Poverty Reduction Effect of Chinese Aid and Investment in the Belt and Road

Yuan Zhang*

China contributes to poverty reduction in developing countries along the Belt and Road (B&R) by the way of aid and investment, taking infrastructure construction as a break through and state-owned capital as the main force. The empirical study of the B&R countries' panel data of 2000–2017 shows that Chinese aid and investment help to reduce poverty rate, and there is a threshold effect between investment and poverty rate reduction. When the per capita GDP level is below the threshold value, the poverty reduction effect of Chinese investment is more significant. Different types of aid and investment generate different poverty reduction effects: construction project investment and green land investment have more significant effects, and poverty reduction mechanism based on infrastructure construction has better poverty reduction effect than transfer payment aid. The correlation between state-owned enterprise investment and poverty rate reduction is significant, and state-owned capital plays an important role in poverty reduction in the B&R developing countries. The research also finds that poverty reduction effect of Chinese aid and investment is realized mainly by capital formation and job creation in these countries.

Keywords: foreign aid, investment, poverty reduction, the Belt and Road

1. Introduction and Literature Review

Since the 1980s, along with the promotion of reform and opening-up and the implementation of large-scale poverty reduction plan, China has achieved significant achievement in poverty reduction. The proportion of absolute poor has declined from 61% in 1990 to 30% in 2002, and goes below the world average level in 2011 (as shown in Figure 1), which contributes more than 70% of the global poverty reduction (The World Bank, 2016). China's tremendous achievement in poverty alleviation[1]

* Yuan Zhang (email: zhangyuan5566@163.com), Associate Professor in China University of Labor Relations. Fund projects: National Social Science Fund "Research on Liquidity Risk and Optimum Classified Management Model of China's Foreign Exchange Reserve" (17BJY199); National Social Science Fund "The Challenges and Paths of China-US Communist Party in Promoting the Reform of Global Economic Governance System" (16BGJ007). The author thanks the reviewers for their constructive opinions and takes responsibility for the article.

[1] "Poverty reduction" and "poverty alleviation" are interchangable in this paper, without other specification.

has won the high praise from the world and provides a "Chinese-style scheme" for the anti-poverty practice of neighboring developing countries. In 2013, President Xi Jinping proposed the "Silk Road Economic Belt" and "Maritime Silk Road in twenty-first Century", the cooperation and development between China and countries along the Belt and Road have been increasingly strengthened. However, in term of per capital GDP, industrialization level, proportion of agricultural population and infrastructure level, most of the countries along the Belt and Road[1] are still developing countries, and anti-poverty is still an important task faced by these countries.

Taking the Belt and Road Initiative as the opportunity, China actively links the development strategy of the countries along the route, and shoulders the responsibility of poverty alleviation. According to the historical data, China's total aid to the Belt and Road gradually stabilized to about 50% of China's global aid (as shown in Figure 5) after the 2008 of financial crisis, and China's investment in the countries along the Belt and Road has risen rapidly to about 80% of the total investment since 2013 (as shown in Figure 6). As China has gradually become the most important aid and investment country in the Belt and Road, the actual poverty alleviation effect of aid and OFID needs to be assessed. What is the mechanism of poverty alleviation in the cooperation between China and countries along the Belt and Road? Is it simply "giving the fish" or "teaching how to fish" to enhance the ability of poverty alleviation of recipient countries? What are the effect and influence channels? All these problems need to be analyzed in depth.

This paper has the following innovations from three aspects. First, this paper elaborates the basic logic of dual mechanism of China's aid and investment to promote the poverty alleviation of the Belt and Road. The single aid perspective has replaced by the integration framework of aid and investment, which studies the core role of poverty alleviation of infrastructure aid and investment in the Belt and Road, the leading role of state-owned capital, as well as the two-way promotion role of poverty alleviation at home and abroad. The second innovation is the empirical research. This paper contributes an empirical model of poverty alleviation of China's aid and investment in the Belt and Road, and uses the panel data of countries along the Belt and Road from 2000 to 2017 with the method of system GMM and threshold regression to analyze the actual poverty alleviation effect of aid and investment, to examines the possible threshold effect of investment, and compares the differences and causes of poverty alleviation effect of different types of aid and investment. Thirdly, the intermediary effect model is used to

[1] Since the the Belt and Road initiative was proposed, the number of countries that respond to the initiative has increased year by year. The statistics on the basis of participating countries would have the comparability problems in different years. Therefore, the concept of the Belt and Road in this paper is defined as the countries along the Belt and Road, which is based on the geographic route of "vision and action for promoting the construction of Silk Road Economic Belt and maritime Silk Road in twenty-first Century" issued by the National Development and Reform Commission, Ministry of Foreign Affairs and Ministry of Commerce in 2015, as well as countries that signed the cooperation agreement with China as of December 2017.

study the channels and mechanism of poverty alleviation of China's aid and investment to analyze their roles in capital accumulation and employment creation, which outlines the main paths for China's aid and investment to "teach how to fish".

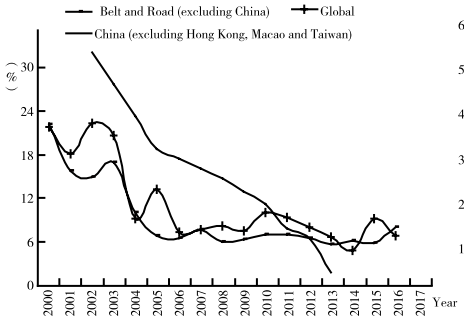

Figure 1. The Proportion of Poor People with the Living Cost below $1.9

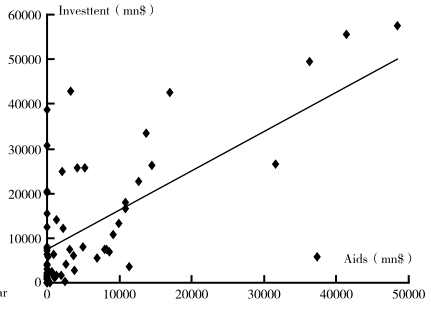

Figure 2. China's Aid and Investment on the Belt and Road

Sources: The data of proportion of poor is from the World Bank database and the data of foreign aid is from AidData of William Mary College in the United States. The data of outward investment is from the China Global Investment Tracker (CGIT), which excludes China's investment in Hong Kong, Cayman Islands, Virgin Islands and Bermuda. The charts and other data in the paper are from the above databases without special explanation.

2. The Mechanism of Poverty Alleviation of Chinese Aid and Investment in the Belt and Road: Statistical Observation

2.1. Promoting Poverty Reduction through both Aid and Investment

China has a long history of helping the developing countries along the Belt and Road. However, limited by the stage and capability of China's economic development, the total size and number of recipient countries before 1990s were relatively small. After 2000, it began to increase significantly. The first selected target country along the Belt and Road that China aids and invests is the traditional friendly country that needs poverty alleviation with less resistance. The main recipient country has gradually become investment host country, which shows a trend of expanding from point to panel. At present, China's aid and investment have a positive correlation in many countries that along the Belt and Road (as shown in Figure 2).

