Poverty Reduction Effects of China's Aid and Investment to Developing Countries*

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Abstract: *The Chinese approach to poverty reduction is a government-led and market-based approach that gives priority to infrastructure and combines fiscal subsidy with development as an antidote to poverty. These characteristics are also evident in China's cooperation with other developing countries on poverty reduction. China supports other developing countries to reduce poverty via aid and investment mainly in the field of infrastructure. While the government and SOEs take the lead in foreign aid and investment, China also invites other sources of capital to participate in market-based development in partnership with recipient countries. Our empirical research finds that aid and investment from China are generally conducive to reducing poverty incidence in recipient developing countries, but their poverty reduction effects vary across different types of aid and investment. The elements characteristic of the Chinese approach to poverty reduction proved to be effective in helping other developing countries reduce poverty as well. Nevertheless, the effectiveness of aid and investment in reducing poverty is subject to the governance and market efficiency of recipient countries. In order for the Chinese experience to work in less developed countries, future cooperation on poverty reduction must put a premium on governance and market systems.*

Keywords: *poverty reduction effects, foreign aid, cross-border investment, cooperation on poverty reduction, threshold regression.*
JEL Classification Codes: F35, F21
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1. Introduction

Since the 1980s, China's sweeping poverty reduction efforts have yielded significant results. In 2017, China's poverty incidence dropped to 3.1%,[1] which was below the world average. China has contributed over 70% of world poverty reduction (the World Bank, 2016). China's poverty reduction achievements provide valuable experience for other developing countries. In recent years, China has taken an active part in bilateral and multilateral poverty reduction cooperation under the vision of building a "community of shared future."

Launched in 2000, the Forum on China-Africa Cooperation (FOCAC) offers a framework for

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[1] Calculated by the standard of 2,300 yuan per person per year (2010 constant price) with data from the Statistical Communique of the People's Republic of China on the 2017 National Economic and Social Development released by the National Bureau of Statistics (NBS), website: http://www.stats.gov.cn/tjsj/zxfb/201802/t20180228_1585631.html.

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poverty reduction cooperation in such areas as economic aid, scientific research, education, culture, health, trade, and investment. By putting forward the Belt and Road Initiative (BRI) in 2013, China seeks to explore a mechanism of development cooperation with countries in Europe and the rest of Asia, and is committed to poverty reduction cooperation with BRI countries in such areas as food assistance, industry, agriculture and trade, and small and medium-sized poverty reduction programs.

Unveiled in 2015, China-CELAC (Community of Latin American and Caribbean States) Forum create a mechanism of multidimensional cooperation with the CELAC on poverty reduction in such fields as economic and technical aid, infrastructure, industrial capacity cooperation, education, and training. Aside from state-to-state cooperation on poverty reduction, China also supports poverty reduction in other developing countries via aid funds of international organizations for South-South cooperation under the UN 2030 Agenda for Sustainable Development (2030 Agenda). Since 2005, China has been ramping up aid and investment to other developing countries at an annual rate above 25%. Today, China's international cooperation programs for poverty reduction have covered most developing countries, mainly in Africa, Asia, and Latin America.[2]

China's domestic poverty reduction is known as the "most successful anti-poverty campaign ever in history" (United Nations, 2015). Other developing countries and international organizations have started to draw upon China's experience in reducing poverty (Zhang, 2015; UNDP, 2015). With growing international cooperation on poverty reduction, however, whether the Chinese solution works elsewhere is yet to be tested. After the dawn of the new century, China has built an image as a "responsible stakeholder" in international affairs. Yet as an emerging international donor and external investor, China is still exploring a suitable approach for assisting poverty reduction in other countries. What can the rest of the world learn from the Chinese approach to poverty reduction? What would be the spillover effects? Is China's experience worth learning and replicating for other developing countries? This paper attempts to offer answers to these questions.

2. Literature Review

In the existing literature, Chinese and international academics have investigated the characteristics of the Chinese approach to poverty reduction. Over the past decades, China has reduced poverty incidence at home via state-funded antipoverty programs and rapid economic development. While the state-funded programs eased inequalities and reduce poverty incidence (Su and Xie, 2015; Xie, 2017), economic activity created jobs for the poor (Cai *et al*., 2001; Jiang, 2008). Based on its experience, China has carried out international cooperation for poverty reduction via both aid and investment for development. After an early-stage focus on aid, China now lays equal emphasis on investment and aid in partnering with other countries to reduce poverty (Zhang, 2018a).

Infrastructure tops China's poverty reduction priorities. At home, China has constructed a broad range of infrastructure, from roads to water conservancy, water supply, electric power, telecom, and housing (Ye, 2005). Numerous empirical studies indicate the positive effects of infrastructure investment on poverty reduction in China (Gao and Li, 2006; Guo and Gao, 2009). In recent years, infrastructure has become an important area of poverty reduction cooperation between China and other developing countries.

The government-led system is a hallmark of the Chinese approach to poverty reduction. In China, the government is responsible for making policies and mobilizing resources for poverty reduction (Zhang, Xu, 2016). The government plays a dominant role in allocating poverty relief funds and implementing

[2] Calculated based on AidData from the College of William and Mary and the China Global Investment Tracker (CGIT). Unless otherwise indicated, all data in the remainder of this paper are from the same source.

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pro-poor projects (Wang, 2017). In international cooperation for poverty reduction, the Chinese government has always followed the principle of "no strings attached and non-interference in the internal affairs of recipient countries" and does not demand any political and social reforms of recipient countries in exchange for aid. With market-based operations for win-win results, multinational companies are the critical stakeholders of overseas investment from China. However, China still relies on its institutional advantage in partnering with other countries for poverty reduction: Both the Chinese government and state-owned enterprises (SOEs) play an irreplaceable role in financing and undertaking overseas pro-poor projects (Zhang, 2018b).

Development-oriented poverty reduction based on market forces is another vital experience of poverty reduction in China. It includes such elements as small credit, feature industries, labor export, public and private partnership, and revenue-generating assets for assisting the poor (Huang and Tan, 2013; Sun, 2001; Guo and Yu, 2006). Compared with government aid, market players play a more significant role in promoting the initiative of the poor. One of the key principles that China upholds in foreign aid is to promote "shared interests" and the role of the market in poverty reduction. Through a combination of official development assistance (ODA) and other official flows (OOF), China encourages aid recipients to escape poverty without dependence on aid. Specific projects include aid, commercial, and mixed-type projects. Private capital from China plays an increasingly active role in supporting the economic and social development of other developing countries (Zhang, 2019).

