Signifying the relationship between education input, social security expenditure, and urban-rural income gap in the circular economy

Yuan Wang[1,2],*, Yingjun Huang[1] and Muddassar Sarfraz[3],*

[1]Department of Finance, School of Economics and Business Administration, Chongqing University, Chongqing, China, [2]Department of Finance, Chongqing College of Finance and Economics, Chongqing, China, [3]School of Management, Zhejiang Shuren University, Hangzhou, China

This paper takes the inter-provincial panel data of China from 1999 to 2015 as the research sample and uses the GMM estimation method to empirically test the relationship among education input, social security expenditure, and urban-rural income gap. The results show that education input and social security expenditure have a significant impact on the urban-rural income gap, and there are regional differences. Specifically, the augments of education input and social security expenditure widens the urban-rural income gap in the western region, and narrows the urban-rural income gap of the eastern and central regions but has less impact on the eastern region. The paper provides a new perspective for understanding the urban-rural income gap in China, and has a significance meaning for further increasing the educational investment in the western rural areas, and improving the redistribution efficiency of social security expenditure.

KEYWORDS

educational input, social security expenditure, urban-rural income gap, GMM estimation, circular economy, sustainable practices

1 Introduction

Investment in education is an essential factor that massively influences a country's economic growth and distribution of income. In the view of the economic model, education refers to investment in a country's resources (e.g., human capital) on equity grounds. According to modern economic growth theory, investment in education can improve the level of human capital and then enhance labor productivity and boost economic growth. With the influx of a large number of rural surplus labor forces into cities at present, human capital is likely to widen the income gap between urban and rural residents while promoting economic development in cities.

In recent years, the People's Republic of China has massively invested in education. However, the situation in China still demands economists to manage and eradicate the existing urban-rural income inequality. Over the years, the high level of income disparity

in China has curbed the country's economic activities, demanding an improved redistribution process. Indeed, as per this requirement, China needs to effectively focus on the existing urban-rural income disparities that may cause serious harm to the country's economic efficiency and social equality. In China, the increasing urban-rural income gap increases poverty, thus boosting the need for economic prosperity (Guo and Zhang, 2019). Considering such a background, it has become necessary to mitigate the growing economic disparities to help stabilize China's long-term economic development (Khan, et al., 2022a; Yu et al., 2022).

At the same time, at the present stage, a socialized and multi-level social security system, in which the government dominates with shared responsibilities, has been formed in China. In particular, launching sustainable economic reforms has made China the fastest growing country (Khan, et al., 2022b). However, the regions of China have not shared the fruits of economic development equally. Consequently, China has experienced a rise in unequal income distribution. With the increasing trend in urban-rural income inequality, the conventional systems have failed to identify the root cause of the growing disparities. As such, the literature states that accelerating income inequality has potentially hurt China's economic and social development, thereby signaling the need to resolve the imbalance in urban-rural income (Wang et al., 2019).

After a long period of negligence, researchers have focused on the subject of urban-rural economic disparities. Over the years, several factors have contributed to accelerating the widespread income distribution. But, today, the desire to minimize the income disparities has liberalized education and social security expenditure to stop the progressing effect of resource inequalities. Social security is a primary source that provides financial support to the world economies. Therefore, the research shows that China has reduced urban-rural income inequality through social assistance provisions. Social security expenditure has an impact on the income distribution of residents by affecting the accumulation of human capital elements, wage distribution, and the accumulation of material capital. When the initial distribution pattern is determined, the government re-distributes the income by transfer payment, thereby narrowing the income distribution gap arising from the initial distribution (Xiao and Yu, 2017). From the empirical aspect, the literature shows that lower expenditures on social policies unfavorably influence the urban-rural residents' disposable income. The decrease in social security reforms led to a decline in fiscal expenses. In explaining this notion, the research states that the transfer payment in education reduces the urban-rural income gap by significantly contributing to the country's economic prosperity (Beneke et al., 2017; Sarfraz et al., 2020). Thus, it is evident that both education investment and social security expenditure can impact the income distribution and hence the income gap between urban and rural areas.