From the perspective of the flow of aid and investment, poverty alleviation is an important goal of China's cooperation with countries that along the Belt and Road. Since countries with high economic development level are not the main targets of aid, who receive less than 20% of China's total aid and investment. China's aid mainly moves to the poor countries, which leads to the negative relationship between aid and the GDP per capita. Investment also has similar characteristics. In countries with GDP per capita below

the median level, China's investment is also negatively correlated with host country's GDP per capita, as well as with the infrastructure, manufacturing and capacity cooperation investment. In countries with GDP per capita above the median level, China's investment accounts for 47.7%, and there is no such negative correlation. The "threshold effect" with the per capita GDP as the watershed indicates that China has different investment targets in different countries along the Belt and Road. Investment in developing countries has significant aid characteristics, which indicates that aid and investment simultaneously are important ways to promote poverty alleviation in these countries.

2.2. Relying on Infrastructure Construction to Promote Development-Oriented Poverty Alleviation

The causes of poverty in countries along the Belt and Road are different and there are also various ways to alleviate poverty. From the perspective of traditional international aid system, growth theory (economic growth promoting poverty alleviation), trade promoting theory (international trade promoting poverty alleviation), capacity promoting theory (capacity promoting poverty alleviation) and good governance theory (social system reform promoting poverty alleviation), to a certain extent, have all influenced the poverty alleviation ideas of these countries (Sebastian, 2015). China promotes the development of countries along the Belt and Road by the way of aid and investment, which is an innovation and exploration of existing aid system. The practice of poverty reduction in many countries and relevant international organizations over the years has also shown that direct transfer payments are usually difficult to achieve sustainable and effective poverty alleviation. However, raising the income levels by increasing employment opportunities and sharing the benefits of growth by participating in the process of economic growth are more effective in poverty alleviation (Jalilian and Weiss, 2002; Ye, 2005).

However, due to economic and geographical constraints, backward countries along the Belt and Road have long been constrained by the "poverty trap" formed by inadequate infrastructure. Self-help and development-based poverty alleviation mechanisms could not be effectively launched. From the perspective of the effect of poverty alleviation, infrastructure construction goes ahead of the rest, which includes road construction, water supply, agricultural water conservancy, and even power supply, communications and other fields. These infrastructures require large-scale and sustained investment, and they are not favored by private capital due to the low return and long payback period. According to the estimates of the Asian Development Bank, only if the annual investment in infrastructure such as transportation, water, electricity and communications in Asian economies between 2016 and 2030 would have the scale of 1.7 trillion US dollars and the total investment exceeds $26 trillion, the world average level could be achieved. However, the actual investment is only half of the demand

(Asian Development Bank, 2017). It is harder for the countries along the Belt and Road to bear, and the primary bottleneck of poverty reduction could not be solved. As a typical positive externality public good, infrastructure is essential in promoting the development of manufacturing, as well as other energy of resources. Local and foreign private capital prefer to invest countries with better infrastructure, which increases the employment opportunities and income, and further promotes the improvement of the investment environment and poverty alleviation is put on a sound track. For the countries with low infrastructure level, the shortage of private investment leads to the inadequate job opportunities, which results in a vicious circle of economic development.

2.3. Joint Mechanism of Government and Market

It is due to the large demand of infrastructure, high difficulty in development and low participation in private capital, state power has become the most important force in China's aid and investment in countries along the Belt and Road. At the same time, it is also the outward extension of the institutional advantages of "China-style poverty alleviation" (Zhang and Xu, 2016; Wang *et al*., 2017). These factors objectively determine the scale and duration of investment in China's state-owned capital.

From the perspective of investment, state-owned capital plays a major role, and the role of non-state-owned capital has also increased. In 2005, 98% of China's total investment in the Belt and Road came from state-owned enterprises. The proportion of state-owned enterprises accounted for 93.8% and almost all investments came from state-owned capital. In the rest of the world except for countries along the Belt and Road, the above two values were 87.8% and 80% respectively. In 2017, the share of state-owned investment in the Belt and Road dropped to 59.7% and the share of number of state-owned enterprise dropped to 62.9%, which is still higher than that of non-state-owned enterprises. In other parts of the world, non-state capital began to take the lead after 2015 (as shown in Figure 3). China's investment in the Belt and Road is still dominated by state-owned capital, but the trend towards diversification has gradually emerged.

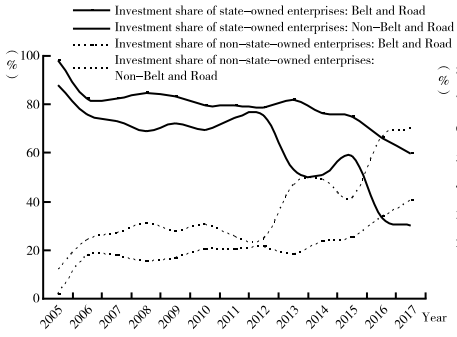

Figure 3. Investment Shares of Different Types of Chinese Enterprises in Different Areas

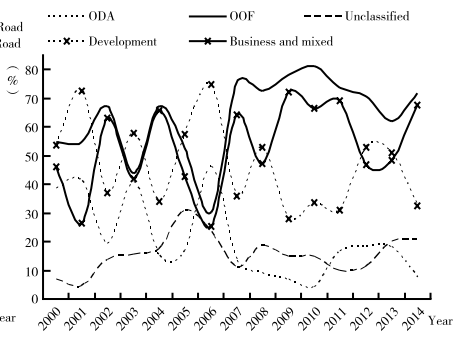

Figure 4. Proportion of Different Types of Foreign Aid Fund

3. Empirical Study on Poverty Alleviation of Aid and Investment: Analysis of the Effect of "Teaching How to Fish"

3.1. Econometric Method

China contributes to poverty alleviation in developing countries along the Belt and Road by the way of aid and investment, taking infrastructure construction as a breakthrough and state-owned capital as the main force. Whether this method of poverty alleviation could produce practical results needs to be evaluated by the empirical evidence. In order to further analyze the impact of China's aid and investment on poverty alleviation in the countries along the Belt and Road, this paper constructs an econometric model on the basis of model of Gohou and Soumaré (2012) and Collier and Dollar (1999):

$$POVR_{it} = \mu + \alpha_0 AID_{it} + \cdots + \alpha_T AID_{it-T} + \beta_0 OFDI_{it} + \cdots + \beta_T OFDI_{it-T} + \theta X_{it} + \varepsilon_{it} \quad (1)$$

$$POVR_{it} = \mu + \sum_{m=1}^{M}(\alpha_0 AID_{it}^{m} + \cdots + \alpha_T AID_{it-T}^{m}) + \sum_{n=1}^{N}(\beta_0 OFDI_{it}^{n} + \cdots + \beta_T OFDI_{it-T}^{n}) + \theta X_{it} + \varepsilon_{it} \quad (2)$$