These "Chinese characteristics" are unlike the traditional "vertical paradigm" of North-South aid (Pang, 2013). China has explored innovative modes of foreign aid, cross-border investment, trade, among other forms of financing (Zheng, 2017), and shared its poverty reduction concepts and experience with other developing countries (Li, 2016). China's international cooperation on poverty reduction reflects the principles of inclusiveness, mutual benefit and independence (Ngaire, 2008; Dreher & Fuchs, 2011; Dreher, 2011).

However, China is still fighting an uphill battle against poverty at home, and yet to gain more experience on its new model of cooperation for development via aid and investment (Xue and Weng, 2018). The existing literature focuses on China's cooperation with other Asian countries and some African regions for poverty reduction from historical, policy, and strategic perspectives (Ju and Shao, 2015; Wang, 2013). A few empirical studies have evaluated the economic growth effects of China's aid to Africa and other parts of the world (Banik, 2013; Dreher *et al*., 2017; Zhu and Huang, 2018) and the poverty reduction effects of China's investments in Africa (Zheng, 2015). Yet these studies offer overall descriptions without telling the Chinese model apart from the traditional approach, not to mention evaluating the applicability of the Chinese solution to other developing countries.

There has been a growing interest in the poverty reduction effects of China's aid and investments to BRI countries and some CELAC countries (Zhang, 2018a, 2018b), but empirical research is yet to be carried out to evaluate the overall status of developing countries. While numerous empirical studies deal with how aid or investment contributes to growth, economic growth is not always pro-poor (Fan, 2017; Zhang and Feng, 2010). Given the existence of wealth gaps, the assumption that a rise in per capita GDP will always lead to a fall in poverty is likely to cause a significant empirical bias (Sen, 2003).

Hence, this paper seeks to make the following innovations: (i) Unlike previous studies that dwell on a single dimension of aid, this paper examines how China assists other countries in reducing poverty via both aid and investment; (ii) introduce a structural perspective after an overall analysis of empirical research, and investigate the poverty reduction effects of aid and investments from China with panel data of 2005-2014 from developing countries; (iii) further uncover whether such poverty reduction effects differ across countries and which external factors affect the applicability of the Chinese approach. Our findings will depict a complete picture of what the Chinese approach to poverty reduction is about, and whether and how the Chinese solution will work in other countries.

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3. Poverty Reduction Effects of the Chinese Approach: Overall and Structural Perspectives

In partnering with other developing countries for poverty reduction, China puts a premium on both aid and investment via the government, state capital and other market actors, focusing on infrastructure construction as the entry point for broader cooperation. Yet the effects of the Chinese approach to poverty reduction are to be tested empirically.

3.1 Econometric Model

Building upon Gohou & Soumare (2012) and Dreher *et al*. (2017), we create the following econometric model:

$$HDI_{it} = \mu + \alpha_0 AID_{it} + ... + \alpha_T AID_{it-T} + \beta_0 FDI_{it} + ... + \beta_T FDI_{it-T} + \theta' X_{it} + \varepsilon_{it} \quad (1)$$

$$HDI_{it} = \mu + \sum_{m=1}^{M}(\alpha_0 AID_{it}^{m} + ... + \alpha_T AID_{it-T}^{m}) + \sum_{n=1}^{N}(\beta_0 FDI_{it}^{n} + ... + \alpha_T FDI_{it-T}^{n}) + \theta' X_{it} + \varepsilon_{it} \quad (2)$$

Where the UNDP's Human Development Index (HDI) denotes the level of development or poverty in each country. We select this indicator because it provides an objective and uniform measure of development with a reliable source of data. Earlier studies measure poverty on single dimension such as income, spending, or the poverty line (Rowntree, 1901), thus failing to provide a full picture of poverty. After the 1990s, the HDI and the Multidimensional Poverty Index (MPI) based on Amartya Sen's capability theory (Sen, 1992) gained currency (Alkire and Foster, 2007; Guo and Zhou, 2016). The UNDP measures and releases each country's HDI in different years, and started to measure MPI as a more scientific indicator as of 2010. Since the latter's sample size and temporal span are insufficient for panel data analysis, this paper sets HDI as the primary dependent variable.

Model (1) measures how China's aid (AID_{it}) and investment (FDI_{it}) help recipient countries reduce poverty (HDI_{it}). Subscripts i and t respectively denote country/region and time. Control variables (X_{it}) include the share of the agricultural population, capital per capita, the geographical location of a recipient developing country, and the net amount of aid and investment received from other countries. Considering the potential "poverty trap" and "lag effect," the model also identifies HDI and the total amount of aid and investment in the previous phase as independent variables. Model (2) examines the poverty reduction effects of aid and investment of different types, as classified in Table 1.

3.2 Explanation on Data Sources

Empirical data are from AidData of the College of William & Mary and the China Global Investment Tracker (CGIT). AidData contains over 5,000 aid projects carried out by China in 141 countries and regions from 2000 to 2014. CGIT contains close to 3,000 investment projects in 151 countries and regions since 2005. UNDP's human development database provides HDI data of all countries. The World Bank database offers such data as net global aid and investment, capital per capita, and the share of the agricultural population.

By matching the above data by the group of countries, we obtain the panel data of 114 developing countries from 2005 to 2014. Among them, Africa, Asia, Latin America, Europe, South Pacific islands, and countries in the Middle East account for 40.7%, 21.5%, 18.6%, 8.3%, 5.8%, and 5.1%, respectively, and BRI countries[3] make up about 34.6% (Table 1).

[3] In this paper, "BRI countries" refer to countries along the geographical routes as identified in the Vision and Actions on Jointly Building the Silk Road Economic Belt and 21st Century Maritime Silk Road released by the National Development and Reform Commission (NDRC), the Ministry of Foreign Affairs and the Ministry of Commerce in 2015, as well as countries outside the said geographical scope but having reached BRI cooperation agreements with China (till December 2017).

