Poverty Reduction in China: Experiences and Measurement of Effects

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Abstract: *This study employs the generalized method of moments (GMM) and panel vector autoregression (PVAR) models for a multi-factor quantitative dissection of China's poverty reduction process across multiple stages, using provincial panel data from 2000 to 2019. According to our research, economic growth and social development are the key drivers of poverty reduction in China, but the trickle-down effect of economic growth is diminishing and marketization is having a lesser pro-poor effect. Public expenditure has failed to provide social protection and income redistribution benefits due to issues such as targeting error and elite capture. Increasing the efficiency of the poverty reduction system calls for adaptive adjustments. Finally, this study highlights China's poverty reduction experiences and analyzes current challenges, which serve as inspiration for consolidating poverty-reduction achievements, combating relative poverty, and attaining countryside vitalization.*

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1. Introduction

At the national poverty reduction recognition conference on February 25, 2021, President Xi Jinping made the following solemn statement: "After the joint efforts of the whole Party and people of all ethnic groups across the country, we have scored a complete victory in our battle to fight poverty, resolved overall regional poverty, and accomplished the arduous task of eliminating absolute poverty." On the centenary celebrations of the Communist Party of China (CPC), China has fulfilled its first "centennial goal" on schedule and with high quality, built a moderately prosperous society in all aspects, and eradicated absolute poverty. Without a question, this is a watershed moment in the history of poverty eradication. With this accomplishment, China has accomplished the United Nations 2030 Sustainable Development Goals ten years ahead of schedule, contributing 70% to global poverty reduction.

Poverty reduction efforts, guided by poverty reduction philosophies with Chinese characteristics, have combined poverty reduction theory with a clear rationale, and represent a systematic project driven by different factors across various stages (Yang, 2021). In view of the poverty-reducing effect of socio-economic development, Li et al. (2019) divided Chinese poverty reduction journey since 1949 into three stages: Poverty reduction in the broad sense, developmental poverty reduction, and targeted poverty reduction. Socio-economic growth established the groundwork for poverty-reduction initiatives before

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exerting a poverty-reduction effect; however, this influence later diminished. Yang et al. (2016) divided China's poverty reduction journey into the planned economy period and the socialist market-based economy era based on the change in government role. The primary duty of the government in the first stage was to construct mechanisms and give remedies, but in subsequent stages, the government began to focus on reforms and development-oriented poverty reduction. Based on the goals and strategic choices, Wang (2018) divided China's poverty reduction journey after the reform and opening-up into four stages focusing on institutional reforms, adequate food and clothing, consolidation of poverty reduction achievements, and the creation of a moderately prosperous society; meanwhile, poverty reduction strategy evolved from regional to village-wide (Chen and Du, 2009) and targeted poverty reduction. Despite differing classification standards, they reflect China's poverty-reduction path, which is consistent with general poverty-reduction experiences and the country's national conditions (Huang and Yuan, 2020). That is, the Party and government continually adapted their strategies to the changing poverty situation (Sun et al., 2019), combining socio-economic development with the poverty reduction process. As a result, the three drivers of poverty reduction process are socio-economic development, government poverty reduction intervention, and poverty reduction strategy. The contributions of these factors have been acknowledged in different studies conducted by Chinese academics, but the majority of those studies have been qualitative and have rarely been merged into a cohesive framework for assessment and comparison. As a result, the purpose of this paper is to provide answers to the questions: What roles do socio-economic development, government poverty intervention, and strategy adjustment play in China's poverty reduction process? What are their individual contributions to poverty alleviation? Will such contributions differ significantly across the various stages of poverty reduction? This paper aims to provide a comprehensive summary and systematic review of China's poverty reduction experiences and achievements in order to aid policymaking to create long-term poverty reduction mechanisms.

While taking pride in our efforts in reducing poverty, we should also be mindful that building a moderately prosperous society in all respects does not imply the abolition of poverty. China's development continues to be unbalanced and insufficient, and poverty will almost certainly persist in the long run. Given this situation, the CPC Central Committee made accurate assessments and decided in the No. 1 Central Document for 2020 to promote long-term mechanisms for addressing relative poverty, and in the No. 1 Central Document for 2021 to adopt a five-year period for the transition from poverty reduction campaign to countryside vitalization. The priority for the next stage will be to investigate long-term mechanisms for tackling relative poverty on the basis of poverty reduction successes and to transition to a new era of countryside vitalization. The three goals of poverty reduction, relative relative poverty reduction, and countryside vitalization aim to meet people's needs for a better life. President Xi Jinping, during the implementation of the countryside vitalization strategy, called for maintaining the overall stability of the poverty relief policy and continuing to provide accountability, policy support, relief, and oversight after poor counties are lifted out of poverty to consolidate these achievements. This means that the challenges encountered during a poverty reduction program will have a long-term influence on relative poverty reduction and countryside vitalization. While reviewing successful examples of the poverty-reduction initiatives, we seek to explore the major issues that continue to plague China's poverty-reduction initiatives to help provide policy guidance for the transition between poverty reduction and countryside vitalization.

This paper conducts a multistage quantitative analysis of the poverty-reducing effects and contributions of socio-economic development, government poverty reduction interventions and poverty reduction strategy adjustment using provincial panel data from 2000 to 2019 and identifies the experiences and successes in poverty reduction as well as the problems that still exist. In comparison to previous studies, this paper may provide the following four marginal contributions. First, a two-step iterative approach and expectation maximization (EM) parametric method was used for a microscopic restoration of income group data to arrive at poverty incidence in each province, which

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are more representative and accurate than estimation based on microscopic survey data or the ratio of residents receiving minimum subsistence allowance as a proxy of poverty incidence. Second, the three driving forces of socio-economic development, government poverty reduction intervention, and strategy adjustment are incorporated into the analytical framework with GMM and PVAR to overcome the endogeneity problem caused by the interaction of variables within the system in order to obtain relatively comprehensive quantitative results to supplement the existing qualitative research on poverty reduction. Third, a multistage research perspective was used to divide samples into two stages from 2000 to 2012 and from 2013 to 2019, with targeted poverty reduction as the boundary, in order to quantify the poverty reduction contributions of the three driving forces across the two stages. The comparison of the two periods exposes the shifting influence of each factor and helps make sense of China's development rationale for poverty reduction. Fourth, citing the approach of economic growth accounting that uses residual to substitute total factor productivity (TFP), this study uses residual to estimate the impact of difficult-to-quantify poverty-reduction strategies. The poverty reduction contribution rate of residual approximates the poverty-reducing efficiency of each poverty reduction strategy, allowing for a straightforward examination of the efficiency of each reduction strategy.

2. Literature Review: Theoretical Explanations of Poverty-Reducing Effects of the Three Primary Factors

Poverty is a major hindrance to people's rights to life and development, presenting a constant challenge to human society. The abolition of absolute poverty is frequently highlighted as China's national governance achievement. As a worldwide paradigm, China's poverty reduction presents a story of broad socio-economic transformation while also expressing its political and cultural traits and poverty reduction wisdom (Li et al., 2018). Many academics have researched China's poverty-reduction journey and the reasons behind its success using qualitative or quantitative research in a systematic or targeted way. As noted in the introduction, China's driving forces for poverty reduction can be loosely classified into three categories: Socio-economic development, government poverty reduction intervention, and strategic adjustment. Socio-economic development is a key factor in reducing poverty. Government interventions have allowed for the allocation of resources and organizational capacity that goes beyond the interests of specific groups. This is particularly important when socio-economic conditions are no longer pro-poor. By adjusting its strategy, the government can optimize the allocation of resources and integrate socio-economic development with the poverty reduction process in a gradual and reasonable manner (Huang and Yuan, 2020).

2.1 Impact of Socio-Economic Factors on China's Poverty Reduction Process

Following the implementation of the reform and opening up in 1978, China underwent a period of swift economic expansion and significant social change. Currently, poverty reduction has transitioned to a new phase that focuses on development, creating a pro-poor socio-economic development mode with such an approach (Li et al., 2019). First, economic growth has a considerable impact on poverty reduction. Among the different poverty-reduction factors, the trickle-down effect of economic growth is the most important, both directly and indirectly. Economic growth offers underprivileged populations the direct benefit of better income growth and job opportunities. Furthermore, economic growth indirectly provides the government with greater poverty relief resources to improve infrastructure and public services, allowing those in poverty to pursue personal development (Wang, 2018). Li et al. (2010) estimated the poverty reduction elasticity of China's economic growth to be 1.09 using provincial data spanning the years 2000 to 2008. Furthermore, the study found that the sectoral coefficients for agriculture were considerably higher than those for the secondary and tertiary sectors. Other studies have shown opposite viewpoints. For example, Zhang et al. (2012) believe that industrialization has created

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a large number of non-farm jobs, allowing poor farmer households to earn more income from labor-intensive industrial sectors.