In order to avoid the errors of index of per capita GDP or per capita income caused by the gap between rich and poor on measaring poverty, this paper uses the proportion of the poor population ($POVR_{it}$) as the dependent variable. Equation (1) mainly investigates the impact of China's total amount of aids (AID_{it}) and investment ($OFDI_{it}$) on the proportion of the poverty-stricken population, and i represents country while t represents time. Since there may be delays in the effect of aid and investment on poverty alleviation, current term and the earlier 1~T term of the index are also included in the regression analysis. The equation (1) also includes other factors X_{it} that affect the proportion of poor population, such as aids and investments received by other countries, net exports from other countries, capital formation per capita, unemployment rate, proportion of agricultural population, industrialization stage and location. Equation (2) further examines the poverty alleviation effects of m-types aid and n-types investment. The aids are divided into ODA and OOF to examine the difference of poverty alleviation effect between different types of aid while the investments are divided into project contract investment, green land investment and other direct investment to observe the difference between infrastructure investment and other types of investment. At the same time, this paper distinguishes the investment of state-owned enterprises and non-state-owned enterprises to analyze the poverty alleviation effects of different types of capital ownership, which could verify the effectiveness of cooperative poverty alleviation promoted by national forces.

There may be endogeneity or simultaneity bias between aid and poverty rate, which

is mainly solved by theoretical analysis and econometric models. First, aid-oriented investment may prefer to less developed countries, and it only accounts for a part of global outward investment. It can be seen from the trend of different types of aid funds in China in recent years (as shown in Figure 4) that since 2008, the share of aid-oriented development funds has been lower than that of commercial and mixed types in most years, and ODA funds have also been lower than that of OOF funds in the same period. There is no significant negative relationship between China's investment and per capita GDP of developed countries. Second, this paper uses the method of SYS-GMM with the lag terms as tool variables, which could be conducive to solve the possible endogenous problems. Regression analysis will test the problem of insufficient identification, excessive identification and weak instrumental variables, and adopt the one whose test is significant.[1]

The statistical observation shows that China's choice of recipient country along the Belt and Road is more diversified. The aid-oriented investment is mainly distributed in the less developed countries along the Belt and Road. There may be the threshold effect with per capita GDP as the watershed. The threshold regression model is further used to analyze the poverty alleviation effect (Hansen, 1999) with per capita GDP ($PERGDP_{it}$) as the threshold variable and invest as the main variable:

$$POVR_{it}=\alpha_0+\alpha_1 OFDI_{it}(PREGDP_{it}\leqslant\psi)+\alpha_2 OFDI_{it}(PREGDP_{it}>\psi)+\theta X_{it}+\varepsilon_{it} \quad (3)$$

ψ is the threshold of per capita GDP, and X_{it} is the other factor that affects poverty rate, which is same with equation (1) and (2).

3.2. Data Description

The data of regression analysis are mainly from College of William and Mary's "aid data" (Aid Data) and China's foreign investment tracking data (CGIT). The former includes China's data of 5466 projects that China aids 141 countries or regions in the world while the latter contains data of 2933 projects that China invests in 151 countries or regions in the world. The data of China's aid and investment in the countries along the Belt and Road is extracted from the database. Data on the proportion of poor people, net global aid and investment, import and export, per capita capital formation, per capita GDP, unemployment rate, proportion of agricultural population, and employment of three industries were mainly derived from the World Bank database, which forms the panel data of 62 countries along the Belt and Road from 2000 to 2017.

[1] There is no definite conclusion on whether SYS-GMM could solve the endogenous problem. Babajide, James and Jeffry (2012) hold the relatively optimistic conclusion that GMM could solve the heterogeneity and simultaneity errors. In the absence of better tool variables, SYS-GMM method may be more effective.

The distribution among ASEAN, Western Asia, South Asia, Central Asia, CIS, Central and Eastern Europe and other countries are 16.1%, 24.2%, 11.3%, 8.1%, 8.1%, 19.4% and 12.9% respectively. Proportion of countries that in the prime stage, mid-stage, late-stage of industrialization and post industrialization is 21.2%, 25.7%, 47.0% and 6.1% respectively (Zhang and Liu, 2017).

From the perspective of the overall size of aid and investment, China's aid and investment in the countries along the Belt and Road were basically flat before 2010. At the same time, the amount of aid even exceeded the amount of investment in some years, but the growth trends of aid and investment appeared to be divergent in that the growth rate of investment was obviously accelerated with the total amount rapidly exceeded the amount of aid. Before the financial crisis in 2008, China's aid to countries along the Belt and Road accounted for a relatively high proportion of China's global aid, which accounted for 86% in the peak period, then gradually dropped to below 30% and picked up again during the financial crisis in 2008, but continued to decline slowly and gradually stabilized (as shown in Figure 5). Overall, the amount of China's aiding in the Belt and Road shows a downward trend while that of investment shows a steady or slight increase. Since 2013, the proportion of investment stocks has increased significantly and 80% of the global investment stock of China is concentrated in the countries along the Belt and Road (as shown in Figure 6), which shows that investment may play a more important role in poverty alleviation than aid. From the perspective of national distribution of funds, the total number of countries along the Belt and Road that receive aid and investment is rising, but the growth of investment is more significant than aid. The concentration of aid and investment R_5 in China declined from 89.0% in 2005 to 47.3% in 2017, and R_{10} also declined by about 28%. [1]The concentration of aid distribution is higher than that of investment on the whole, but there is also a downward trend, which indicates the increasing of number of country and scale of funds.

3.3. The Impact of Aid and Investment on Poverty Rates

The preliminary regression of OLS shows that China's aid and investment could reduce the proportion of poor people with the lag effect (as shown in Table 1). This paper uses the system GMM method with the aid and investment, net exports, unemployment rate, proportion of agricultural population and per capita capital formation as the explanatory variables, and the estimated values of AR (1) and AR (2) showed that there was only one-order sequence correlation in the residual error, and the random error term of the model has no correlation. Therefore, the model

[1] The algorithm of R_5 is the proportion of the sum of China's investment funds in the top 5 countries in the total investment of China in the Belt and Road, while R_{10} is the top 10 countries.

was reasonable. The regression results show that poverty rate is relatively high in the countries along the Belt and Road that with the high unemployment rate, large agricultural population, and low per capita capital level. China's aid and investment has the effect of poverty alleviation with aid lagging for two years and investment lagging for one year. The comparison between the correlation coefficients of aid and investment shows that the latter plays a slightly higher role than former. However, the global aid and investment (except for China) have no significant impact on poverty alleviation.[1] Two reasons may lead to the conclusion.