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Table 1: Statistical Characteristics of Variables

Variable \ Statistical value		Mean	Standard error	Min.	Max.	Variable \ Statistical value		Mean	Standard error	Min.	Max.
Aid from China (in 100 million USD)		4.84	20.63	0.00	362.96	Investment from China (in 100 million USD)		5.61	14.79	0.00	191.50
Class 1	ODA	0.57	2.83	0.00	60.51	Class 1	SOEs	4.51	13.18	0.00	191.50
	OOF	3.50	18.73	0.00	341.53		Non-SOEs	1.09	4.43	0.00	69.90
Class 2	Development	1.87	9.53	0.00	197.93	Class 2	Construction projects	2.90	8.94	0.00	136.00
	Commercial	1.28	11.82	0.00	255.00		Greenfield investment	0.90	4.35	0.00	69.90
	Mixed type	1.69	11.98	0.00	341.53		Other direct investment	0.92	5.94	0.00	132.90
Class 3	Infrastructure	1.47	7.48	0.00	138.33	Class 3	Infrastructure	1.26	5.87	0.00	112.40
	Resource and energy	1.27	8.81	0.00	250.44		Resource and energy	1.73	8.31	0.00	188.40
	Manufacturing	1.26	10.80	0.00	278.84		Manufacturing	1.24	4.74	0.00	69.90
	Trade & finance	0.16	1.68	0.00	30.00		Trade & finance	0.21	2.04	0.00	56.00
	Scientific research, education and culture	0.02	0.20	0.00	5.00		Scientific research, education and culture	0.06	0.56	0.00	11.00
	Government/NGO	0.12	1.73	0.00	60.00		Industrial capacity cooperation	1.89	6.48	0.00	86.50
	Food and supplies	0.02	0.29	0.00	8.89	Net global investment (in 100 million USD)		29.09	78.34	-119.21	1011.58
Class 4	Non-liability loans	4.11	18.47	0.00	317.96	Net global aid (in 100 million USD)		6.16	11.44	-9.41	220.57
	Debt restructuring	0.05	1.61	0.00	60.00	Effectiveness of public institutions GCI	Overall	3.60	0.73	1.80	5.97
	Debt exemption	0.01	0.02	0.00	0.55		Ethics and corruption	3.06	0.90	1.44	6.32
	Fund appropriation	0.10	0.38	0.00	8.11		Inappropriate influence	3.21	0.83	1.30	6.24
	Scholarship and training	0.00	0.01	0.00	0.07		Government efficiency	3.44	0.64	1.57	5.29
	Independent technology	0.01	0.02	0.00	0.33		National security	4.53	0.80	2.58	6.50
	Export credit	0.35	2.94	0.00	62.51	Market efficiency GCI	Product market	4.02	0.49	2.78	5.58
	Strategic supplier	0.03	0.09	0.00	3.25		Labor market	4.16	0.46	2.55	5.29
	Not classified	0.21	4.41	0.00	140.00		Capital market	3.91	0.69	1.95	6.02
HDI		613.66	148.11	118.00	918.84	Infrastructure GCI		3.26	0.94	1.54	6.30

Source: AidData database, CGIT database, UNDP database, the World Bank database, and the World Economic Forum (WEF) database. Region and time variables (dummy) are not shown in this table. For the convenience to measure and analyze result readings, original HDI values are multiplied by 1,000 times.

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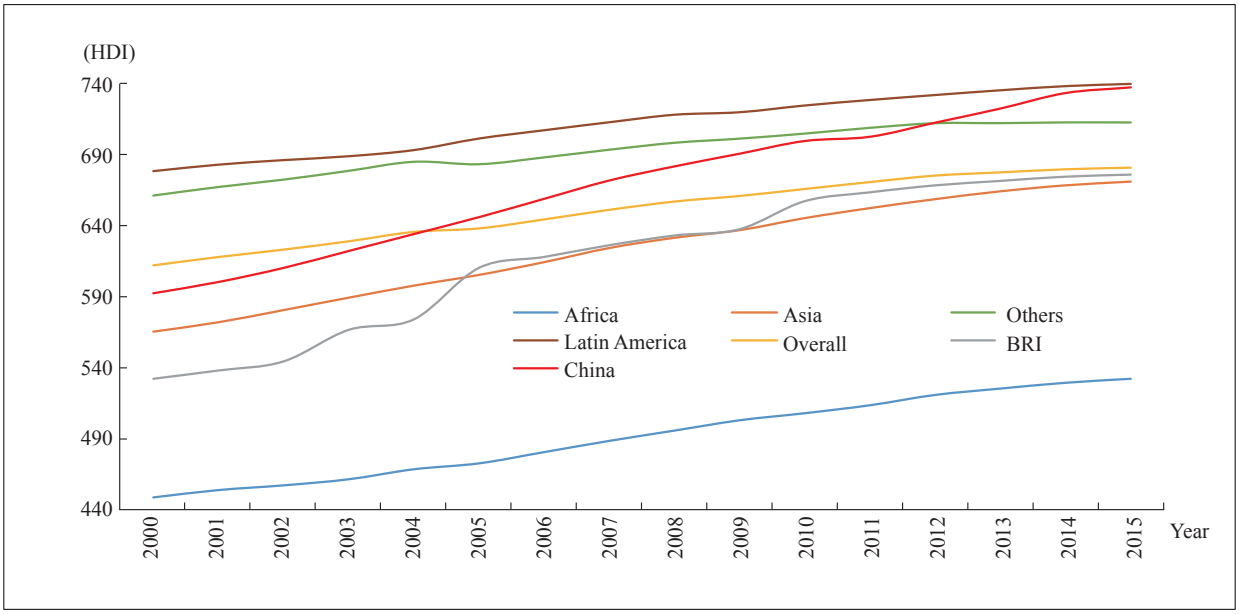

Figure 1: HDI Trends of China and Other Developing Countries with Aid and Investment from China
Source: UNDP Human Development Data.

Judging by the HDI's trend, there has been an improvement in poverty in both China and other developing countries with aid and investment from China since 2000. By the annual average growth rate of HDI, BRI countries have experienced the most significant improvement, followed by developing countries in Asia, Africa, Latin America, and elsewhere. China's own HDI growth rate has outperformed the average level of these countries. Before 2005, China's HDI was above the average level of developing countries in Asia and Africa, but below the average level of Latin America and other regions. By 2005, China's HDI surpassed the average level of developing countries. By 2015, China's HDI was above the level of most developing countries and on a par with the average level of Latin America (Figure 1).

