and Road” has emerged from the typical inverted “U” curve structure. Prior to 1980, the proportion of secondary industries in these countries continued to rise and reached an average high of 38.4% in 1980. After that, the proportion of service industries showed a relatively downward trend (Figure 3). According to our calculation of advanced industrial structure indicators, from 2000 to 2018, the average industrial structure advanced index of the countries along the “Belt and Road” has steadily climbed from 2.42 to a higher position of 2.54. From the distribution point of view (Figure 4), as of 2018, the countries with relatively advanced industrial structures are Cyprus, Israel, Greece, and Singapore. Uzbekistan, not only, Indonesia, etc. have relatively developed agriculture and relatively primary industries.

4. Empirical Test of Human Capital Promoting Industrial Upgrading

Based on the analysis above, the countries along the “Belt and Road” are in a state of continuous improvement, both in terms of the quantity of human capital and the quality of human capital. At the same time, the industrial structure is also in the process of continuous upgrading.

According to the general theory of human capital and industrial upgrading, in the process of globalization promoting industrial upgrading, the quantity and quality of human capital determine the pace and rhythm of industrial upgrading to a certain extent. On the one hand, the amount of human capital determines the factor endowment. With their young labor structure, emerging market countries have natural advantages in undertaking labor-intensive industries, thereby accumulating funds and experience for industrialization. On the other hand, the quality of human capital plays a pivotal role in attracting foreign investment and promoting technological absorption and conversion. Therefore, a theoretical hypothesis needs to be tested: **Human capital determines the industrial structure**. The extended assumption is that the age structure and quality structure of human capital determine the structure of industrial upgrading.

Therefore, this paper designs the measurement model as follows:

$$\begin{aligned} \text{StrInd}_t = & \alpha_0 + \alpha_1 \text{Quantity}_t + \alpha_2 \text{Quality}_t + \alpha_3 \text{NI}_t \\ & + \alpha_4 \text{FDI}_t + \alpha_5 \text{HtEx}_t + \alpha_6 \text{StrInd}_{t-1} + \varepsilon \end{aligned}$$

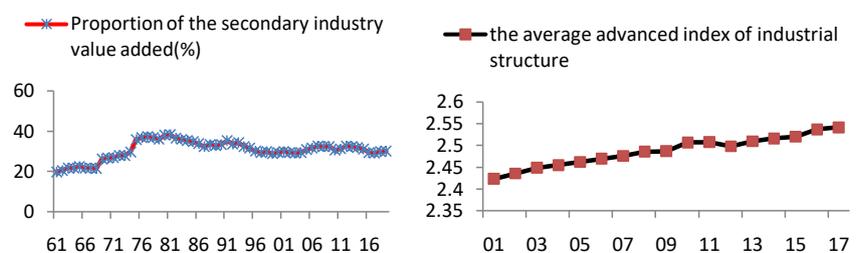


Figure 3. Proportion of the secondary industry value-added and the average advanced index of industrial structure of the “Belt and Road” countries. Source: *World Bank Data*.



Figure 4. The advanced index of industrial structure of the “Belt and Road” countries in 2018. Source: *World Bank Data*.

Among them, StrInd represents the level of the industrial structure, and t represents time. The independent variable Quantity represents quantitative indicators of human capital, and Quality represents quality indicators of human capital. Three control variables are introduced, namely per capita national income (NI), international direct investment (FDI), and export of high-tech products (HtEx). In addition, considering that the advanced process of the industry is a gentle process, and in order to improve the explanatory power of the model, this paper has added a lagging period StrInd_{t-1} to the independent variables.

In the measurement process, the following statistical reference data are used to refer to:

1) Advanced Index of Industrial Structure: As mentioned above, it is the weighted sum of industrial structure indicators. The data comes from the World Bank’s WBD database and CEIC.

2) The amount of human capital: In order to unify the dimensions, use the proportion of the working age population to refer to. The greater the proportion of the working-age population, the better it is to use the comparative advantages of the labor force and promote industrial upgrading, so it is expected that its parameter sign should be positive.

3) The quality of human capital: Considering that secondary education has greater economic growth in the “Belt and Road” countries, the indicator of junior high school enrollment is used. The higher the average education level, the more conducive to the absorption, diffusion, and innovation of science and technology. Therefore, its parameter sign is expected to be positive.

4) National income (NI): National income per capita represents the level of economic growth of a country. According to Kuznets’ theoretical hypothesis, the higher the national income, the higher the industrial structure should be, so the sign of the expected parameter is positive.

5) International direct investment: The purpose of international direct investment is to make use of the endowment of the host country or to seek new markets. Generally speaking, it contributes to the advancement of the industrial structure; however, when human capital is low, it can also cause industrial “Low-end lock”. Therefore, the theoretical relationship between FDI and indus-

trial structure is uncertain, and is used here as a control variable.

6) Export of high-tech products: refers to the proportion of exports of high-tech products.

The above data comes from the World Bank WDI database and CEIC. Due to the lack of data in some years, this paper adopted linear interpolation. And in order to avoid drastic fluctuations in the data, eliminate possible heteroscedasticity, and not affect the long-term stable relationship between the variables, after the data is collected, the control variables NI and FDI are logarithmically processed.