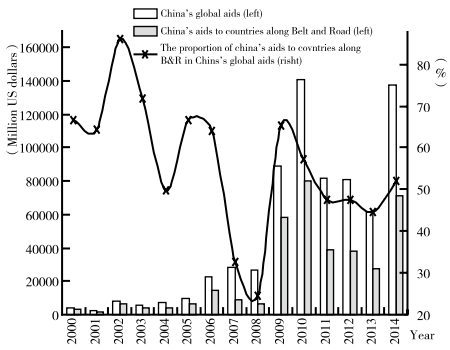

Figure 5. The amount of Chinese aids along the Belt and Road and in Global

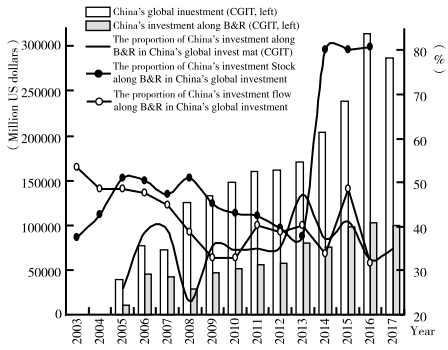

Figure 6. The amount of Chinese investmant along the Belt and Road and in Global

Source: The data of the proportion of China's investment stock and flow in countries along the Belt and Road in the global investment is from China's foreign direct investment statistics bulletin (2004–2017). To make it comparable with CGIT data, investments in Hong Kong, the Cayman Islands, the Virgin Islands and Bermuda were eliminated.

First, there are differences in the role of poverty alleviation among different types of aid. In addition to China, the international aid in the countries along the Belt and Road mainly comes from the official development aid (ODA) of the "North South aid" system. These aids are mostly concentrated in the fields of children's education, women's rights, environmental protection, medical and health care, while China's aid focuses on infrastructure, productive cooperation and other fields. The former's role in material capital accumulation and employment promotion is not very obvious and it mainly affects the economic growth through human capital and more long-term social

[1] To answer the question whether this phenomenon is caused by the multiple collinearity between variables and aid and investment, this paper uses the method of variance inflation factor (VIF) with the correlation coefficient of variables. The results show that the correlation coefficient between China's aid and global aid (except China) is 0.501 while the coefficient between China's investment and global investment (except China) is 0.329. VIF test found that VIF value of global aid (except China) was 4.63 (average), VIF value of global investment (except China) was 2.71 (average), and the overall VIF value of equation was 4.15 (average), which indicates that there is no serious multi-collinearity problem.

Table 1. Regression Results of Poverty Alleviation Effect of Chinese Aid and Investment

		Poverty rate(OLS)			Poverty rate(GMM)				Poverty rate (threshold regression)				
China's total aid	t	0.02			0.06				–0.07				
		(0.08)			(0.24)				(–0.31)				
	t-1	–0.07			–0.02				–0.18				
		(–0.34)			(–0.10)				(–0.79)				
	t-2	–0.40***			–0.38**		–0.41**		–0.40**		–0.39**		
		(–2.93)			(–1.94)		(–2.14)		(–2.22)		(–2.21)		
China's aid:ODA	t		2.28	3.05		2.42	2.41			2.65	3.23		
			(1.01)	(1.06)		(1.29)	(1.25)			(1.54)	(1.38)		
	t-1		–0.26	–0.22		–0.05	0.17			–0.18	0.23		
			(–0.16)	(–0.13)		(–0.03)	(0.10)			(–0.12)	(0.14)		
	t-2		2.09	1.68		3.12	2.71	2.19	2.11	0.54	1.43	0.71	1.42
			(0.49)	(0.40)		(0.99)	(0.85)	(0.70)	(0.67)	(0.17)	(0.46)	(0.23)	(0.46)
China's aid:OOF	t		–0.24	–0.33*		–0.20	–0.30*			–0.27	–0.26		
			(–1.15)	(–1.80)		(–0.71)	(–1.06)			(–1.01)	(–0.99)		
	t-1		0.05	–0.02		0.10	0.01			–0.03	–0.01		
			(0.18)	(–0.08)		(0.37)	(0.04)			(–0.12)	(–0.05)		
	t-2		–0.42***	–0.47***		–0.42**	–0.46**	–0.44**	–0.46**	–0.37*	–0.36*	–0.36*	–0.33*
			(–2.60)	(–2.77)		(–1.99)	(–2.14)	(–2.13)	(–2.18)	(–1.84)	(–1.77)	(–1.88)	(–1.69)
China's total investment	t	0.02			–0.21				–0.01				
		(0.09)			(–0.53)				(–0.04)				
	t-1	–0.40*			–0.56*		–0.57*		main variable rx		main variable rx		
		(–1.61)			(–1.58)		(–1.67)						
	t-2	–0.03			–0.20				–0.28				
		(–0.05)			(–0.46)				(–0.70)				
China's investment: Engineering contract	t		–0.08			–0.43				0.25			
			(–0.13)			(–0.62)				(0.36)			
	t-1		–0.81*			–1.03*		–0.92*		main variable rx		main variable rx	
			(–1.87)			(–1.70)		(–1.59)					
	t-2		–0.26			–0.54				–0.42			
			(–0.37)			(–0.96)				(–0.73)			
China's investment: Greenland	t		0.68			0.43				2.45			
			(0.34)			(0.24)				(1.34)			
	t-1		–1.97*			–2.43*		–2.04*		–2.15*		–1.35*	
			(–1.70)			(–1.53)		(–1.51)		(–1.63)		(–1.52)	
	t-2		–3.06			–3.39*				–1.38			
			(–1.23)			(–2.13)				(–0.87)			
China's investment: Direct investment	t		0.22			0.72				–1.54			
			(0.18)			(0.64)				(–1.33)			
	t-1		0.48			0.72		0.67		0.01		0.13	
			(0.46)			(0.75)		(0.71)		(0.01)		(0.14)	
	t-2		1.73			1.05				0.60			
			(0.84)			(1.06)				(0.60)			
China's investment: State-owned enterprise	t			–0.02			–0.26				–0.17		
				(–0.07)			(–0.68)				(–0.44)		
	t–1			–0.43*			–0.63*		–0.34*		main variable rx		main variable rx
				(–1.75)			(–1.76)		(–1.47)				
	t-2			–0.05			–0.31				–0.42		
				(–0.07)			(–0.69)				(–0.98)		