3.3 Regression Results

According to system GMM regression results (Table 2), an increase in aggregate aid and investment from China leads to an improvement in the HDI of recipient developing countries. Despite the similar effects of net investments from other countries, the role of global net aid is insignificant. In 2013, China put forward the Belt and Road Initiative (BRI) to partner with other developing countries for common development. Therefore, our regression model creates a dummy variable of BRI countries in 2013 for a test. The results show little difference in the poverty reduction effects of aid from China before and after 2013, but a spike in the poverty reduction effects of investment after 2013. There is no significant difference in such effects between BRI countries and other recipient countries.

Announced in 2013, the BRI calls for greater economic and trade cooperation, particularly outward investment from China to other developing countries, which may explain the change in the poverty reduction effects after 2013. Compared with investment, the BRI makes no significant progress in planning for foreign aid.[4] Hence, there is no significant temporal difference in the poverty reduction

[4] In November 2014, the Ministry of Commerce enacted Administrative Measures for Foreign Aid, which is the first comprehensive departmental regulation on the management of foreign aid. In February 2017, the Central Leading Group for Deepening Overall Reform adopted the Implementation Opinions on Reforming the Work of Foreign Aid. Compared with outward investment, China's foreign aid reform made less progress.

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effects of aid. As an open and inclusive initiative, the BRI does not limit itself to BRI countries in a geographical sense. Therefore, aid and investment from China should contribute to poverty reduction in all developing countries keen on reducing poverty through cooperation, rather than less developed countries along the BRI route alone. We have verified this assumption by a test with the interaction term of region dummy variable (Equation 5). The interaction terms on aid and investments from China to Asia, Africa, Latin America, the Middle East, and Pacific island countries are all not significant, indicating no significant regional preference of the poverty reduction effects of aid and investment from China.

The regression results (Table 3) of Model (2) indicate a significant difference in the poverty reduction effects of other official flows (OOF) and official development assistance (ODA), i.e. the former outweighs the latter. A possible reason is that ODA is smaller and focuses on emergency relief and humanitarian aid. While alleviating poverty in the short run, ODA does not create sustained poverty reduction effects. In comparison, OOF helps increase capital stock per capita and jobs in developing countries by developing manufacturing, trade, and natural resources. Similarly, development aid contributes less to poverty reduction compared with commercial and mixed-type aid. Market-based mechanisms may lead to better poverty reduction effects by enabling recipient countries to develop local capabilities essential for poverty reduction.

The regression results suggest that the poverty reduction effects of aid differ across sectors and are more significant for such sectors as infrastructure, scientific research, education, and culture. Infrastructure aid, which accounts for the highest share of China's foreign aid, helps developing countries overcome the lack of infrastructure as an impediment to poverty reduction in the long run. Despite the smaller share, aid in sectors including scientific research, education, and culture will help developing countries foster human capital and reduce poverty more sustainably. Due to various reasons, there is an insignificant correlation between HDI and aid in sectors like natural resources and energy, manufacturing, trade and finance, government and civil organizations, and food and non-food supplies. In the sectors of natural resources and energy, manufacturing, trade, and finance, China offered aid to recipient countries to leverage their comparative advantages and expand local market share. Such aid is yet to better align with the poverty reduction needs of recipient countries.

Without proper supervision, direct aid to governmental and civil organizations in poorly governed countries may give rise to rent-seeking and corruption and extend little help to the poor. Food and non-food supplies for emergency aid and prevention of humanitarian crises will not contribute to pro-poor capital accumulation in the long run.

Further incorporating investments of different ownership types into the regression equation (Table 3), we discover differences in the poverty reduction effects of outward investment from SOEs and non-SOEs, i.e. the former outweighs the latter. While infrastructure is a core area of outward investment for SOEs, private capital invests more in sectors like natural resources and energy, manufacturing, and trade and finance. Since private companies tend to invest in countries with relatively good infrastructure and business climate, there is a weak correlation between private investment and poverty reduction.

Similarly, poverty reduction effects also vary across different types of investment. While a rise in construction and greenfield investments from China is conducive to the HDI of host countries, other types of direct investment demonstrate no significant poverty reduction effects. Construction projects are related to infrastructure and tend to be carried out in less developed countries, and greenfield investments are new project investments with a higher economic multiplier effect. Hence, both types of investment significantly reduce poverty. Other direct investments involve a more complex composition. Specifically, brownfield investments refer to the acquisitions of existing companies in host countries and usually only involve the transfer of property rights with little new capital input. Commercial investments often occur in countries with higher levels of social and economic development and are less correlated with poverty reduction. Similar to aid, investments in infrastructure, scientific research, education, and culture significantly reduce poverty.

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Table 2: GMM Regression Results