Sample selection: From the perspective of data availability, this paper selected 44 sample countries, namely Bangladesh, Belarus, Bhutan, Brunei Darussalam, Bulgaria, Croatia, Cyprus, Czech Republic, Arab Republic of Egypt, El Salvador, Estonia, Greece, Hungary, India, Indonesia, Islamic Republic of Iran, Israel, Jordan, Kazakhstan, Kyrgyzstan, Laos, Latvia, Lithuania, Northern Macedonia, Malaysia, Moldova, Nepal, Pakistan, Philippines, Poland, Romania, Russia Federation, Saudi Arabia, Serbia, Singapore, Slovak Republic, Slovenia, Sri Lanka, Thailand, Turkey, Ukraine, United Arab Emirates, Uzbekistan, Vietnam.

Time span: Considering the comprehensiveness and availability of data coverage, 1995-2018 was selected.

Using STATA to perform fixed-effect regression on the 14-year data of the above 44 countries, the regression results of the model are as follows:

The regression results (Table 1) show that the impact of the quantity and quality of human capital on the advanced structure of the industry is positive, and the impact is significant, consistent with the theoretical assumptions. In addition, the effects of national income, FDI, and high-tech product exports on industrial upgrading in the control variables are basically positive, which is in line with theoretical reasoning³.

Table 1. The Estimation of key coefficient.

| Dependent Variable | Coefficient | t-Statistic | Prob. |
|-----------------------|-------------|---------------------|--------|
| C | 0.293458 | 8.14 | 0.000 |
| Quantity | 0.1221048 | 4.63 | 0.000 |
| Quality | 0.0000304 | 3.09 | 0.002 |
| NI | 0.0054654 | 2.96 | 0.003 |
| FDI | 0.0066148 | 3.18 | 0.002 |
| HtEx | 0.0001626 | 9.37 | 0.000 |
| StrInd _{t-1} | 0.8635762 | 63.19 | 0.0034 |
| $R^2 = 0.8912$ | | D-W stat = 0.184717 | |

³In order to test the robustness of the model, this paper sorted 44 countries according to the level of per capita national income in 2000 and automatically divided them into two groups. The regression results show that the amount of human capital and the quality of human capital have a positive impact on the advancement of industrial structure. And still significant. Due to space limitations, it will not be expanded here.

The results of empirical analysis show that the amount of human capital and the quality of human capital do have an impact on the high-level industrial structure. Moreover, the coefficient of the labor force indicator (age structure) is 0.12, which is much larger than the labor force indicator (education level). This means that at the current stage of economic development, compared with the level of education, the industrial structure is more sensitive to changes in the age structure of the labor force. This is somewhat similar to the research by [Petrakis and Stamatakis \(2002\)](#).

5. Conclusions and Policy Recommendations

In theory, human capital has a significant role in promoting the upgrading of the industrial structure. By combing the industrial structure and human capital structure of the “Belt and Road” countries, this paper uses panel data to prove that in the “Belt and Road” countries, the mathematics and quality of labor forces have significantly promoted industrial upgrading. Therefore, in order to promote the continuous upgrading of the industrial structure and the sustainable development of the “Belt and Road” construction, we have the following policy recommendations:

1) Further open up and give full play to the advantages of the “Belt and Road” countries in the endowment of labor factors. According to the theory of “new structural economics” proposed by [Lin \(2012\)](#), in order to give full play to its advantages in terms of labor force, relevant governments should fully promote their economic development and industrial structure optimization and adjustment through industrial policies. There are two types of industrial policies, one is positive and supportive, such as subsidies and government procurement, while the other is negative and inhibiting, such as strict market access, price limits and salary standard. Relevant countries should comprehensively use these policies to prioritize the development of labor-intensive industries

2) Due to the low level of overall economic development of the countries along the “Belt and Road”, the number of labor forces at this stage has a stronger driving force for industrial upgrading. However, in reality, due to the existence of institutional barriers such as culture, religion, and law, the unemployment rate, especially the structural unemployment rate, in the “Belt and Road” countries is relatively serious ([Zhang & Liu, 2017](#)). Therefore, these institutional obstacles should be actively removed, including strengthening the education of the national common language, increasing vocational education and vocational training, and doing a good job of legal protection and social relief.

3) Looking into the future, with the improvement of the economic level of the countries along the “Belt and Road”, it is expected that the quality of labor force will have an increasing impact on the upgrading of the industrial structure. Therefore, in the long run, while the “Belt and Road” governments attach importance to secondary education at this stage, they should also pay attention to higher angles and training of senior technicians. In order to upgrade the indus-

trial structure in the future, do a good job of human capital reserves. These measures include increasing the scale of education investment and improving the construction of educational infrastructure; strengthening international cooperation to attract talents through the education of international students; and fostering skilled labor through industrial training.

The innovation of this article is to use the data of the “Belt and Road” countries to test the relationship between human capital and industrial upgrading. The shortcoming lies in the lack of a more detailed and in-depth discussion of related theoretical mechanisms. Moreover, the implementation of the “Belt and Road” initiative requires concrete analysis of specific issues and targeted measures. Therefore, the heterogeneity of the countries is also the direction that the author needs to further study.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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