		Poverty rate(OLS)				Poverty rate(GMM)					Poverty rate (threshold regression)					
China's investment: Non state-owned enterprise	t			2.24			2.76						2.72			
				(1.13)			(1.30)						(1.44)			
	t-1			–0.94			–0.35			–0.86			0.05			–0.28
				(–0.81)			(–0.22)			(–0.55)			(0.03)			(–0.19)
	t-2			–1.50			–0.85						–0.24			
				(–1.20)			(–0.55)						(–0.17)			
Global total aid	t	0.02	–0.38	0.12	–0.07	0.09	0.00				0.06	0.31	0.17			
		(0.03)	(–0.34)	(0.20)	(–0.10)	(0.13)	(0.00)				(0.10)	(0.46)	(0.25)			
	t-1	0.51	0.17	0.32	0.43	0.22	0.25				0.89	0.67	0.60			
		(0.38)	(0.26)	(0.22)	(0.35)	(0.18)	(0.20)				(0.82)	(0.60)	(0.55)			
	t-2	–0.30	0.41	–0.23	–0.49	–0.42	–0.42	–0.22	0.22	0.16	–1.17	–1.43	–1.02	–0.54	–0.61	–0.46
		(–0.28)	(0.30)	(–0.21)	(–0.45)	(–0.39)	(–0.40)	(–0.45)	(0.43)	(0.32)	(–1.14)	(–1.37)	(–1.00)	(–0.74)	(–0.83)	(–0.62)
Global total investment	t	0.09	0.01	0.08	0.09	0.06	0.08				0.05	0.00	0.04			
		(1.09)	(0.26)	(1.14)	(1.13)	(0.80)	(0.97)				(0.69)	(0.05)	(0.46)			
	t-1	–0.04	–0.02	–0.02	–0.04	–0.02	–0.01	0.04	0.04	0.04	–0.05	–0.03	–0.03	–0.03	–0.03	–0.02
		(–0.82)	(–0.37)	(–0.31)	(–0.43)	(–0.23)	(–0.16)	(0.79)	(0.69)	(0.70)	(–0.62)	(–0.39)	(–0.38)	(–0.34)	(–0.37)	(–0.22)
	t-2	0.02	0.07	0.03	0.04	0.02	0.04				0.02	0.02	0.03			
		(0.46)	(1.42)	(0.70)	(0.49)	(0.30)	(0.57)				(0.30)	(0.24)	(0.44)			
Net export	t	0.08*	0.01	0.07	0.07*	0.08	0.08				0.06*	0.01	0.03			
		(1.39)	(1.15)	(1.20)	(1.44)	(0.77)	(0.90)				(1.53)	(0.02)	(0.65)			
	t-1	–0.04*	–0.02*	–0.01	–0.03	–0.02	–0.02	0.04*	0.03	0.03	–0.02*	–0.01	–0.01	–0.02*	–0.01	–0.01
		(–1.93)	(–1.39)	(–0.74)	(–1.31)	(–0.53)	(–0.36)	(1.76)	(1.07)	(0.99)	(–1.55)	(–0.43)	(–0.29)	(–1.44)	(–0.77)	(–0.62)
	t-2	0.01	0.02	0.01	0.03	0.02	0.03				0.02	0.02	0.03			
		(0.51)	(0.98)	(0.67)	(0.52)	(0.78)	(0.60)				(0.34)	(0.44)	(0.19)			
Per capita capital	t	0.26	0.21	0.23	0.08	0.01	0.09									
		(0.59)	(0.47)	(0.52)	(0.13)	(0.02)	(0.14)									
	t-1	–0.04*	–0.67*	–0.61*	–0.58*	–0.64*	–0.56	–0.42***	–0.30*	–0.29*						
		(–1.35)	(–1.50)	(–1.48)	(–1.91)	(–1.42)	(–1.35)	(–2.56)	(–1.85)	(–1.78)						
	t-2	–0.59	0.015	0.10	0.07	0.017	0.03									
		(–0.07)	(0.24)	(0.16)	(0.07)	(0.18)	(0.03)									
Unemployment rate	t	0.14*	0.10*	0.14*	0.14*	0.05	0.13*	0.14*	0.12*	0.14*	0.31*	0.30*	0.31	0.31*	0.30*	0.32*
		(1.79)	(1.39)	(1.48)	(1.41)	(1.32)	(1.37)	(1.33)	(1.32)	(1.39)	(1.68)	(1.62)	(1.35)	(1.68)	(1.66)	(1.41)
Proportion of agriculture population	t	3.48*	3.50*	2.42*	5.95*	6.66*	4.78*	5.92*	3.40*	2.85*	16.23*	15.14*	16.04*	15.38*	16.97*	21.23*
		(1.87)	(1.57)	(1.59)	(1.48)	(1.64)	(1.81)	(1.49)	(1.37)	(1.73)	(1.79)	(1.71)	(1.45)	(1.77)	(1.48)	(1.43)
Threshold effect（rx≤γ）											–2.23***	–2.84***	–2.30***	–2.24***	–2.94***	–2.30***
											(–3.00)	(–3.00)	(–3.10)	(–3.06)	(–3.17)	(–3.17)
Threshold effect（rx>γ）											–0.02	0.32	–0.09	–0.03	0.15	0.05
											(–0.05)	(0.44)	(–0.21)	(–0.08)	(0.22)	(0.13)
Other control variables		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant term		7.81***	7.90***	6.74***	7.67***	8.65***	7.48***	7.75***	9.23***	9.08***	2.33	2.92	2.02	2.72	2.30	0.64
		(3.29)	(3.31)	(2.83)	(2.99)	(3.38)	(2.93)	(3.11)	(3.78)	(3.71)	(0.37)	(0.45)	(0.31)	(0.46)	(0.38)	(0.10)
AR(1)					–1.16	–1.07	–1.43	–1.21	–1.65	–1.09						
					(0.91)	(0.15)	(0.68)	(0.32)	(0.81)	(0.27)						
AR(2)					–0.89	–0.09	–0.45	–0.31	–0.21	–0.14						
					(0.17)	(0.03)	(0.21)	(0.10)	(0.73)	(0.44)						
F		4.30***	3.61***	4.02***	1.99***	1.98***	1.88***	2.94***	3.43***	3.41***	5.02***	4.93***	4.96***	5.17***	5.04***	5.07***
R^2		0.14	0.16	0.15	0.18	0.14	0.13	0.11	0.14	0.13	0.15	0.17	0.16	0.14	0.15	0.14
Sargan					0.98	0.69	0.60	0.80	0.62	1.30						

Notes: ***, *** and * mean *t* value (OLS regression) or *Z* value (GMM regression) that estimates at the significant level of 1%, 5% and 10% respectively. Sargan test indicates the over-identification test of tool variables. Other control variables such as region, industrialization stage and year binary variables are omitted. The unit of aid and investment is billion US dollars.

and environmental construction channels. Therefore, the role of ODA in poverty alleviation needs a long time to be reflected. China's aid is more focused on infrastructure, energy development, product and service production, which may be more consistent with the actual needs and resource endowment characteristics of poor countries, and therefore has a more obvious role in the short-term wealth creation in poor countries. Secondly, investment by both China and other countries around the world is resource, which has the similar role in promoting economic growth in backward regions. However, the capital accumulation, employment increase and economic growth brought by different types of investments have different effects of poverty alleviation. The poor may not obtain the direct "trickle-effect" in the economic growth. The trickle effect of investment and economic growth is different in one country at different stages of development. According to the law of marginal decline of poverty alleviation effect, when the incidence of poverty drops to a certain extent, "trickle effect" would become weaker and weaker. The transnational investment of the developed countries to some countries along the Belt and Road is much earlier than that of China. The western Asian and ASEAN countries are relatively high developed, and among the countries along the Belt and Road, Central and Eastern European Countries that EU invests are also high developed, which leads to the marginal diminishing effects of investment and economic growth. The continued declining of poverty rate is limited. However, the countries that China aids and invests include Central Asia, South Asia and some developing countries in ASEAN, which are not the major recipients of international investment in a long time. It is due to the low level of economic development, large-scale infrastructure, energy and productive investment could produce a more significant poverty alleviation effect.