Dependent variable / Independent variable	HDI: Equation 1	HDI: Equation 2	HDI: Equation 3	HDI: Equation 4	HDI: Equation 5
Aid from China(t)	0.110**(2.15)	0.130***(2.63)	0.132**(2.05)	0.133**(2.06)	0.176*(1.48)
Aid from China(t)×After 2013			-0.021(-0.21)	0.042(0.22)	
Aid from China(t)×After 2013×BRI countries				-0.074(-0.36)	
Aid from China(t)×Asian countries					0.032(0.19)
Aid from China(t)×African countries					-0.113(-0.73)
Aid from China(t)×CELAC countries					-0.044(-0.25)
Aid from China(t)×Countries in the Middle East					-0.075(-0.50)
Aid from China(t)×Pacific island countries					0.619(0.11)
Investment from China (t)	0.165**(2.22)	0.172***(2.56)	0.108*(1.48)	0.109*(1.49)	0.568*(1.51)
Investment from China (t)×After 2013			0.316**(2.13)	0.330*(1.60)	
Investment from China (t)×After 2013×BRI countries				-0.035(-0.14)	
Investment from China (t)×Asian countries					-0.438(-1.13)
Investment from China (t)×African countries					-0.314(-0.80)
Investment from China (t)×CELAC countries					-0.370(-0.92)
Investment from China (t)×Countries in the Middle East					-0.463(-1.15)
Investment from China (t)×Pacific island countries					-4.894(-1.44)
Aid from China(t-1)	-0.074(-1.48)				
Investment from China(t-1)	0.063(0.95)				
Aid from China(t-2)	0.038(0.75)				
Investment from China(t-2)	0.038(0.58)				
Global net aid flows(t)	0.081(0.62)	0.119(1.33)	0.114(1.28)	0.115(1.29)	0.114(1.27)
Global net investment flows(t)	0.077**(2.08)	0.030**(1.94)	0.028*(1.78)	0.027*(1.69)	0.028*(1.73)
Global net aid flows(t-1)	0.029(0.20)				
Global net investment flows(t-1)	-0.063(-1.39)				
Global net aid flows(t-2)	-0.014(-0.11)				
Global net investment flows(t-2)	0.010(0.31)				
Other control variables	Yes	Yes	Yes	Yes	Yes
Constant term	27.566***(5.79)	28.796***(6.30)	28.672***(6.28)	28.517***(6.22)	29.414***(6.26)
F test	1069.49***	2125.12***	1743.34***	1472.81***	1002.15***
Sargan	2.745	1.997	0.957	0.983	1.750
Sample size	1120	1140	1140	1140	1140

Note: ***, ** and * denote the significance of z or t value at 1%, 5%, and 10% respectively; Sargan denotes the over-identification test of instrumental variables, the same below.

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Table 3: GMM Regression Results (Cont.)

Dependent variable / Independent variable		HDI: Equation 1	HDI: Equation 2	HDI: Equation 3	HDI: Equation 4	HDI: Equation 5	HDI: Equation 6	HDI: Equation 7
Aid from China (t)						0.130***(2.63)	0.121***(2.44)	0.131***(2.62)
Class 1	ODA	0.062(0.16)						
	OOF	0.146***(2.64)						
	Not classified	0.034(0.19)						
Class 2	Development		0.108(1.00)					
	Commercial		0.154*(1.58)					
	Mixed type		0.129*(1.67)					
Class 3	Infrastructure			0.255**(1.91)				
	Natural resources and energy			0.085(0.47)				
	Manufacturing			0.111(1.20)				
	Trade and finance			-0.085(-0.13)				
	Scientific research, education and culture			1.991*(1.45)				
	Government/civil organizations			2.517(0.58)				
	Food and supplies			-1.510(-0.47)				
Class 4	Non-liability loans				0.171***(2.89)			
	Debt restructuring				14.937***(3.95)			
	Debt exemption				-4.009(-0.49)			
	Fund appropriation				7.046***(2.82)			
	Scholarship and training				3.351*(1.57)			
	Independent technology				-26.584(-0.42)			
	Export credit				-0.412(-1.19)			
	Strategic supplier				-2.152(-1.21)			
	Not classified				0.022(0.11)			
Investment from China (t)		0.173***(2.58)	0.171***(2.56)	0.170***(2.51)	0.170***(2.56)			
Class 1	SOEs					0.173**(2.33)		
	Non-SOEs					0.163(0.74)		
Class 2	Construction projects						0.294***(2.72)	
	Greenfield investment						0.335*(1.54)	
	Other direct investment						0.127(0.77)	
Class 3	Infrastructure							0.190*(1.40)
	Natural resources and energy							0.102(0.87)
	Manufacturing							-0.090(-0.32)
	Trade and finance							0.151(0.33)
	Scientific research, education and culture							3.918**(1.93)
	Industrial capacity cooperation							0.251(1.15)
Global net aid flows (t)		0.123(1.37)	0.120(1.34)	0.115(1.29)	0.104(1.17)	0.119(1.33)	0.100(1.11)	0.121(1.35)
Global net investment flows (t)		0.029**(1.90)	0.029*(1.86)	0.029*(1.81)	0.035**(2.26)	0.030**(1.92)	0.029*(1.85)	0.032**(2.04)
Other control variables		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant term		29.051***(6.31)	28.820***(6.28)	28.099***(6.11)	27.601***(6.00)	28.800***(6.30)	28.515***(6.24)	29.064***(6.31)
F test		1736.34***	1735.81***	1272.75***	1150.50***	1910.92***	1742.31***	1364.21***
Sargan		2.179	2.069	1.885	1.871	2.010	0.640	1.611
Sample size		1140	1140	1140	1140	1140	1140	1140

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4. Differentiated Effects of the Chinese Approach to Poverty Reduction: Based on External Determinants

Aid and investment from China have relatively significant poverty reduction effects. Yet this finding only proves that the Chinese approach to poverty reduction can be exported to other countries via aid and investment. Whether this model for poverty reduction generates lasting effects is subject to the social governance and existing economic conditions of recipient countries. Therefore, the heterogeneity of recipient countries needs to be further investigated to reveal the effects of China's poverty reduction cooperation with other countries.

4.1 Econometric Model and Data Explanations

Generally speaking, whether or not the government-led system works for poverty reduction is related to a country's social governance. In countries with rampant corruption and government inefficiencies, foreign aid and investment may lead to greater inequalities in social distribution and more deprivation of low-income people due to the lack of good governance. The functioning of market-based mechanisms is subject to the efficiency of products, labor, and capital markets. Monopoly, trade barriers, and poor tax regimes may cause the product market to be inefficient and market-based poverty reduction mechanisms to fail. Unmotivated and incompetent workforce and distorted incentives may lead to labor market inefficiencies and cause recipient countries to depend on foreign aid and investment and become unable to reduce poverty independently and sustainably.