Second, the social development process will alleviate poverty. Economic growth is required but insufficient for poverty reduction (Li et al., 2018). In the process of social development, the trickle-down effect is subject to both structural change and institutional transformation (Adelman and Morris, 1973); structural change will modify resource distribution, while differences in institutional structure have a substantial impact on poverty alleviation. Scholars have conducted numerous studies on the growth of economic gaps, the upgrading of industrial structure, and the poverty-reducing effect of urbanization. Luo (2012) estimated the growth and distribution elasticity of change in poverty across various years using microscopic household survey data, Datt-Ravallion decomposition, and Shapley decomposition, and discovered that economic growth in China between 2002 and 2007 was not pro-poor due to widening income gaps. Industrial structure has an impact on poverty through its effects on factor density. According to Shan (2013), a low-skilled-intensive industrial structure is more helpful to the poor. Yet Li et al. (2019) considered industrial upgrading to be detrimental to poverty alleviation by increasing skill requirements. Xie (2020) conducted an empirical research on the poverty-reduction effects of urbanization, identifying rural land, non-farm employment, and skills market spillovers as the key paths of poverty reduction. According to He and Cui (2017), there is a U-shaped link between urbanization and poverty; urbanization helps to reduce poverty until it reaches an optimal level. In terms of institutional factors, effective socio-economic reforms should be implemented to empower the poor and enable them access to socio-economic opportunities to benefit from reform and development, which is a critical avenue of institutional poverty reduction (Mi and Wang, 2021). The construction and growth of the socialist market economic system is without a doubt the most profound institutional change in Chinese society. Some academics have compared the poverty-reduction effects of market-based development. For example, Yang (2021) believed that China had entered a market-based poverty reduction stage after the turn of the century, in which endogenous momentum was fostered by developing advantageous resources in poor regions and balancing regional poverty reduction with sustainability. However, in the absence of regulatory monitoring and restraint, market-based poverty reduction practice may result in the misuse of market forces, necessitating top-down policy design for market-based poverty reduction (Gong, 2016).

2.2 Impact of Government Intervention Factors on China's Poverty Reduction Process

Although economic growth offers a material foundation for poverty reduction, strong government involvement is required to further increase economic growth's poverty inclusiveness (Fan and Wu, 2011). Poverty reduction on a large scale is primarily a government initiative, demonstrating the government's resolve to eradicate poverty and to build organizational capabilities to ensure its implementation. Fiscal resources, as a fundamental tool for macroeconomic management, are also an excellent weapon for government intervention in poverty alleviation. The government may employ fiscal resources for redistribution through transfer payments to help the poor and expand the availability of public services to improve their living and working situations (Zhao, 2021). Regarding the poverty-reduction effect of government fiscal spending, some scholars evaluated the targeting precision of transfer payments (Westmore, 2018), others measured the recipients of public service spending such as healthcare and education (Li and Zheng, 2016), and still others compared their respective poverty reduction efficiency under a unified framework (Lu and Du, 2019).

2.2.1 The poverty-reducing effect of transfer payments, particularly social security spending

Among all transfer payments, social security spending has the most typical poverty-reduction effect. It allows the poorest social members to gain from economic progress by securing their basic living standards (Hua, 2010). However, some researchers argue that government funds for social security and public relief payments have not reached the hands of the poor (Xie, 2016), and that there may be

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leakages due to targeting inaccuracy (Zhang et al., 2019) and elite capture (He and Zhu, 2019). Even if such transfers reach the poor, the resulting welfare dependency and induction effect may encourage sloth, which is counterproductive to poverty reduction (Fan and Xie, 2014).

2.2.2 The poverty-reducing effects of public service spending, particularly educational spending

The Chinese philosophy of poverty alleviation emphasizes education as a cure to poverty. The initiative to mitigate poverty via ecological compensation, economic development, resettlement, education, and social protection places a high priority on educational spending. In general, educational spending can be converted into human capital, which is necessary for economic growth (Wang, 2018). Education may raise the personal viable capacity of poor populations and reduce deprivation of rights and opportunities at the microscopic level (Omoniyi, 2013) for endogenous poverty alleviation. However, some researchers have questioned the effect of educational spending. They argued that education might not have an immediate effect and, in the short run, education might even have a negative impact by crowding out other inputs, thus giving rise to the hypothesis that "education creates poverty" (Cao, 2010).

2.2.3 The impact of fiscal decentralization on poverty reduction

Under the tax sharing system, fiscal decentralization affects poverty reduction through its effects on local government transfer payments and spending on public services. According to Wei et al. (2021), fiscal decentralization has led local governments to optimize fiscal spending structure and thus alleviate the multidimensional poverty of low-income people. Tian et al. (2021) believe that fiscal decentralization has distorted the fiscal spending structure of local governments, creating an adverse effect on poverty reduction. Liu et al. (2018) called for a differentiation between spending and income decentralization, and suggested that spending decentralization was conducive while income decentralization was unfavorable to poverty reduction.

2.3 Impact of Strategic Adjustment Factors on China's Poverty Reduction Process

According to the Inclusive Green Development Survey (IGDS) conducted by the Chinese Academy of Social Sciences (CASS), 58.08% of respondents believed that the most valuable experience of the CPC's leadership over socialist development was an "accurate grasp of the principal contradiction in each historical stage proceeding from national conditions to address dominant problems and the realization of the modernization goal in a step-by-step manner". In China's poverty reduction endeavor, this experience is reflected in the constant adjustment of the poverty reduction strategy through the creation of top-down design and improvement of the poverty reduction system based on its national conditions throughout the five stages of revolutionary campaigns, poverty relief, development-oriented, endogenous, and targeted poverty reduction (Yang, 2021).

2.3.1 The poverty-reducing effect of the CPC's adjustment to its poverty reduction strategy

The leadership of the CPC has transformed political resources into government organizational resources. The government undertook policies, programs, and resource mobilization efforts to combat poverty in accordance with the Party's poverty reduction guidelines at different stages, employing the Party's governance capabilities to assist in the modernization drive and poverty reduction (Sun et al., 2019). China's successful poverty governance system and poverty reduction outcomes can be ascribed to its proactive response to changing poverty conditions, continuous refinement of the poverty reduction strategy, and the implementation of new methods for poverty reduction (Lyu, 2017). The CPC considers seeking truth from facts and being up-to date with the times as fundamental principles for socialist development. These principles are also crucial for the CPC to uphold its progressiveness and foster creativity. The CPC effectively recognized emerging patterns and challenges in poverty reduction

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through its poverty reduction initiatives. It promptly adapted its guidelines and strategic decision-making to address these issues. Additionally, it ensured that poverty reduction resources and projects were in line with the current state of poverty reduction. By doing so, the CPC maximized the impact of government interventions in reducing poverty, while simultaneously advancing socio-economic development (Huang and Yuan, 2020).

2.3.2 Poverty-reduction impact of the targeted poverty-reduction strategy

Targeted poverty reduction, as a major innovation of China's poverty reduction system, has boosted the overall performance of the program by precisely targeting sporadic poor populations dispersed across the country and implementing a variety of measures to lift them out of poverty (Sun et al., 2019). This strategy has significantly increased poverty reduction efficiency and aided in the completion of building a moderately prosperous society in all respects, effectively overcoming challenges such as inaccuracy in identification, inadequate implementation of poverty reduction responsibilities, and the lack of a synergy and poverty reduction evaluation mechanism (Huang and Yuan, 2020). Huang and Zhu (2021) conducted a multidimensional assessment of the targeted poverty reduction policy, identifying its significant poverty-reducing effects on various dimensions, particularly income, labor capacity, and quality of life, which contributed to the targeted reduction of deep poverty. According to Cai (2021), this strategy may have a spillover effect on the non-poor population through infrastructure improvements, social capital accumulation, and changes in relative income, in addition to having a direct impact on the poor population.

Academics have conducted an extensive body of theoretical and empirical research on the determinants of poverty reduction in China, yielding contradictory results. Those studies are concerned with one factor or a mix of factors. Yet China's poverty reduction strategy is a systematic endeavor driven by a multitude of factors with specific characteristics at different stages. As a result, a quantitative analysis of the poverty reduction process requires a comprehensive perspective in order to clarify its intrinsic rationale and cover all poverty reduction factors in order to estimate the contributions of socio-economic development, public finance, and other factors across various stages. It is especially vital to measure the difficult-to-quantify contribution of adjustment to the poverty reduction approach.