The threshold regression results show that threshold effect does not exist between aid and poverty rate, while exists between investment and poverty rate. For the countries along the Belt and Road with per capita GDP below the threshold value (US $1450), China's investment can significantly reduce the poverty rate, while in the countries above the threshold value, the poverty reduction effect is not significant. For the state-owned capital, the threshold value of per capita GDP is $1640. Similarly, for the countries along the Belt and Road with GDP per capita below the threshold value, there is a significant negative correlation between the investment in China's state-owned enterprises and the poverty rate.

In further, if different types of aid and investment were included in the regression equation, the results show that OOF has the poverty alleviation effect on countries along the Belt and Road, while ODA has no significant effect on the countries. On the one hand, the overall size of ODA is relatively small and concentrated in distribution with large volatility. On the other hand, the proportions of emergency relief, humanitarian supplies, and debt relief in the ODA funds are relatively high, which is conductive to reduce instantaneous poverty, but the role of sustained poverty

alleviation is relatively limited. At the same time, the alleviation effect of education, environmental protection, health and other funds need to be observed for a longer period of time. The proportion of OOF is relatively high, and with the expansion of the total amount of aid, some OOF projects begin to have the tendency of mix-style aid and investment development. Among the OOF aid in countries along the Belt and Road, the proportion of productive manufacturing, infrastructure, resources, energy, and Commerce and finance is relatively high. Since these OOF aid linked to production, trade and resource development, which is conductive to the continuous improvement of capital stock, job creation, as well as poverty alleviation.

In terms of investment type, the increase of green land investment and contract investment could reduce poverty rate. These two types of investment have the lag period of one-year, and the poverty alleviation of direct investment is not significant. The reason is that China's engineering investment and green investment are mainly based on infrastructure construction, which flows to countries with low social and economic development. However, other types of direct investment are relatively complex, which flows to developed countries that are the important destinations for China's direct investment, such as Singapore, Saudi Arabia, and the United Arab Emirates. Therefore, these investments have no significant effect of poverty alleviation. From the perspective of ownership of investment entities, the role of state-owned enterprises in reducing poverty rate is more significant with a lagging effect, while the non-state-owned enterprises has no significant effect, which is mainly due to the fact that the investment of state-owned enterprises is mainly concentrated in the field of infrastructure, and the investment demand of countries along the Belt and Road for infrastructure is mainly concentrated in developing countries. For private capital, there is a certain gap in the scale, duration, risk, return of infrastructure investment with the investment objectives and capabilities of enterprises. The scale in the field of private capital participation is usually small, while that in the field of business finance and manufacturing is larger. Investment prefer to the countries along the Belt and Road with better infrastructure and business environment, which contributes to the non-significant relationship between investment and poverty alleviation.

4. Empirical Study on Aid and Poverty Alleviation: Path Analysis of "Teaching How to Fish"

4.1. Mediation Effect Model

Regression analysis shows that despite the differences in the poverty reduction effects of different types of aid and investment, China's aid and investment in the less developed areas along the Belt and Road would help reduce the proportion of the poor population as a whole, and per capita capital formation, rise of the non-agricultural

sector population and the decline in unemployment rate would also help reduce the proportion of the poor population. Therefore, capital accumulation and employment creation may be the important channels for the independent poverty alleviation in backward areas. Whether China's aid and investment have the poverty alleviation effect through the above two ways needs to be analyzed by constructing corresponding mediation effect models. Based on the mediation effect test models and basic steps proposed by Bollen and Brand (2010) and Wen and Ye (2014), this paper constructs the following econometric equations:

$$POVR_{it} = \mu + \alpha_T AID_{it-T} + \beta_T OFDI_{it-T} + \theta X_{it} + \varepsilon_{it} \tag{4}$$

$$CAPIT_{it} = \lambda + \lambda_T^1 AID_{it-T} + \lambda_T^2 OFDI_{it-T} + \upsilon_{it} \tag{5}$$

$$EMPLO_{it} = \delta + \delta_T^1 AID_{it-T} + \delta_T^2 OFDI_{it-T} + \tau_{it} \tag{6}$$

$$POVR_{it} = \gamma + \gamma_T^1 AID_{it-T} + \gamma_T^2 OFDI_{it-T} + \gamma_T^3 CAPIT_{it-T} + \gamma_T^4 EMPLO_{it-T} + \gamma_T^5 X_{it} + \eta_{it} \tag{7}$$

The parameters of equation (4) have the same meanings as those in equation (1), λ、δ and γ in the equation (5) to equation (7) are the parameters to be estimated, υ、τ and η are residual terms. $CAPIT_{it}$ and $EMPLO_{it}$ represent the volume of per capita capital formation and employment respectively. Considering the lagging effect in regression of equation (1), as well as the lagging effect of aid and investment on capital formation and employment, the independent variables of 1-T period are still retained in the intermediary model.

The steps to test the mediation effect are as follows. Firstly, the regression analysis of poverty rate is made with China's aid and investment as the core explanatory variables. If the estimation results of parameters α and β in equation (4) were significant, it means there is a mediation effect at China's aid and investment in the poverty alleviation. Otherwise, there would be the concealment effect. Previous study shows that China's aid and investment have a lagging impact on the poverty alleviation, so mediction effect should be considered in the equation. Secondly, equation (5) and (6) with capital and employment as the dependent variable, and with aid and investment as the explanatory variable should be regressed to test whether the increase of China's aid and investment could contribute to the capital formation and employment growth in recipient and host countries. Thirdly, if the λ, δ,γ_T^3 and γ_T^4 were significant in equation (7), it means that the indirect effect would be significant. If γ_T^1 and γ_T^2 were not significant, it means that only mediation effect plays the role, and if significant, it means that both direct and indirect effect play the role of poverty alleviation, in which regression coefficients could be used to test the effect of complete or partial mediation effect. If the regression coefficients of

aid and investment in equation (7) are less than that of equation (4), it shows that capital formation and employment have partial mediation effect. If the regression coefficients of aid and investment in equation (7) were not significant, but those in equation (4) were significant, it shows that capital formation and employment have the function of complete mediation effect. Fourthly, if the regression coefficients of λ, δ, γ_T^3 and γ_T^4 are not all significant, Bootstrap method could be used to test hypothesis H_0: $\lambda_T^1\gamma_T^3=0$、$\lambda_T^2\gamma_T^3=0$、$\delta_T'\gamma_T^4=0$、$\delta_T^2\gamma_T^4=0$. If the hull hypothesis is rejected, then the direct effect would also be significant, and the second half of the third step can be continued. Otherwise the indirect effect is not significant, and the test could be ended.