The stability of monetary and financial markets reflects the efficiency of capital markets. It will have a direct impact on the market-based allocation of poverty relief funds and the poverty reduction effect. In this section, we will employ a threshold regression model for the analysis of the above problem (Hansen, 1999; Wang, 2015) with a host of indicators for measuring governance, market efficiency, and existing infrastructure in developing countries as threshold variables and aid and investment as main variables, respectively:

$$HDI_{it} = \alpha_0 + \alpha_1 ADI_{it}(GCI_{it} \le \gamma) + \alpha_2 ADI_{it}(GCI_{it} > \gamma) + \theta' X_{it} + \varepsilon_{it} \quad (3)$$

$$HDI_{it} = \alpha_0 + \alpha_1 FDI_{it}(GCI_{it} \le \gamma) + \alpha_2 FDI_{it}(GCI_{it} > \gamma) + \theta' X_{it} + \varepsilon_{it} \quad (4)$$

Indicators for governance, market efficiency, and existing infrastructure are from the World Economic Forum (WEF) and the Global Competitiveness Index (GCI). Specifically, governance is measured by ethics and corruption, inappropriate influence, government efficiency, and national security, and market efficiency is measured by the efficiency of the product, labor, and capital markets. Higher GCI means better social governance systems and higher market efficiency. γ is GCI threshold value to be measured, and the definitions of other variables are similar to regression equations (1) and (2). An analysis of regression equations (3) and (4) may thus reveal whether the poverty reduction effects of aid and investment from China vary across countries with different levels of governance, market efficiency, and infrastructure. The results of such analysis will indicate whether the Chinese solution to poverty reduction can be replicated in other developing countries. The latter part of Table 1 shows the statistical characteristics of the above variables.

4.2 Regression Results

The results of threshold regression (Tables 4 and 5) reveal more significant poverty reduction effects of China's aid and investment to other developing countries with governance above the threshold values. In countries with less corruption, smaller improper government influence, and higher government efficiency and national security, a rise in aid and investment from China helps boost HDI; for aid, their

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GCI threshold values are 3.18, 3.29, 3.09, and 4.89 respectively; for investment, their GCI threshold values are 2.83, 1.42, 1.87, and 2.90 respectively. Compared with investment, aid requires a higher level of governance to reduce poverty effectively. In countries below the threshold values, the poverty reduction effects of aid and investment are insignificant or relatively low.

In a nutshell, aid and investment from China may help recipient countries elevate their level of development, provided that they have put effective governance into place. As a vital element of the Chinese solution to poverty reduction, the government-led system requires strong organizational capability, efficient policy execution, and self-discipline at the local level in formulating pro-poor policies, allocating funds, and implementing pro-poor projects. For developing countries with weak governance, the Chinese model of poverty reduction may not work.

In countries with an efficient product market, aid and investment from China contribute more significantly to poverty reduction with threshold values of 3.88 and 4.19, respectively. In countries below the threshold values, aid has insignificant effects on reducing poverty, and the poverty reduction effects of investment, though existent, are less correlated with HDI.

Developing countries with an inefficient product market often face problems like monopoly, market disintegration, weak tax regimes, and high cost of doing business. In such countries, the poor find it hard to start a small business or find jobs in the industrial sector. As a result, market mechanisms are of little help in reducing poverty in these countries. High costs and risks of doing business and uncertain return on investment often deter foreign investors from making inroads in countries where the product market is inefficient. Although product market efficiency is less a factor for foreign aid than for investment, similar challenges also confront commercial and mixed-type aid, both of which demonstrate significant threshold effects.

In countries with an efficient labor market, aid and investment from China have significant poverty reduction effects with threshold values of 4.66 and 2.85, respectively. For countries below the threshold values, the poverty reduction effects are insignificant for investment and still exist for aid, but the coefficient values are significantly smaller.

Countries with an efficient labor market often face challenges in workforce motivation and labor participation, competence, income distribution, and labor relations. In such countries, both domestic and foreign investors find it costly and inefficient to manage and train the workforce and cope with labor disputes.

Moreover, the poverty reduction effects of foreign aid are also related to the labor market efficiency of recipient countries. For development-oriented poverty reduction, the drive of working populations to improve their skills and devote themselves to work determines the outcomes of poverty reduction in recipient countries.

As can be found from the regression coefficients of aid, countries above the threshold values of labor market efficiency have an estimation value of about 2.10, and countries below the threshold values have an estimation value as low as 0.12. Regression with capital market efficiency as a threshold variable indicates an insignificant threshold effect between aid and HDI, i.e. capital market efficiency is not correlated with the poverty reduction effects of aid. In contrast, investment from China contributes more to poverty reduction in countries with capital market efficiency above the threshold value of 4.43. In countries below the threshold values, however, the correlation coefficient between investment and HDI is insignificant.

Such a difference may stem from the following reasons: (i) Aid funds mainly consist of non-liability loans, fiscal appropriations, export credit, debt exemptions and restructuring financed by Chinese parties, and even commercial and mixed-type aid projects require no refinancing in recipient countries, whose capital market efficiency does not influence the poverty reduction effects of aid from China. (ii) China's investment projects in developing countries include not only aid investments but commercial and mixed-

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Table 4: Threshold Regression Results