3. Research Design

3.1 Model Specification

In this study, we select "poverty incidence" as the explained variable for a quantitative decomposition of change in poverty. With respect to the selection of explanatory variables, we incorporate all the three major factors into the econometric model. Factors easier to quantify, such as socio-economic development and government intervention, are measured by a few concrete variables. The Solow residual measures the contribution of intangible TFP to GDP growth, excluding physical factors such as capital and labor. In a similar way, our model employs a residual for the less quantifiable strategic adjustment factor. This residual measures the contribution of technology progress and efficiency improvement stemming from the adjustment to the poverty reduction strategy, excluding the effects of socio-economic development and government intervention. Our econometric model is expressed by equation (1):

$$Y_{it}=\alpha+\sum_{j=1}^{2}\sum_{r=1}^{n_j}\beta_{jr}ESD_{jrit}+\sum_{k=1}^{3}\sum_{s=1}^{m_k}\theta_{ks}GOV_{ksit}+\mu_i+\varphi_t+\varepsilon_{it} \quad (1)$$

where i denotes the province and t denotes time measured in years. For instance, Y_{it} is the poverty incidence of province i at time t. Economic and social development (ESD) refers to a series of variables for socio-economic development, where j=1 means economic growth and j=2 means social development;

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r identifies the r-th variable in the j-th category of ESD, which contains n_j specific variables[1]; β_{jr} denotes the poverty reduction coefficient of the r-th variable in the j-th category of ESD; government (GOV) refers to a series of variables for government fiscal intervention: k takes on the values 1, 2 or 3 where 1 means educational spending, 2 social security spending, and 3 fiscal decentralization; s identifies the s-th variable in the k-th category of GOV, which contains m_k specific variables; θ_{ks} denotes the poverty reduction coefficient of the s-th variable in the k-th category of GOV; μ_i and ψ_t denote the fixed effects of province and year, respectively, and such dual fixed effects should be conducive to eliminating certain endogeneity (Yang and Liu, 2019); ε_{it} is residual error, that measures technology progress and efficiency improvement stemming from the adjustment to the poverty reduction strategy. It is a less quantifiable factor that may influence poverty reduction efficiency.

3.2 Variable Specification

(i) Explained variable. We select the "absolute poverty incidence", i.e. population below the absolute poverty line as a share of total population, as the explained variable. Change in the absolute poverty line, which is measured by monetary value, stems only from price volatility. The countryside is the main arena for the study of poverty reduction because this is where the vast majority of people in this condition live. Hence, the absolute poverty incidence in the countryside is used as the explained variable. After three adjustments[2], China's current absolute poverty line is per capita 2300 yuan/year (in 2010 constant prices). However, this national poverty line cannot reflect changes in the provincial poverty lines owing to price volatility and differences in the cost of living. Referencing Zhang and Ye (2011), we have adjusted the national poverty line of 2,300 yuan using the rural household consumer price index (CPI) of various provinces to arrive at the provincial poverty lines for various years. Provincial data after the adjustment to the poverty line of 2010 are recorded in the "China's Rural Poverty Monitoring Report" (the latest edition contains data from 2010 to 2019), but data before 2010 under the new standard are not available and must be estimated based on survey data in relevant years. After conducting each annual household survey, the National Bureau of Statistics (NBS) would release aggregated income group data rather than original micro survey data, which cannot be used to estimate poverty incidence[3]. Academics have attempted to restore income group data to the original data in order to obtain the poverty incidence.

We have estimated China's rural poverty incidence between 2000 and 2009. Poverty incidence is the proportion of population living below the poverty line. In order to obtain this ratio, we need a set of individual samples that enumerate individual income levels. In this case, microscopic data are the most appropriate for poverty research. Although microscopic data from various national surveys (UHS, CGSS, CHIP and CFPS) contain income information, their temporal span is relatively short and inappropriate for investigating long-term poverty problems. In comparison, the income group data in various provincial statistical yearbooks span across a long and continuous timeframe, but the income group data are an aggregation of data rather than original data. Therefore, it is necessary to restore the aggregated data into the original data. In other words, information of the income group data should be used to obtain an overview of the samples. Currently, provincial statistical yearbooks primarily provide two types of income group data, including equal division and interval types. Equal division means that all samples are ranked by income and divided into groups of an equal size to calculate the average income of each

[1] As can be learned from variable specification, n_1=3 means ESD in the economic growth category includes three variables, i.e. agricultural development, non-farm employment, and infrastructure; n_2=4 means ESD in the social development category contains four variables, including industrial structure, income gap, urbanization, and marketization. Hence, ESD for socio-economic development contains a total of seven variables. The definition and value of m_k are comparable to those of n_j, and we have m_1=3, m_2=1 and m_3=1, i.e. GOV for government intervention in poverty reduction includes five variables, as detailed in "variable specification".

[2] China's poverty line was 100 yuan in 1978 and 1,196 yuan in 2008 before raised to the current level of 2,300 yuan since 2010.

[3] Some studies have substituted poor population with those living below the subsistence protection (*dibao*) line. However, the *dibao* line's frequent - in some years substantial - increases have led to a rise in poor population. This treatment method is therefore not adopted in this paper.

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group. Interval type means the division of several income groups to compute the percentage of samples in each income group. Different types of income group data contain inconsistent group information, necessitating the selection of an appropriate method of data restoration based on information attributes. According to data attributes and existing literature practices, we restored samples using Shorrocks et al.'s(2008) two-step estimation method for equal division income group data,and we restored samples using the parametric estimation method based on the EM algorithm(Dempster,1977) developed by Gao(2002) for interval income group data. The detailed steps of data restoration will not be elaborated here but are available upon request.

(ii) Explanatory variable. Socio-economic development, government fiscal intervention and adjustment to the poverty reduction strategy are the three major determinants of poverty reduction in China. Among them, economic growth, social development and fiscal spending can be quantified with specific indicators.

The trickle-down effect of economic growth exerts direct and indirect effects on poverty reduction. While the direct effect stems from the creation of income growth and job opportunities for the poor through economic development, the indirect effect from economic development provides the government with greater capabilities and more resources to reduce poverty. Economic development in agricultural and urban sectors reflects the direct poverty reduction effect, while the indirect effect is manifested in government efforts to build rural infrastructure and improve public services using the poverty alleviation fund. Accordingly, we created three variables for *agricultural development*, *non-farm employment* and *infrastructure* to represent the two direct effects and one indirect effect.

The trickle-down effect of economic growth is supposed to be inclusive. However, there tends to be nuances in its manifestations due to social and institutional differences; social differences will alter resource distribution and differences in institutional arrangements will influence people's access to these resources. Factors that influence the trickle-down effect include various structural and institutional factors, such as changes in the income distribution structure, urban-rural structure, industrial mix, and market systems. Therefore, we created four variables to measure social development: *Industrial structure, income gap, urbanization, and marketization*.

The term *fiscal instrument* refers to the principal mechanism of government macroeconomic management, which also applies to poverty reduction. Spending on social security and education, in particular, is seen to have a considerable impact on poverty. While the former provides essential protection for the poor, the latter may provide a means to escape poverty. Social security spending, as a government subsidy or relief offered to low-income persons through transfer payments, may directly boost the income of the poor and is measured in this paper by the *social security spending* variable. Educational spending can be classified into three areas: (a) Compulsory education, which constitutes a key part in the educational system; (b) vocational education, which has a short learning cycle and broad job prospects; and (c) higher education, which is critical in preventing intergenerational poverty transmission. Therefore, we used three variables to measure educational spending: *Compulsory education, vocational education,* and *higher education*. Furthermore, *fiscal decentralization* will have an impact on the prioritization of public spending, as well as the incentives for social security and educational spending; therefore, a decentralization variable was also included in our model.

(iii) Interpretation of residual error. We estimated the technological development and efficiency improvement from the adjustment to the poverty reduction strategy using a residual, similar to the Solow residual that evaluates TFP in economic growth accounting. TFP is decomposed by the frontier production function into technological innovation and advancement, technological efficiency improvement, economies of scale, and increased resource allocation efficiency (Yao, 2009). Thus, the government may modulate its poverty reduction policy in these four areas. First, innovation and progress are shown by poverty reduction in the following ways: (a) Paradigm innovation, as reflected in the shift from regional development-oriented poverty reduction to targeted poverty reduction; (b)

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theoretical innovation, as reflected in the adaptation of Marxist theory to China's national conditions; (c) institutional innovation, as reflected in the shift of the poverty relief approach from the creation of external conditions for poverty relief to the creation of internal conditions for poverty reduction. Second, technologically efficient poverty monitoring takes place through accurate identification and analysis of archives, poverty reduction big data, cloud computing, and other information technologies; the development of new business modes for poverty reduction through modern logistics and e-commerce; and the provision of digital finance and credit insurance to poor households to alleviate their financial constraints. It is vital to improve supervision efficiency, enhance inspection and acceptance of poverty reduction achievements, and involve the political consultative and audit agencies as third-party supervisors. Third, poverty reduction using economies of scale is visible in China's remarkable tactics and institutional strength in mobilizing resources for an extensive poverty reduction program. Poverty reduction responsibilities have been delegated to provincial, municipal, county, township, and village Party secretaries throughout the country. Government agencies and businesses have been selected to help reduce poverty in specific localities. The collaboration of government, business, and civil society created a large-scale poverty reduction synergy. Fourth, improvement of allocation effectiveness by sending cadres to poorly organized villages to help with execution and oversight. Poverty reduction initiatives have been developed and executed to reduce poverty through industrial development, relocation, ecological mitigation, education, and social protection, with a focus on the most impoverished regions.