Since different types of aid and investment in China have different effects on poverty rate in the previous analysis, the mediation effect of aid and investment on capital and employment are analyzed by distinguishing different types of investment and aid funds. The specific equations are (8) and (9).

$$\begin{aligned} CAPIT_{it} &= \mu + \sum_{n=1}^{N}(\alpha_1 OFDI_{it}^n + ... + \alpha_2 OFDI_{it-T}^n) \\ &+ \sum_{m=1}^{M}(\beta_0 AID_{it}^m + ... + \alpha_T AID_{it-T}^m) + \theta' X_{it} + \varepsilon_{it} \end{aligned} \tag{8}$$

$$\begin{aligned} EMPLO_{it} &= \mu + \sum_{n=1}^{N}(\alpha_1 OFDI_{it}^n + ... + \alpha_2 OFDI_{it-T}^n) \\ &+ \sum_{m=1}^{M}(\beta_0 AID_{it}^m + ... + \alpha_T AID_{it-T}^m) + \theta' X_{it} + \varepsilon_{it} \end{aligned} \tag{9}$$

4.2. The Impact of Aid and Investment on Capital Formation and Employment

GMM regression analysis[1] shows that total amount of aid and investment of China in countries along the Belt and Road positively related to the total capital of these countries, and the efficient is significant with lagging period of one or two periods. The overall effect of investment on capital formation is higher than aids. Imvestment by other countries around the world have similar effects on poverty alleviation for countries along the Belt and Road, but the role of aid is not significant. The contributions of different types of aid and investment on total capital formation are different. China's OOF aid has a significant positive impact on total capital formation, while ODA has no obvious impact. The reason is that emergency relief, humanitarian supplies, and debt relief, as the most part of ODA are mainly consumed or used for

[1] Due to the limited space of the paper, the results of GMM regression are not listed in the paper, and the reserve claim is retained.

writing off debts, and they could not directly promote capital formation. There is a significant positive correlation between the total amount of capital formation and green land. The two-period lagging of project contract has the significant effect while direct investment has no significant effect, and the reason is that green land investment is a creative investment, which covers the whole process of financing, construction, and operation and results in a higher investment multiplier effect. Project contract investment also has a significant positive impact on the total capital formation. Since there is a long preparation period from the signing of the project contract to the real realization of investment, the impact of project contract on the total capital formation of the host country would be lagged. Other direct investments include the "brownfield investment" of existing enterprises in the host country. Since such investments generally only involve the transfer of property rights, it would not increase the scale of the capital formation in the host country.

From the perspective of employment, China's aid and investment have a significant positive effect on the employment of industry and service in the host country along the Belt and Road with varying degrees of lag. Investment has no significant impact on employment growth in the agricultural sector, but aid has a positive impact. The reason is related to the industrial structure of aid and investment that China's agricultural investment accounts for only 3% of the total investment in the country along the Belt and Road, and the rest investment is concentrated in the industrial and service sectors, while agricultural aid is relatively high with an annual average of over 6%, and the related projects in the agricultural and rural areas are related to poverty reduction. The employment promotion effect of Chinese investment in the countries along the Belt and Road is similar with that of other countries, but the aid of other countries in the world does not directly affect employment, which is different from China. Different types of aid and investment also have different impacts on employment in different sectors. OOF aid has a positive impact on employment growth in all sectors with lag period of one or two years. ODA aid has no significant effect. The poverty alleviation effect based on development aid has a better employment creation effect than that based on transfer payment. Green land investment has a positive impact on industrial sector employment with a lag period of one year. Engineering contract investment has a significant promotion effect on employment in industry, service industry, and agricultural sector. The reason is the wide distribution of Engineering investment that includes not only industrial sector projects, but also agricultural-related water conservancy and power supply projects, which plays a significant role in the development of agriculture and job creation.

4.3. Transmission Path of Poverty Reduction Effect of Aid and Investment

Regressing equation (4) with current data shows that the estimating results of α and

β are not significant, and mediation effect is not founded, while regression with lagging period of one or two years has the significant mediation effect. In the regression analysis of lagging one period, the total investment is significantly negative in equation (4) and (7), and the absolute value of the former is greater than that of the latter. The indirect effects of investment-capital formation, investment-industrial employment, and investment-service employment are all significantly negative, which indicates that China's investment has a significant mediation effect on one year lagged poverty rate reduction, and that capital formation and employment in industry and service industries bear part of the mediation effect. China's investment could promote capital formation and employment in industries and services in developing countries, which reduces the poverty rate. At the same time, investment has a direct impact on poverty alleviation with one lagged year. In the regression analysis of lagging two periods, the total amount of aid is significantly negative in equation (4) and (7), and the absolute value of the former is slightly larger. The three indirect effects of aid-employment, aid-industrial employment, and aid-service employment are all significantly negative, which indicates that China's aid has a significant mediation effect on the two period lagged poverty rate reduction, and that the total number of employed persons, the number of employed persons in industry and service industries bear part of the mediation effect function. Aid could promote employment of industry and service, which reduces poverty rates. At the same time, aid has a direct impact on poverty rates with lag period of two or more years.

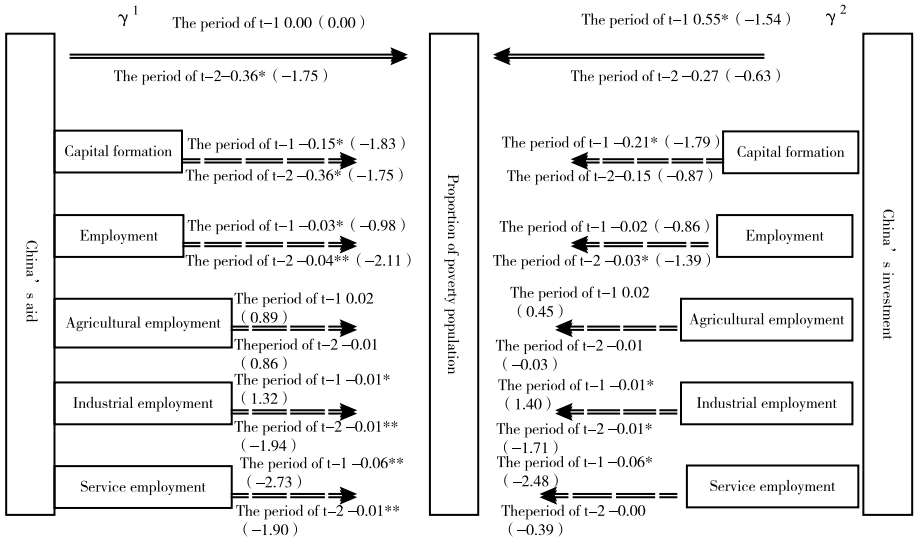

Figure 7. Investment Shares of Different Types of Chinese Enterprises in Different Regions

Notes: The figure is drawing with basis of regression results and mediation effect test. Due to the limited space of the paper, the regression results of complete mediation effect are not listed in the paper, which are retained on request. Solid arrows indicate the direct effects while dashed arrows indicate indirect effects.