Dependent variable / Independent variable	HDI: Equations 1~5					HDI: Equations 6~8			HDI: Equation 9
Threshold variable (qx)	Governance					Market efficiency			Existing infrastructure
	Overall	Ethics and corruption	Inappropriate influence	Government efficiency	National security	Product market	Labor market	Capital market	
Threshold value (r)	3.738	3.180	3.289	3.085	4.887	3.875	4.662	3.485	3.702
Aid from China(t)(qx≤r)	0.052 (0.82)	0.062 (1.01)	0.059 (0.93)	0.019 (0.27)	0.069 (1.14)	-0.033 (-0.36)	0.120* (1.86)	0.056 (0.78)	0.115* (1.56)
Aid from China(t)(qx>r)	0.363** (1.96)	0.516** (1.96)	0.296* (1.60)	0.235** (2.19)	0.909** (2.17)	0.167** (2.13)	2.098* (1.57)	0.142 (1.35)	0.004 (0.05)
Investment from China (t)	0.218** (2.39)	0.215** (2.37)	0.217** (2.38)	0.213** (2.35)	0.207** (2.27)	0.220** (2.42)	0.198** (2.17)	0.211** (2.31)	0.201*** (2.56)
Aid from China(t-1)	-0.039 (-0.64)	-0.041 (-0.68)	-0.040 (-0.66)	-0.036 (-0.60)	-0.051 (-0.85)	-0.034 (-0.57)	-0.034 (-0.57)	-0.038 (-0.64)	-0.066 (-1.16)
Investment from China(t-1)	0.154* (1.86)	0.148* (1.78)	0.156* (1.88)	0.163** (1.97)	0.148* (1.78)	0.162** (1.95)	0.148* (1.78)	0.150* (1.81)	0.141* (1.87)
Aid from China(t-2)	0.060 (0.98)	0.067 (1.10)	0.061 (1.01)	0.064 (1.05)	0.064 (1.05)	0.064 (1.05)	0.065 (1.07)	0.065 (1.08)	0.041 (0.71)
Investment from China(t-2)	0.179** (2.13)	0.174** (2.08)	0.176** (2.10)	0.179** (2.14)	0.168** (2.01)	0.171** (2.05)	0.175** (2.09)	0.173** (2.06)	0.143* (1.87)
Global net aid flows(t)	0.143 (0.81)	0.143 (0.81)	0.145 (0.82)	0.153 (0.87)	0.139 (0.79)	0.152 (0.87)	0.140 (0.80)	0.151 (0.86)	0.168 (1.03)
Global net investment flows(t)	0.048* (1.49)	0.054* (1.68)	0.048* (1.51)	0.049* (1.54)	0.052* (1.63)	0.054* (1.68)	0.049* (1.53)	0.049* (1.53)	0.051* (1.78)
Global net aid flows(t-1)	0.053 (0.29)	0.056 (0.31)	0.055 (0.30)	0.059 (0.32)	0.065 (0.36)	0.060 (0.33)	0.068 (0.37)	0.063 (0.34)	0.055 (0.32)
Global net investment flows(t-1)	-0.019 (-0.56)	-0.017 (-0.52)	-0.018 (-0.54)	-0.020 (-0.59)	-0.017 (-0.50)	-0.018 (-0.54)	-0.004 (-0.11)	-0.015 (-0.45)	-0.015 (-0.48)
Global net aid flows(t-2)	0.113 (0.67)	0.114 (0.68)	0.113 (0.67)	0.114 (0.67)	0.105 (0.62)	0.113 (0.67)	0.107 (0.63)	0.113 (0.67)	0.061 (0.38)
Global net investment flows(t-2)	0.045* (1.42)	0.040 (1.28)	0.045* (1.42)	0.047* (1.49)	0.044 (1.41)	0.045* (1.44)	0.037 (1.16)	0.043 (1.35)	0.049* (1.69)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant term	280.210*** (17.34)	280.347*** (17.36)	280.346*** (17.35)	280.166*** (17.34)	280.100*** (17.35)	280.741*** (17.38)	279.517*** (17.31)	280.503*** (17.35)	241.444*** (17.64)
R^2	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
F test	40.55***	40.57***	40.45***	40.58***	40.67***	40.58***	38.64***	40.36***	55.95***
Sample size	850	850	850	850	850	850	850	850	850

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type investments as well. Although China provides start-up funds, the sources of follow-up funds are more complex, and long-term projects are very likely to entail local financing from host countries. In this manner, the capital market efficiency of host countries will influence the efficiency and poverty reduction effects of such investment projects.

In this section, we have examined how product, labor, and capital market efficiency is related to the poverty reduction effects of aid and investment from China. Our findings suggest that China may contribute to poverty reduction in other developing countries via aid and investment, provided that recipient countries have put effective market mechanisms into place. Behind the success of China's poverty reduction at home is the role of market mechanisms for poverty relief funds to operate efficiently and poor populations to develop marketable skills. Whether the Chinese solution may work elsewhere depends on the fundamental market systems in recipient countries. While capital market efficiency has an impact on the extent to which investment helps reduce poverty, the efficiency of product and labor markets will influence the poverty reduction effects of both investment and aid. In less developed countries with underdeveloped and inefficient market systems, the Chinese approach to poverty reduction may not generate desirable results.

The threshold regression results also suggest that infrastructure may also influence the poverty reduction effects of aid and investment from China. By including the infrastructure GCI of a previous phase into the regression equation as a threshold variable, we find that aid from China helps reduce poverty significantly for countries below the threshold value of 3.70, but such effects are insignificant for countries above the threshold value. On the contrary, investment from China has significant poverty reduction effects for countries above the threshold value of 1.63; otherwise, the effects are insignificant.

Two reasons may explain this discrepancy: (i) Compared with donors, cross-border investors will consider whether a host country has adequate infrastructure to develop relevant industries. Even when investing in infrastructure, they seldom invest in regions with poor social and economic conditions or scarce potentials. (ii) In comparison, aid projects are intended to match the demand of recipient countries. In this respect, countries with more deficient infrastructure are in a higher demand for aid. For countries with more decent infrastructure, the investment will replace aid as a critical driver of economic growth.

The Chinese approach to poverty reduction is characterized by infrastructure construction as an entry point for development-oriented poverty reduction. Yet as can be learned from the above threshold regression results, it takes certain conditions for the Chinese solution to work. Less developed countries with poor infrastructure cannot entirely rely on investment for the supply of public goods and need to start with aid. For developing countries with adequate infrastructure in place, the poverty reduction effects of aid will diminish. Therefore, the size and the domain of infrastructure construction should suit the development stage of recipient countries.

5. Conclusions and Policy Recommendations

The Chinese approach to poverty reduction is a government-led and market-based approach that gives priority to infrastructure and combines fiscal subsidy with development as an antidote to poverty. These characteristics are evident in China's cooperation with other developing countries on poverty reduction. We may derive the following findings from empirical research based on the panel data of developing countries from 2005 to 2014:

(1) There is a positive correlation between aggregate aid and investment from China and HDI, and aid and investment are generally conducive to poverty reduction in developing countries;

(2) Poverty reduction effects are the most significant for aid and investment in the following domains of other official flows (OOF), mixed-type and commercial aid, infrastructure, scientific research,

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Table 5: Threshold Regression Results (Cont.)