Table 1: Variable Explanation and Descriptive Statistics

Type of variable			Name of variable	Description	Data source	Mean	Standard error	Sample size[4]
Explained variable			Poverty incidence	Rural absolute poverty incidence (%)	See "explained variable"	17.77	18.16	533
Explanatory variable	Socio-economic development	Economic growth	Agricultural development	Per capita total power of agricultural machinery (kW/person)	CEInet Statistics Database	1.26	0.75	651
			Non-farm employment	Per capita wage income / per capita disposable income (%)	*China Labor Statistical Yearbook*	36.89	14.53	651
			Infrastructure	Per capita railway and highway length (km/10,000 inhabitants)	CEInet Statistics Database	35.24	36.92	651
		Social development	Industrial structure	Industrial structure sophistication index	CEInet Statistics Database	6.51	0.34	651
			Income gap	Theil index	CEInet Statistics Database	0.12	0.07	651
			Urbanization	Permanent urban population / total permanent population (%)	CEInet Statistics Database	49.82	16.00	651
			Marketization	Marketization index[5]	Wind Database	5.99	2.19	651
	Government fiscal intervention	Educational spending	Compulsory education	Growth rate of average rural compulsory education spending for each student (%)	*China Statistical Yearbook for Educational Spending*	17.59	12.41	620
			Higher education	Higher education scholarship / higher education spending (%)	*China Statistical Yearbook for Educational Spending*	6.09	4.35	651
			Vocational education	Growth rate of educational spending for secondary vocational schools (%)	*China Statistical Yearbook for Educational Spending*	12.07	23.82	620

[4] Growth rates need to be calculated for some variables. Hence, data for all variables start from 1999; the sample size is the number of provinces times the number of years (1999-2019), and the result is 651; the growth rate related variables start from 2000, hence the sample size in this case is 651-31=620. The "poverty incidence" variable is missing for certain provinces in certain years, hence the limited sample size of 533.

[5] Refer to Wang et al. for the calculation method. China Provincial Marketization Index Report (2018) [M]. Beijing: Social Science Literature Press, 2019. This report employs data of 2016 and before, and data of 2017 through 2019 is extrapolated based on trending.

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Table 1 Continued

Type of variable			Name of variable	Description	Data source	Mean	Standard error	Sample size[4]
Explanatory variable	Government fiscal intervention	Social security spending	Social security	Per capita social protection and employment spending (yuan/person)	*China Statistical Yearbook*	929.57	918.82	651
		Fiscal decentralization	Fiscal decentralization	Per capita local intra-budgetary spending / per capita central intra-budgetary spending[6] (times)	*China Fiscal Yearbook*	5.26	3.68	651

Source: Compiled by the authors.

4.Results and Exploration of Empirical Analysis

4.1 Effect Test of Poverty-Reducing Factors

We estimated the poverty-reducing effects of several factors through regression; the results of the three methods are reported in Table 2. Specifically, columns (1) and (4) are based on the mixed least square method and dummy variables of province and time; columns (2) and (5) are based on the two-way fixed effect model and checked for robustness through heteroscedasticity, serial correlation, and cross-sectional correlation using xtscc command in Stata; and columns (3) and (6) are based on the generalized method of moments (GMM), which is applicable to models containing multiple endogenous variables. Given the different measurement units and dimensions of variables, we used the standardized regression coefficient to compare the size of coefficients without changing their symbol and significance. It should be noted that several types of specification have been made in GMM estimation according to actual circumstances in order to overcome the potential problem of endogeneity in the model. The socio-economic development variables are specified as endogenous variables because of their reverse causality with poverty and potential influence from certain unobservable common factors. The government fiscal intervention variables are specified as predetermined variables considering that the government tends to formulate a spending plan for the next phase according to poverty status in the previous phase in order to distribute fiscal resources. Moreover, we adopt the climatic and geographical variables of annual mean temperature, annual mean precipitation, annual mean sunshine duration, average altitude, and relief amplitude[7] as purely exogenous instrumental variables (IV). As can be learned from the comparison, there is no significant difference between the estimated results of POLS and FE in terms of the size and significance of coefficients, but certain differences exist in GMM results. Therefore, endogeneity does indeed exist in the original model, necessitating the selection of IV and treatment with GMM results. Hence, the analysis and interpretation of the regression coefficients are also based on the estimated results of GMM. The Arellano-Bond (2) tests in columns (3) and (6) cannot reject the null hypothesis of no autocorrelation of disturbance term ε_{it}, and the Hansen test also shows that the instrumental variables have passed the over-identification test. Therefore, the choice of GMM estimation is appropriate.

[6] Reference: Zhang et al. Will Fiscal Decentralization Help Reduce Poverty? Inter-Provincial Evidence after the Tax Sharing Reform [J]. Journal of Quantitative & Technical Economics (JQTE), 2010, 27 (12): 3-15.

[7] Annual mean temperature, annual mean precipitation and annual mean sunshine duration are from the China Meteorological Yearbook of various years, the average altitude data of various provinces are obtained from Internet search, and relief amplitude data are calculated referencing Feng et al. (2007).

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Table 2: Poverty-Reducing Effects of Various Factors: Based on Three Types of Regression Estimation

	Variable		2000-2012			2013-2019		
			(1) POLS	(2) FE	(3) System GMM	(4) POLS	(5) FE	(6) System GMM
Economic growth and social development	Economic growth	Agricultural development	-0.217*** (-3.86)	-0.239*** (-4.46)	-0.048 (-0.86)	0.023 (0.76)	0.023 (1.37)	-0.002 (-0.07)
		Non-farm employment	-0.139* (-1.86)	-0.153*** (-3.99)	-0.428*** (-5.80)	-0.142** (-2.11)	-0.142*** (-7.86)	-0.071 (-0.74)
		Infrastructure	-0.374*** (-4.30)	-0.324*** (-5.25)	-0.455*** (-3.28)	-0.516*** (-5.52)	-0.516*** (-4.14)	-0.147 (-1.46)
	Social development	Industrial structure	0.005 (0.06)	0.009 (0.28)	0.383** (2.06)	0.042 (0.80)	0.042 (1.02)	0.147 (1.08)
		Income gap	0.323*** (3.83)	0.382** (2.23)	0.460*** (3.07)	-0.008 (-0.23)	-0.008 (-0.30)	0.032 (0.41)
		Urbanization	-0.836*** (-5.97)	-0.929*** (-6.31)	-0.370** (-2.32)	-0.326*** (-3.86)	-0.326** (-3.71)	-0.394*** (-4.86)
		Marketization	-0.046 (-1.04)	-0.062 (-1.48)	-0.419*** (-5.61)	0.103* (1.82)	0.103 (1.30)	-0.073 (-1.23)
Goverment public fiscal spending	Educational spending	Compulsory education	-0.051*** (-3.12)	-0.058*** (-3.22)	-0.057*** (-2.92)	0.010 (0.64)	0.010 (1.09)	0.021 (0.95)
		Higher education	-0.015 (-1.46)	-0.017 (-1.38)	-0.012 (-0.48)	0.034 (1.48)	0.034** (2.76)	-0.083*** (-6.07)
		Vocational education	0.020 (1.56)	0.017*** (3.42)	0.052*** (3.15)	0.002 (0.13)	0.002 (0.20)	-0.002 (-0.13)
	Social security spending		-0.135 (-1.61)	-0.174* (-1.99)	0.102 (0.89)	0.041* (1.69)	0.041 (1.12)	0.117 (1.56)
	Fiscal decentralization		0.054 (0.54)	0.042 (0.56)	0.133 (0.72)	-0.122* (-1.90)	-0.122** (-2.61)	0.030 (0.23)
Constant term			1.474*** (3.84)	0.187* (1.93)	0.872*** (5.91)	-0.173 (-0.56)	-0.197*** (-5.42)	-0.365*** (-6.94)
Province			Yes	Yes	Yes	Yes	Yes	Yes
Time			Yes	Yes	Yes	Yes	Yes	Yes
Observations			316	316	316	217	217	217
R^2			0.966	0.902		0.904	0.799	
Arellano-Bond (1)					0.024			0.036
Arellano-Bond (2)					0.919			0.370
Hansen test					0.502			0.412

Note: Numbers in parentheses are *t* values; *, ** and *** denote significance at 10%, 5% and 1% levels; FE estimation reports R^2 within the group.
Source: Estimated using Stata 15.0 software.