5. Conclusion and Prospect

Since the 1980s, China has made a remarkable achievement in the field of anti-poverty, and the positive spillover effect of poverty reduction in China has become increasingly apparent. China contributes to poverty alleviation in developing countries along the Belt and Road by the way of aid and investment, taking infrastructure construction as a breakthrough and state-owned capital as the main force. Based on the sample data of countries along the Belt and Road from 2000 to 2017, this paper empirically tests the poverty alleviation effect of China's aid and investment on the countries along the Belt and Road by means of GMM and threshold regression method, and analyzes the influence path of aid and investment on poverty reduction by means of mediation model. The study finds that first, Chinese aid and OFDI help to reduce poverty rate, and there is a threshold effect between OFDI and poverty rate. When the per capita GDP level is below the threshold value, the poverty reduction effect of Chinese OFDI is more significant. Second, different types of aid and OFDI generate different poverty reduction effects, OOF, construction project investment, and green land investment have more significant effects, and poverty reduction mechanism based on infrastructure construction has better poverty reduction effect than transfer payment aid. Third, the correlation between state-owned enterprise OFDI and poverty rate is significant, state-owned capital plays an important role in poverty reduction in the B&R developing countries. Fourth, the research also finds that poverty reduction effect of Chinese aid and OFDI is realized mainly by capital formation and job creation in these countries, especially by improving the employment level in the industrial and service sectors. The conclusions of this study show that China should deepen the following aspects in order to better enhance the performance of poverty alleviation along the Belt and Road.

Firstly, aid and investment are the main ways to promote poverty alleviation in the countries along the Belt and Road. Since China's economic aid system for foreign countries and the development of enterprise's "going out" strategy are relatively immature, clear strategic planning and detailed system design is lacking, which makes the poverty alleviation of aid and investment overlap. In particular, the initiative of the Belt and Road adheres to the basic principles of "open cooperation, market operation, and mutual benefit", which could not be simply classified as the strategy of traditional foreign aid or foreign investment, but be related to the two strategies of development cooperation. It is more necessary to clarify the functional boundaries of aid and investment in different countries and regions, so as to help developing countries to achieve the goal of reducing poverty.

Secondly, infrastructure construction is the focus of China's development-oriented poverty alleviation in the countries along the Belt and Road, which plays an irreplaceable fundamental role in improving the basic livelihood of the developing

countries. However, water conservancy, transportation, energy, construction and other infrastructure projects often have the characteristics of large scale and long construction period, which has the greater impact on the ecological environment, as well as the risks of investment and international disputes. In this regard, the existing development models of China need to be improved. At the same time, it is important to appropriately adjust the increase of infrastructure aid and investment, and enhance the proportion of education and training, medical and health, women's rights and interests, cultural poverty alleviation and social organizations' aid and investment, so as to enhance China's "soft power" of poverty alleviation in the countries along the Belt and Road. On the other hand, the concept of "green poverty alleviation" should be implemented in infrastructure aid and investment construction, the eco-environmental protection services and support for major infrastructure projects in the countries along the Belt and Road should be strengthened, and principles of resource conservation and environmental friendliness should be integrated in investment.

Thirdly, China's state-owned capital has a very significant effect of poverty alleviation on the countries along the Belt and Road. However, promoting poverty alleviation of countries along the Belt and Road requires not only the role of "advance army" of state-owned capital, but also the actively participation of other capital, as well as the cooperation with donor countries, World Bank, the Asian Development Bank and other intergovernmental multilateral agencies and various non-governmental poverty alleviation organizations. Along with the establishment of new development bank of the BRICs, the Asian infrastructure investment bank, the Silk Road Fund and other organizations, the development concept in the countries along the Belt and Road is also showing a more diversified development trend. China needs to change its past thinking of poverty alleviation of "emphasizing bilateral and less multilateral", and to improve the compatibility between "China-style poverty alleviation" with the existing international development aid system, which could give full play to the positive spillover effect of poverty alleviation.

References

Asian Development Bank. (2017). *Meeting Asia's Infrastructure Needs*. Asian Development Bank Special Report, Mandaluyong City.

Bollen, K. A., & Brand, J. E., A General Panel Model with Random and Fixed Effects: A Structural Equations Approach. *Social Forces*, 89(1), 1-34.

Bu, J., & Wang, B. (2018). Research on the Trade Growth Effect of China's Investment on Countries along the Belt and Road. *Journal of Southwest Minzu University (Xinan*

Minzu Daxue Xuebao), 1, 119-128.

Collier P., & Dollar D. (1999). Aid Allocation and Poverty Reduction. The World Bank Policy Research Working Paper, No.2041.

Edwards, S. (2015) Economic Development and the Effectiveness of Foreign Aid: A Historical Perspective. *Kyklos*, 68(3), 277-316.

Gohou, G., & Soumaré, I. (2012). Does Foreign Direct Investment Reduce Poverty in Africa and Are There Regional Differences? *World Development*, 40(1), 75-95.

Hansen, B. E. (1999). Threshold Effects in Non-dynamic Panels: Estimation, Testing, and Inference. *Journal of Econometrics*, 93, 345-368.

Jalilian, H., & Weiss, J. (2002). Foreign Direct Investment and Poverty in the ASEAN Region. *Asean Economic Bulletin*, 19(3), 231-253.

The World Bank. (2016). *Development Goals in an Era of Demographic Change*, Global Monitoring Report 2015/2016, Washington, D. C.

Wang, J., Bao, E., & Bu, C. (2017). Excellent System, China has Become the Locomotive of Global Poverty Alleviation, *People's Daily (Renmin Ribao)*, June 26.

Wen, Z., & Ye, B. (2014). Intermediate Effect Analysis: Methodological and Model Development, *Advances in Psychological Science (Xinli Kexue Jinzhan),* 22(5), 731-745.

Wintoki, M. B., Linck, J. S., & Netter, J. M. (2012). Endogeneity and the Dynamics of Internal Corporate Governance. *Journal of Financial Economics*, 105(3), 581-606.

Ye, P. (2005). Research on Poverty Economics: A Literature Review, *The Journal of World Economy (Shijie Jingji)*, 9, 70-79.

Zhang, X., & Xu, X. (2016). China's Promoting Anti-Poverty Model: China's Practice in the Anti-Poverty Troika Driving System, *Jiangsu Social Sciences (Jiangsu Shehui Kexue),* 3, 55-63.

Zhang, Y., & Liu, L. (2017). Comparison and Enlightenment of the Labor Market in the Countries along the Belt and Road, *Western Forum (Xibu Luntan),* 6, 93-110.