Dependent variable / Independent variable	HDI: Equations 1~5					HDI: Equations 6~8			HDI: Equation 9
Threshold variable (qx)	Governance					Market efficiency			Existing infrastructure
	Overall	Ethics and corruption	Inappropriate influence	Government efficiency	National security	Product market	Labor market	Capital market	
Threshold value (r)	1.988	2.825	1.418	1.869	2.895	4.189	2.846	4.430	1.632
Investment from China (t) (qx≤r)	0.067 (0.44)	0.151* (1.53)	0.067 (0.44)	0.065 (0.43)	0.064 (0.45)	0.203** (2.07)	0.065 (0.42)	0.025 (0.15)	0.070 (0.46)
Investment from China (t) (qx>r)	0.285*** (2.62)	0.469*** (2.60)	0.285*** (2.62)	0.286*** (2.62)	0.301*** (2.70)	0.262* (1.45)	0.284*** (2.61)	0.283*** (2.73)	0.283*** (2.60)
Aid from China(t)	0.076* (1.45)	0.079* (1.41)	0.076* (1.45)	0.076* (1.44)	0.075* (1.44)	0.083* (1.47)	0.075* (1.43)	0.081* (1.44)	0.076* (1.425)
Aid from China(t-1)	-0.045 (-0.76)	-0.035 (-0.59)	-0.045 (-0.76)	-0.045 (-0.76)	-0.042 (-0.71)	-0.042 (-0.71)	-0.045 (-0.75)	-0.044 (-0.73)	-0.044 (-0.74)
Investment from China(t-1)	0.143* (1.71)	0.150* (1.81)	0.143* (1.71)	0.143* (1.71)	0.148* (1.78)	0.153* (1.84)	0.143* (1.71)	0.161** (1.94)	0.141* (1.69)
Aid from China(t-2)	0.062 (1.01)	0.053 (0.87)	0.062 (1.01)	0.062 (1.02)	0.060 (0.99)	0.065 (1.06)	0.062 (1.02)	0.072 (1.18)	0.063 (1.03)
Investment from China(t-2)	0.167** (1.99)	0.172** (2.06)	0.167** (1.99)	0.167** (1.99)	0.176** (2.11)	0.170** (2.04)	0.166** (1.99)	0.163** (1.94)	0.166** (1.99)
Global net aid flows(t)	0.145 (0.83)	0.152 (0.86)	0.145 (0.83)	0.145 (0.83)	0.146 (0.83)	0.145 (0.82)	0.145 (0.83)	0.157 (0.90)	0.145 (0.83)
Global net investment flows(t)	0.050* (1.55)	0.052* (1.62)	0.050* (1.55)	0.050* (1.55)	0.049* (1.52)	0.050* (1.55)	0.050* (1.55)	0.047* (1.48)	0.049* (1.55)
Global net aid flows(t-1)	0.067 (0.37)	0.064 (0.35)	0.067 (0.37)	0.067 (0.37)	0.063 (0.34)	0.063 (0.35)	0.067 (0.37)	0.068 (0.37)	0.068 (0.37)
Global net investment flows(t-1)	-0.015 (-0.45)	-0.026 (-0.77)	-0.015 (-0.45)	-0.015 (-0.45)	-0.015 (-0.46)	-0.017 (-0.49)	-0.015 (-0.45)	-0.017 (-0.50)	-0.015 (-0.45)
Global net aid flows(t-2)	0.095 (0.56)	0.108 (0.64)	0.095 (0.56)	0.094 (0.56)	0.099 (0.59)	0.110 (0.65)	0.095 (0.56)	0.135 (0.80)	0.095 (0.56)
Global net investment flows(t-2)	0.042 (1.33)	0.045* (1.44)	0.042 (1.33)	0.042 (1.32)	0.041 (1.30)	0.045* (1.43)	0.042 (1.33)	0.052* (1.62)	0.042 (1.33)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant term	280.853*** (17.38)	280.715*** (17.38)	280.853*** (17.38)	280.852*** (17.38)	280.679*** (17.37)	280.601*** (17.35)	280.792*** (17.37)	280.107*** (17.33)	280.847*** (17.37)
R^2	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
F test	40.45***	40.56***	40.45***	40.45***	40.49***	40.33***	40.45***	40.49***	40.44***
Sample size	850	850	850	850	850	850	850	850	850

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education and culture, construction, greenfield investment, and SOE investment. The characteristic elements of the Chinese approach to poverty reduction proved to be effective in helping other developing countries reduce poverty;

(3) Although aid and investment contribute to poverty reduction in developing countries, the effects are subject to governance, market efficiency, and the existing level of infrastructure in aid recipients and host countries. There are prerequisite government and market conditions for the Chinese solution to help reduce poverty effectively in other countries.

Based on the above findings, we have identified the following priorities for China's future cooperation with other developing countries on poverty reduction:

- Improving the multi-channel approach of cooperative financing that combines aid with investment for targeted poverty reduction. In the new era, China is yet to improve its nascent foreign aid system and corporate "going global" strategy and define the roles of aid and investment in assisting other developing countries in reducing poverty according to their local conditions, avoiding a "one-size-fits-all" approach.

- China should enhance its soft power in international aid and investment cooperation via a combination of infrastructure and enabling projects. Infrastructure aid and investment from China have significantly improved people's livelihood in recipient countries. However, infrastructure projects are capital-intensive and entail labor and environmental risks. In comparison, less risky enabling projects for technology cooperation, healthcare, education, and training - which make up a small share of China's international cooperation on poverty reduction - may also significantly reduce poverty. In the future, China should curb the growth of infrastructure projects and increase the share of enabling projects for poverty reduction.

- Coordinating the relationship of government, companies and multilateral organizations, and promoting international cooperation on poverty reduction based on shared interests and inclusiveness. While the government and SOEs play a pivotal role in China's international cooperation on poverty reduction, commercial and mixed-type projects also contribute to poverty reduction in significant ways. Since government and domestic funds are insufficient to meet the ever-growing need for international cooperation on poverty reduction, China should leverage resources in broader markets globally, and work closely with multilateral and non-governmental organizations (NGOs), including the United Nations, the World Bank, and Asian, African, and American development banks. The Asian Infrastructure Investment Bank (AIIB), the BRICS New Development Bank, and the Silk Road Fund should coordinate with existing multilateral governance systems to form an open and inclusive system of international cooperation on poverty reduction.

- China should work more closely with other developing countries to improve governance and standardize market systems for sustainable poverty reduction results. Recipient countries must ensure effective governance and raise product, labor, and capital market efficiency as prerequisites for aid and investment to effectively reduce poverty. China's future cooperation with other developing countries should give more prominence to anti-corruption and governance to improve public administration and standardize market systems for more sustainable and effective poverty reduction.

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