(i) Estimated results for the period from 2000 to 2012. Economic growth, as shown in column (3), had a broad anti-poverty effect. The significantly negative coefficients for *non-farm employment* and *infrastructure* imply that economic growth created non-farm jobs and improved infrastructure, hence creating opportunities for poverty reduction. Transformations in various social structures and systems reflect differentiated poverty-reducing effects, and the coefficients of *industrial structure* and *income gap* are significantly positive, indicating that industrial upgrading and the urban-rural income gap were unfavorable to poverty reduction during this period. Both *urbanization* and *marketization*

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have significantly negative coefficients and are conducive to poverty reduction by providing the poor with information and opportunity to generate greater income. In the public fiscal spending of government, the coefficient of *compulsory education* is significantly negative, demonstrating the effectiveness of the dropout protection mechanism; the coefficient of *higher education* is insignificant, which can be attributed to problems in the issuance of scholarships (Chen et al., 2013) and a possible lag effect in poverty reduction through spending on higher education; the significantly positive effect of *vocational education* reflects the poor quality of vocational education. The coefficient of *social security spending* is insignificant, implying that such transfer payments have failed to aid the poor. The insignificant coefficient of *fiscal decentralization* means that the current tax sharing and performance evaluation systems provide insufficient poverty reduction incentives for local government fiscal spending.

(ii) Estimated results for the period from 2013 to 2018. According to the column (6), none of the three economic growth variables are significant, which shows the diminishing trickle-down effect of economic growth. The significance of *industrial structure* and *income gap* has also diminished, meaning that neither of them has any significant adverse impact on poverty reduction. There is an increase in the poverty-reducing effect of *urbanization*, implying that new-type urbanization has benefited the deeply poor regions left out from traditional urbanization. The poverty-reducing effect of *marketization* is no longer significant, suggesting a decline in its pro-poor effect. A probable reason is that marketization created shocks to the otherwise poverty-reducing effect of private social network capital and other informal systems. Among the three variables of educational spending, the coefficient of *compulsory education* is no longer significant, which explains that the marginal poverty-reducing effect of compulsory education diminished after the universalization of nine-year compulsory education; the coefficient of *vocational education* is no longer significant either, implying that vocational education is no longer unfavorable for poverty reduction; the coefficient of *higher education* becomes significantly negative, suggesting that college scholarships alleviated the financial burden of students from poor households and made it less likely for them to drop out. In fact, most students from poor households who received college scholarships had benefited from the universalization of compulsory education, reflecting the long-term and continuous nature of poverty reduction through education. There is no significant change in the coefficients of *social security spending* and *fiscal decentralization*, which means that their problems persisted during this period.

4.2 Contribution Decomposition of Poverty-Reducing Factors

The preceding section provided an interpretation of the poverty-reducing effects of numerous factors based on estimated GMM coefficients, which depicts an ideal scenario assuming that other variables remain constant. To determine the real effect of each variable on poverty reduction, it is necessary to substitute the coefficients into equation (1) to arrive at the final model, and use actual data for each variable to estimate their contribution to poverty incidence. To this end, we used two decomposition methods: Difference and variance decomposition. While difference decomposition is a factor decomposition of the change in poverty incidence over time, variance decomposition is an itemized decomposition of the inter-provincial variance in poverty incidence over time. Both types of decomposition can be utilized to quantify each factor's contribution to poverty reduction. While the former focuses on the causes of lowering poverty incidence, the latter investigates the causes of inter-provincial poverty incidence convergence to zero. As a robustness analysis, it is recommended to perform variance decomposition after difference decomposition. This technique also allows to consider the reasons for inter-provincial poverty convergence and to assess the driving forces behind overall poverty reduction.

4.2.1 Difference decomposition of poverty incidence change

The difference of poverty incidence can be decomposed into the weights of the differences

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of variables and residual error using the approach for economic growth accounting. Similar to the calculation of TFP for growth accounting using the Solow residual, residual error in this section reflects poverty reduction efficiency, and changes in the residual error reflect changes in efficiency. The results of difference decomposition are shown in Table 3.

Table 3: Decomposition of the Contributions of Poverty-Reducing Factors: Difference Decomposition Based on Change in Poverty Incidence

Key Factors	Sub-Factors	Variable	2000-2012				2013-2019			
			Nationwide	Eastern region	Central region	Western region	Nationwide	Eastern region	Central region	Western region
Economic growth and social development	Economic growth	Agricultural development	4.96	3.30	9.20	3.14	0.05	-0.28	0.37	0.13
		Non-farm employment	36.50	50.39	34.02	22.06	3.72	12.22	-0.44	-1.88
		Infrastructure	23.95	11.42	32.48	31.31	5.66	2.99	6.88	7.50
		Sub-total	65.41	65.11	75.70	56.51	9.43	14.94	6.80	5.75
	Social development	Industrial structure	-38.73	-64.12	-28.25	-17.70	-36.89	-54.03	-34.11	-20.54
		Income gap	12.54	32.33	-18.62	16.85	5.11	6.57	6.58	2.19
		Urbanization	33.67	43.68	35.41	20.09	50.28	66.87	52.15	30.34
		Marketization	76.41	183.80	19.59	-1.31	17.14	33.46	8.28	7.16
		Sub-total	83.89	195.68	8.13	17.92	35.64	52.87	32.90	19.16
	Total		149.30	260.79	83.83	74.44	45.07	67.80	39.70	24.90
Government public fiscal spending	Educational spending	Compulsory education	-9.11	-21.24	-2.42	-0.58	10.74	19.67	5.76	5.41
		Higher education	1.65	0.57	1.33	3.22	6.22	7.04	4.29	7.07
		Vocational education	11.76	24.74	4.08	3.08	-3.39	-8.90	-0.14	-0.27
		Sub-total	4.29	4.07	2.99	5.72	13.57	17.81	9.91	12.21
	Social security spending		-23.25	-46.00	-8.70	-9.05	-43.22	-70.42	-33.91	-21.69
	Fiscal decentralization		-19.72	-30.75	-12.36	-13.11	-3.24	-9.03	-0.20	0.40
	Total		-38.68	-72.67	-18.07	-16.44	-32.89	-61.64	-24.20	-9.08
Poverty reduction system	Poverty reduction efficiency	Residual error	-10.62	-88.12	34.24	42.00	87.82	93.84	84.50	84.17

Notes: Contribution of a certain factor over the period from 2000 to 2012 (or from 2013 to 2019) is the average value in various years during this period, and its contribution in a certain year is the average value for various provinces within the year. As such, the average value of various provinces across the country is adopted to calculate the national value; and the average value of various provinces within the region is adopted to calculate the regional value.
Source: Compiled by the authors.

Over the period 2000–2012, economic growth factors may have contributed 65.41% to poverty reduction and social development factors may have contributed 83.39%. Economic growth resulted in the creation of non-farm jobs, and marketization enabled the labor force in deprived areas to migrate to cities in quest of non-farm opportunities. Meanwhile, economic growth increased government fiscal resources, improved infrastructure in poor regions, and accelerated urbanization and the equalization of basic public services, allowing the poor to share the benefits and opportunities of development. However, the government's public fiscal instruments on the spending side failed to effectively reduce poverty and, in some cases, resulted in resource waste (-38.68%), with compulsory education spending (-9.11%)

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and social security spending (-23.25%) both contributing negatively. Fiscal decentralization (-19.72%) lessened the contribution of fiscal spending even further. Local governments prioritized infrastructure while neglecting public services and transfer payments under the fiscal decentralization system, leaving them underfunded (Zhang et al., 2010). Due to inaccurate targeting, elite capture, crowd-out, and induced effects, the limited financial assets were subject to further losses. The aforementioned issues occurred all across the relative poverty reduction system, resulting in inaccurate poverty identification, waste of poverty reduction resources, and a disordered organizational structure, showing a negative contribution of the residual (-10.62%). Poverty reduction during this time period was ineffective, and the poverty reduction policy needed revision.

From 2013 to 2018, the trickle-down effect of China's economic growth decreased from 65.41% to 9.43%, and the pro-poor effect of social development also decreased from 83.89% to 35.64%, owing primarily to the decreasing contribution of marketization, which shrank from 76.41% to 17.14%. The reason for this is that the countryside trailed behind cities in marketization reforms, with diminishing marginal poverty reduction effects (Zhou and Tao, 2016), potentially causing shocks to informal institutions such as private social network capital. Furthermore, the government's increasingly strong role has distorted market mechanisms to some extent (Shen, 2020). The negative contribution rate of industrial structure (-36.69%) indicates that upgrading industrial structure underlines the challenging nature of providing jobs for the poor, far away from supporting pro-poor industrial projects. As in the previous period, government public fiscal spending's contribution to poverty reduction was negative (-32.89%). This suggests that even during the targeted poverty reduction period, fiscal spending on public services and transfer payments was still susceptible to leakage, and that in the future fiscal system, special poverty reduction funds need to be replaced with conventional fiscal instruments to reduce operating and management costs. Despite a minor increase, educational spending contributions remained modest (13.57%), emphasizing the need to improve the poverty-reducing effects of vocational and higher education and promote endogenous poverty reduction capabilities for the poor. Finally, the contribution of residual error increased significantly over this time span, rising from -10.62% to 87.72%. Therefore, the targeted poverty reduction approach effectively addressed the major contradictions and challenges in poverty reduction, resulting in a large boost in poverty reduction efficiency. According to the IGDS, 39.25% of respondents attributed China's remarkable poverty-reduction achievements to "targeted and effective poverty-reduction programs and policy support".

China's eastern, central, and western regions all reduced poverty with the same features as nationwide. Government public fiscal spending has the biggest negative effect in the eastern region. Local governments in the eastern provinces have not given adequate attention to poverty reduction and have failed to efficiently transfer fiscal resources to the poor despite significant socio-economic development. This issue is also evident in the efficiency of poverty reduction, with the highest negative contribution from 2000 to 2012. The contribution of the income gap became negative in the central region. It should be highlighted that educational investment made only a minor contribution to poverty reduction, and this contribution became the least important after 2013 possibly because of central region's tremendous abundance of human resources. In the western region, socio-economic development contributed the least to poverty reduction, and marketization's effect was even negative, indicating the country's large regional development disparity. The government needs to maximize the role of socio-economic development in future poverty reduction efforts.

4.2.2 Inter-provincial variance decomposition of poverty incidence

Variance decomposition is extensively applied in the analyses of income gaps. Based on the logarithmic form of the Cobb-Douglas production function, Klenow and Rodriguez-Clare (1997) decomposed the variance of income into the sum of the covariance between income and TFP and the covariance between income and factor input. After substituting the regression coefficient into equation (1),

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poverty incidence can be expressed as the linear aggregation (including the constant term and residual error) of each variable terms (the product of the variable and its coefficient). Hence, the variance of inter-provincial poverty incidence in a given year may also be expressed as the sum of covariances between poverty incidence in the current year and individual variables, and the contribution of a given variable is the covariance as a share of the variance of poverty incidence. For instance, the contribution of socio-economic development in year t is expressed as $\sum_{j=1}^{2}\sum_{r=1}^{n_j}\mathrm{cov}(Y_t,\beta_{jr}ESD_{jrt})/\mathrm{var}(Y_t)$, and the contribution of efficiency (residual error) is $\mathrm{cov}(Y_t,\varepsilon'_t)/\mathrm{var}(Y_t)$[8].

According to the statistics, the variance of inter-provincial poverty incidence decreased over the years, showing that poverty gaps in various provinces were shrinking and converging toward zero; therefore, the goal of eradicating absolute poverty was almost complete. The variance in inter-provincial poverty incidence over time is then decomposed to investigate which factors contributed to inter-provincial poverty convergence and which others contributed to its divergence. Figure 1 depicts the variance contributions of socio-economic development, government fiscal intervention, and adjustment in poverty reduction strategy (as reflected in its efficiency).

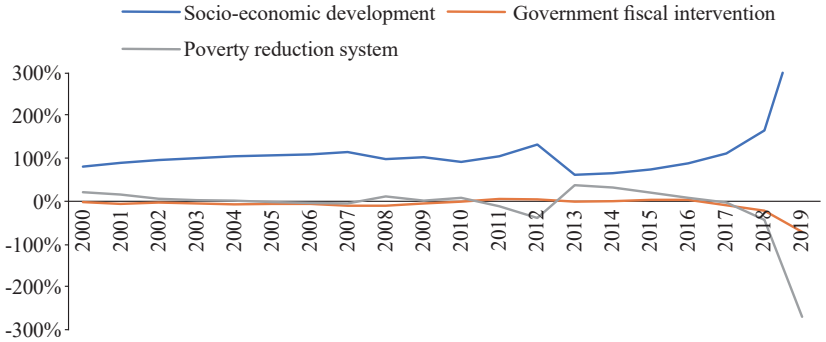

Figure 1: Contributions of Three Factors to the Variance of Inter-Provincial Poverty Incidence (2000-2019)

Source: Compiled by the authors.

Figure 1 shows that, with the exception of a significant increase in 2019[9], the contributions of economic growth and social development to the variance of inter-provincial poverty incidence lingered around 100% in most years. Economic growth and social development were the fundamental drivers of inter-provincial poverty gaps. Specifically, the variance contribution of economic growth is smaller than that of social development and it became negative after 2013 (data available upon request) and began to promote the convergence of inter-provincial poverty incidence. However, social development inequalities among provinces continued to limit inter-provincial poverty convergence.

Except for a significant decrease in 2019 (due to the same reasons described above), the contribution of provincial government public fiscal spending to poverty variance is close to zero, meaning that provincial fiscal spending will not lead inter-provincial poverty incidence to converge. To remedy the lack of synergy between provincial governments, the central government needs to provide additional fiscal resources to specific impoverished areas.

[8] Residual $\varepsilon'_t=\varepsilon_t+\mu$; contribution of the constant term: $\mathrm{cov}(Y_t,cons)/\mathrm{var}(Y_t)=0$, and the constant term includes the common temporal trend of various provinces φ_t.

[9] The absolute values of contributions of various factors in 2019 are subject to substantial increases or decreases, as the goal of eliminating absolute poverty approached its near completion. As a result, the incidence of poverty in provinces converged to zero with minimal variance. As a result, when the contribution ratios were computed, the denominator shrunk considerably.

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The variance contribution of poverty reduction strategy is slightly more than that of fiscal intervention by the government. However, when compared to socio-economic development, poverty reduction strategies are not the primary cause of inter-provincial poverty differences. In recent years, its contribution rate has decreased significantly and turned negative, becoming a key factor impeding inter-provincial poverty incidence divergence and promoting its convergence to zero. This suggests that the targeted poverty reduction strategy has accelerated the pace of poverty reduction in impoverished regions, making it possible to eradicate absolute poverty by 2020.

4.3 Robustness Analysis

When actual conditions are considered in our baseline analysis, the choice of particular variables may have an unpredictable impact on the results. For instance, economic growth variables are limited to *agricultural development*, *non-farm employment*, and *infrastructure*. However, economic growth has many facets, and focusing on only three variables may not properly reflect their impact on poverty reduction. Besides, the choice of variables for educational spending, particularly higher education, has spatial spillover effects[10]. Our baseline analysis created indicators only based on local (provincial) spending in the *China Education Funding Statistical Yearbook* to investigate the effects of educational spending on poverty reduction in various provinces, but such selection may not fully exclude the spatial spillover effect given the recruitment of students from other provinces. Moreover, the selection of the social security spending variable. In the "general public budget spending" section of provincial statistics yearbooks, we have currently selected the "social security and employment spending" item. This component, however, comprises not only low-income allowances, but also payments for retirees from administrative and public institutions, as well as administrative expenses for civil affairs services. As a result, it may not be suitable to calculate the amount of allowances for the poor through transfer payments using "social security and employment spending".

To answer the above three concerns and strengthen the robustness of the empirical results, we created three robustness analysis schemes by supplementing and substituting the variable design. The first robustness analysis scheme established a comprehensive variable *economic growth* in the baseline scenario based on variable selection to measure the level of economic growth based on provincial nominal GDP growth rates. The second robustness analysis scheme restructured the *higher education* variable to include central government spending and investigate the spatial spillover effect of central fiscal allocations. The third robustness analysis scheme changed the variable *social security spending* to exclude "pension funds of administrative and public institutions",[11] which account for nearly one third of total spending but are not intended to subsidize low-income people and thus have little effect on poverty reduction.

The system GMM approach is used in all the three robustness analysis schemes. The results are generally robust and show no significant deviation from the baseline regression. The newly included *economic growth* coefficient is not significant, showing that the three variables of *agricultural development*, *non-farm employment*, and *infrastructure* may include the poverty-reducing conduits of economic growth. In the second robustness analysis scheme, both the significance and absolute values of the *higher education* coefficient have increased, indicating that most universities that have received central government fiscal allocations have outstanding academic performance and have created spillover

[10] The *compulsory education* indicator is based on educational spending for each rural compulsory education student, whereas the *vocational education* indicator is based on secondary vocational education spending. Such schools will only recruit local students, with a low possibility of spatial spillover.

[11] Since 2007, the itemized data of pension spending for administrative and public institutions for individual provinces have ceased to be separately reported, but national data have continued to include such itemized data. As a result, based on existing ratios before 2007 and the rising trend of national statistics, we computed the proportion of pension spending for administrative and public institutions in *social security and employment spending* for various provinces since 2007.

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effects by enrolling non-local students. As such, in order to exclude the spatial spillover effect to some extent, we exclusively used local data and excluded central government data in the formulation of indicators based on our analysis. In the third robustness analysis scheme, the coefficient of *social security spending* turns significantly positive, implying its leakage has aggravated after excluding pension spending for administrative and public institutions. That is, such transfer leakage indeed occurred in the allowance and relief for the low-income people rather than in administrative spending. The difference decomposition results of the three robustness analysis schemes are generally consistent with the baseline decomposition (regression estimates and difference decomposition results are available upon request).

5. Further Analysis

The eradication of absolute poverty in China does not imply that poverty reduction has been completed once and for all. Widening wealth disparities demand ongoing research into long-term strategies to deal with relative poverty while consolidating poverty-reduction results. Meanwhile, during the transition period, poverty reduction policies need to be reasonably stable. Hence, two further analyses will be carried out: First, the Foster–Greer–Thorbecke (FGT) indicator system will be established to analyze the factors of poverty depth and severity in order to draw attention to poverty gaps within poor groups. Second, the PVAR is used to analyze the lag effect and long-term influence of several factors on poverty in order to determine which policies and factors should be kept stable during the transition period and which needed to be corrected immediately.

5.1 Analysis of FGT Indicators

To better identify income distribution within the poor group, FGT indicators include the scope, depth, and severity of poverty. Following a discussion of the effects of several factors on the scope of poverty (poverty incidence), we will examine their effects on the depth and severity of poverty to determine the extent to which poor groups have benefited and to call attention to income disparities within poor groups.

Factors that significantly affect the scope or incidence of poverty will likewise affect poverty depth and severity, according to the regression results (available upon request). Poverty-inducing and poverty-reducing factors both have an increasing impact on the scope, depth, and severity of poverty. In other words, the depth and severity of poverty are more susceptible to those factors, and some adverse situations for poverty reduction, if not addressed promptly, can result in more depth and severity of poverty, as well as widening wealth gap. Certain factors, according to our regression analysis, may limit the scope of poverty without reducing the depth and severity of poverty. That is, those characteristics may only benefit people around the poverty line and rarely reach the truly impoverished. For example, urbanization may benefit poor communities on the edges of towns but does nothing to help the destitute in remote areas.

Economic growth and social development, according to the decomposition results (available upon request), contribute less to poverty depth and severity than to the scope of poverty. That is, while socio-economic growth is important for poverty reduction, the majority of beneficiaries are the moderately poor, who face less poverty and are more likely to benefit. The extremely poor, on the other hand, confront a more dire situation and are less likely to gain. As a result, the government must target the extremely poor. The results of difference decomposition also revealed that government public fiscal investment may help to reduce the depth and severity of poverty. Despite transfer payment leakage due to targeting inaccuracy and elite capture in the process of reducing the scope of poverty, government public fiscal spending remains the most effective means of improving living standards for the deeply poor who are excluded from socio-economic progress.

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5.2 PVAR Estimation

Variables such as economic growth and social development, as well as government public fiscal spending, may all have complicated and dynamic interactions with poverty incidence. As a result, the panel vector autoregression (PVAR) model has emerged as an appropriate choice. This model combines the benefits of the VAR model and panel data, and it considers all variables to be endogenous in order to investigate the interaction and lag effects, making it suited for "large N and small T"[12] short panel data. To detect the long-term trend, we use the PVAR model to analyze dynamic interactions between variables and poverty incidence (model details are available upon request).

We split two systems for separate investigation since incorporating multiple variables into the same model will increase the number of parameters to be estimated at the expense of flexibility. System 1 includes variables such as poverty incidence, economic growth, industrial structure, income gap, urbanization, and marketization, whereas System 2 includes variables such as poverty incidence, compulsory education, higher education, vocational education, social security, and fiscal decentralization (see Table 1). System 1 is obviously meant to examine the dynamic interactions of economic growth and social development variables with poverty incidence, whereas System 2 is intended to examine the dynamic interactions of government public fiscal spending with poverty incidence.

Before proceeding with the PVAR analysis, we first test data stationarity using three unit root test methods of LLC(Levin-Lin-Chu, 2002), IPS(Im, Pesaran & Shin, 1997), ADF-Fisher(Fisher's Augmented Dickey Fuller method)(Fisher,1932), and the results indicate that all the variables belong to stationary sequences. Thus, the optimal number of system lags is determined based on the three information criteria of AIC(Akaike information criterion), BIC(Bayesian Information Criterion), and HQIC(Hannan-Quinn Information Criterion) for model selection, and results show that System 1 is of the second order and System 2 is of the first order. In other words, socio-economic development has a longer-term impact on poverty incidence than government fiscal spending. After determining the order of lag, the data are substituted into the model for GMM parametric estimation as well as the model's stationarity and Granger causality tests. The results indicate that the model is generally stationary, and that all variables in both systems jointly compose the Granger cause of poverty incidence, allowing for pulse response and variance decomposition (test results are available on request). The PVAR model, on the other hand, is just a generic description of the correlation between variables in the system, and the GMM estimated results have no economic significance. Pulse response and variance decomposition, on the other hand, may be more relevant. While the former may show the path of unilateral dynamic effect of one variable after experiencing shock, the latter may demonstrate the contribution of variation(structural shock) in a specific variable to overall variation(forecasted variance) over the forecast period. Both can be used to observe the short-term fluctuations and long-term trends in lag effects.

Because the purpose of this paper is to investigate the effect of each variable on poverty incidence, we only reserve resluts of the pulse response and variance decomposition using poverty incidence as the response variable or forecast variable (additional results are available upon request). Figure 2 depicts the pulse response results, while Table 4 depicts the variance decomposition results.

In Figure 2 (a), the response of poverty incidence in System 1 to its own shock is still positive and the highest, implying the existence of inertia in poverty. Poverty incidence has relatively small responses to economic growth and Theil index, implying that economic growth and income gap under the current data trend are no longer the primary determinants of poverty. Poverty incidence significantly responds to industrial structure, urbanization and marketization, most of which are related to job opportunities and income growth. Compared with the lack of material wealth and income, the deprivation of information

[12] The meaning of "large N and small T" is: there are many individuals at the individual level, but fewer periods at the time level.

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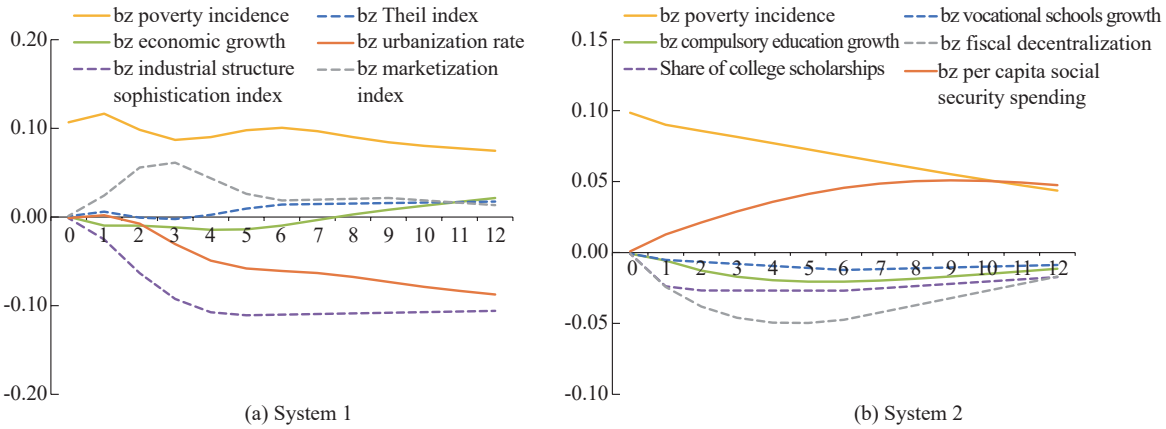

Figure 2: Pulse Response Charts

Notes: "bz poverty incidence" denotes standardized treatment of the poverty incidence variable. The same for other bz variables.
Source: Compiled by the authors.

and opportunities is becoming the main contributor to chronic poverty. Notably, marketization has a long-term positive effect on poverty, implying that it is urgent to address certain factors that are not pro-poor in marketization.

In Figure 2 (b), the response of poverty incidence in System 2 to its own shock is still positive and the highest but is starting to diminish. Poverty incidence responds negatively to compulsory education, vocational education, and higher education. This means that education has a significant lag effect in reducing poverty. Higher education creates the greatest effect in reducing poverty, and therefore holds the key to overcoming the intergenerational transmission of poverty. Fiscal decentralization has a negative effect on poverty; owing to fiscal decentralization, the government developed a preference to invest in infrastructure, creating a crowd-out effect on financial resources that otherwise could have been used to reduce poverty. Yet eventually, infrastructure is conducive to poverty reduction. Social security spending has a positive effect on poverty overall, suggesting the existence of significant leakage[13].

Table 4 reports the results of variance decomposition for 20 periods under both systems. Results of System 1 indicate that when the forecast is conducted for the 20th period, contribution of change in poverty incidence to its own forecasted variance is around 30%, whereas for System 2 is around 50%; this implies that other variables in System 1 have a greater influence on poverty incidence than in System 2. In other words, socio-economic development has a longer-term effect on poverty compared with government fiscal spending. This result also reflects the existence of inertia in the change of poverty, which necessitates adjustment in the poverty reduction strategy in order to rectify poverty-inducing factors. Moreover, Table 4 also indicates that industrial structure and urbanization have a considerable influence on poverty forecast. Therefore, industrial development and new-type urbanization should serve as major contributors to poverty reduction in the future. According to the decomposition results, however, education has a limited contribution to the variance of poverty forecast, implying that the role of education in reducing poverty has yet to be unleashed. In comparison, per capita social security spending contributes significantly to poverty, indicating that flaws in social security system will create an adverse long-term impact on poverty reduction.

[13] The meaning of social security expenditure leakage is that social security expenditure has not been fully distributed to the truly impoverished people, and a part of it has been distributed to non-impoverished people.

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Table 4: Results of Variance Decomposition

System 1 (including economic growth and social development variables)							
	Number of periods	bz poverty incidence	bz economic growth	bz industrial structure	bz income gap	bz urbanization	bz marketization
bz poverty incidence	1	1.00	0.00	0.00	0.00	0.00	0.00
bz poverty incidence	5	0.57	0.01	0.28	0.00	0.04	0.11
bz poverty incidence	10	0.43	0.01	0.39	0.01	0.11	0.05
bz poverty incidence	15	0.35	0.01	0.41	0.01	0.18	0.04
bz poverty incidence	20	0.28	0.03	0.40	0.01	0.25	0.03
System 2 (including government fiscal spending variables)							
	Number of periods	bz poverty incidence	bz compulsory education	bz higher education	bz vocational education	bz social security	bz fiscal decentralization
bz poverty incidence	1	1.00	0.00	0.00	0.00	0.00	0.00
bz poverty incidence	5	0.74	0.02	0.06	0.01	0.05	0.13
bz poverty incidence	10	0.59	0.03	0.06	0.01	0.14	0.16
bz poverty incidence	15	0.55	0.03	0.06	0.01	0.21	0.14
bz poverty incidence	20	0.53	0.03	0.06	0.01	0.23	0.13

Source: Compiled by the authors.

Notes: "bz poverty incidence" denotes standardized treatment of the poverty incidence variable. The same for other bz variables.

6. Concluding Remarks and Policy Recommendations

6.1 Concluding Remarks

Using provincial panel data from 2000 to 2019, this paper provides a multi-stage and multifactor decomposition of China's poverty reduction process to explore contributors to China's poverty reduction and identify China's poverty reduction experiences and problems. We have reached the following findings after classifying poverty-reducing factors into three categories: Economic growth and social development, government public fiscal spending, and adjustment in the poverty reduction strategy.

First, economic growth and social development are the key drivers of poverty reduction in China. According to the variance decomposition based on GMM estimation, economic growth and social development both greatly accelerated the process of poverty reduction from 2000 to 2012. Economic growth has raised government fiscal income and created non-farm jobs, while marketization has allowed the movement of rural labor to cities for non-farm careers. Because of government infrastructure investment, urbanization and equal access to urban and rural public services have made significant progress, allowing poor regions to share in the benefits of development. However, between 2013 and 2019, the trickle-down effect of economic growth diminished, and social development's contribution also saw a decrease as the pro-poor effect of marketization declined. Meanwhile, variance decomposition based on GMM estimation suggests that economic growth and social development are the primary contributors to inter-provincial poverty gaps, although economic growth's contribution is smaller and has begun to promote inter-provincial poverty incidence convergence.

Second, government public fiscal spending has failed to protect the poorest. According to variance decomposition, social security spending through transfer payments contributed negatively to poverty reduction, reflecting problems such as targeting error and elite capture; the modest contribution of educational shows the untapped potential of education in poverty reduction. Another conclusion is that provincial public fiscal investment has failed to increase the convergence of inter-provincial poverty incidence. Therefore, it is necessary for the central government to coordinate and distribute central fiscal

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assets to poor regions.

Third, adaptive adjustment in the poverty reduction strategy is essential to raise the efficiency of poverty reduction efforts. According to difference decomposition, the poverty reduction contribution of residual error was negative over the period from 2000 to 2012, indicating the existence of unquantifiable factors that diminish poverty reduction efficiency; over the period from 2013 to 2019, the contribution of residual error to poverty reduction substantially increased and turned positive, indicating that the implementation of the targeted poverty reduction strategy effectively addressed various contradictions and problems in the previous poverty reduction work and therefore significantly increased poverty reduction efficiency. Meanwhile, variance decomposition also indicates that the poverty reduction strategies and systems of various provinces have to some extent contributed to the inter-provincial poverty gaps, but are not the primary contributors compared with socio-economic development. The implementation of the poverty reduction strategy in recent years began to promote the convergence of inter-provincial poverty incidence, coordinating poverty reduction work in various provinces, accelerating the catch-up pace of poor regions and expediting the process of countrywide poverty eradication.

Fourth, although socio-economic development in the current stage may substantially reduce the scope of poverty, it does little to benefit the deeply poor; despite the leakage of government public fiscal spending in reducing the scope of poverty, it is one of the few effective means in assisting those who are left out from socio-economic development.

Fifth, there is a a longer lag and a greater extent in the poverty-reducing effects of economic growth and social development compared with government public fiscal spending, although the adverse effect of marketization calls for attention. There is a long lag in the poverty-reducing effect of educational spending, indicating that education is of far-reaching significance to poverty reduction. The long-term effect of social security spending on poverty is positive, highlighting the need to address the problem of elite capture to avoid long-term adverse impact on poverty reduction.

6.2 Policy Recommendations

The Central No. 1 Document of 2021 called for "establishing a five-year transition period following the eradication of absolute poverty to shift the priority from poverty reduction to countryside vitalization". The primary task during the transition period is to address various problems during the poverty reduction period and extend the functions of the poverty reduction system to incorporate countryside vitalization into a comprehensive and institutionalized regular poverty reduction framework, as well as to develop long-term mechanisms for addressing relative poverty.

(i) Strengthening the poverty-reduction momentum of socio-economic development through inclusive economic growth and the countryside vitalization strategy centered on market-based mechanisms and industrial development. The government should focus on addressing the problem of unmarketable agricultural products while maintaining stable economic performance and a stable employment environment. More efforts are needed to enhance the role of the market in resource allocation, to create a unified urban and rural land market, to ensure market entry and exit systems, and to facilitate the transaction of rural collective construction land. Financial institutions should develop the rural land finance guarantee business in order to improve the real right of use of rural housing plots. Furthermore, industrial development should contribute to rural vitalization by fostering feature industries based on local conditions, extending industrial chains, bringing farm products to market through leading enterprises, exploring collective economic modes such as cooperatives, creating prestigious brands, and promoting the spillover effects of tourism in reducing poverty (Wang et al., 2020).

(ii) The poverty-reducing efficiency of government public fiscal spending should be increased by improving poverty prevention monitoring and sorted support, as well as promoting equal access to

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basic urban and rural public services, focusing on incentivizing local governance and empowering poor populations. Local governments should build capacity for poverty reduction and rural vitalization, promote a bottom-up self-governance model, and improve remuneration for grassroots cadres. To eliminate information asymmetry, the government should embrace digital information technology. Steps should be taken to improve poverty monitoring and categorized poverty relief, to use big data platforms for poverty reduction with the assistance of early warning and rapid response to poverty recurrence, and to improve monitoring and special groups such as migrant and rural left-behind residents. Priority should be given to poverty prevention and long-term support in order to provide the poor with opportunities for sustainable development. Progress should be made in equalizing access to essential public services between cities and the countryside, as well as promoting public-interest education, healthcare, and other welfare programs in poor regions to encourage people to stay in the countryside. Vocational schools should prepare students for local employment. College graduates should be encouraged to return to the countryside and use their knowledge and talents to help alleviate poverty. Experiences for achieving money and prosperity should be shared in order to inspire others to follow.

(iii) Strategic adjustment and system upgrade are needed to further enhance sustainable poverty reduction capabilities, allowing social forces to participate while prioritizing urban and rural cooperation and regional equilibrium. The approach to poverty reduction should evolve from targeted poverty reduction to a simple and systemic approach to poverty reduction. Simple approach to ensuring the cost effectiveness of poverty reduction is required; many poor groups, such as the elderly and migrant people, should be covered by generic poverty criteria. Furthermore, the complexity of relative poverty highlights the role of private organizations and informal systems in bringing together many stakeholders for poverty reduction on the basis of a capable government and well-functioning market (Huang, 2014; Xie and Song, 2021). It is also advised that cities and rural areas use distinct relative poverty lines to target poor groups in an accurate and simplified manner. Poverty reduction strategies and measures should be integrated to improve efficiency and encourage urban-rural integration, with a focus on the needs of the urban poor. Furthermore, poverty reduction programs should be tailored to local circumstances in order to tap into human capital reserves in the central region and accelerate marketization in the western region. To close regional gaps and establish regional cooperation, less developed regions should be incorporated into priority development plans.

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