Altogether, during the last few years, growing income disparity has caused the Chinese government to experience an imbalance in resource allocation, thus elevating numerous problems such as the urban-rural income gap. China, as the trend-setter of regional economic welfare, has marginalized the need to accelerate the effect of economic equality on the surrounding regions by reducing the urban-rural income gap. However, to address this research gap, this paper empirically investigates the impact of education input level on the income gap of China's circular economy. As China comprises a large population, managing the increasing disparity issue has become a significant issue for the Chinese government.

Therefore, in response to the research gap, this study examines the effect of urban-rural income inequality. It aims to investigate the answer to the following research questions. Does the government's education investment and social security expenditure help narrow the income gap between urban and rural areas? Is there any difference in this impact between different regions? Also, this study enriches the literature on Chinese economics. It substantially improves the research content on unequal income distribution. Fundamentally, this forms the new basis for promoting urban-rural income equality. The literature help boost world economics by showing how to significantly narrow the income gap among the different regions (Taleb Da Costa, 2021). In particular, this study provides suggestions to formulate redistribution policies to reduce the growing income gap in the People's Republic of China.

This study includes five sections. The first section briefly provides an overview of the research objective and significance. Then, Section 2 (i.e., the literature review) presents a comprehensive view of the subject. Next, Section 3 suggests the study methodology, and Section 4 describes the study outcomes. Lastly, Section 5 concludes the article by providing policy implications and future directions.

2 Literature review

The widening of the urban-rural income gap has given rise to a number of economic and social issues as the structural problems in China's economic development process have gradually become apparent. Education investment is closely related to human capital. Suppose the education investment is unevenly distributed in a region. In that case, it will directly affect the development of human capital in the region and the income gap between urban and rural areas. Xue and Wang (2009) show that the investment in educational resources in China is unevenly distributed. Samuelson & Solow (1956) contend that the difference in human capital is the real cause of the income gap between regions.

Many scholars have studied the income gap between urban and rural areas. Lin (2003) has found that the income gap between urban and rural areas in China shows a rapid growth

trend. Wang (2009) analyzed the significant income gap between urban and rural residents in China from the perspective of the mobility of residents' income. Wang and Fan (2004) put forward that the varying degrees of productivity and capital flow disparities are the significant causes of the income gap between regions in China from the allocation and flow of production factors in the different areas. Yang (2009) analyzed the relationship between the income gap of residents and the income redistribution system. The results showed that the income gap of residents is significantly affected by the income redistribution policy. Chen and Feng (2000) finds that the main reason for the income gap of residents in different regions in China is the unbalanced development of private enterprises. Chen and Li (2017) calculated the equalization effect of financial expenditure at all levels of subsistence allowance in cities in China, arguing that the provincial financial departments of the urban subsistence allowances failed to play a positive role and even offset the equalization effect to a certain extent. Guo and Fu (2017) analyzed the relationship between the fiscal expenditure on the social protection floor, urban bias, and the income gap between urban and rural residents according to the provincial panel data from 1999 to 2013. They proposed that the fiscal expenditure on the social protection floor has a reverse relationship with the income gap between urban and rural residents.

In particular, the impact of education input on the urban-rural income distribution is heterogeneous. At present, China is facing considerable challenges concerning income distribution. In this regard, researchers have stated that improvements in the educational input can guide the country to reduce urban and rural disparity. Indeed, this call to manage the country's resource allocation has made economists keen to reduce the urban-rural income gap. The comprehensive view of academic literature on the circular economy suggests the country should embrace effective business models and approaches to optimizing the country's efficiency by marginally reducing the unequal resource allocation. As such, the study states that equal distribution of educational input reduces income inequality in the circular economy (Arshed et al., 2018; Sarfraz et al., n. d.; Shah et al., 2019).

Recently, increasing urbanization has significantly contributed to China's economic development. However, in this regard, social security plays a fundamental role in influencing the income gap. The social security expenditure in China tends to be urbanized. At the same time, the transfer income of urban residents is higher than that of rural residents, and there is a substantial income gap between urban and rural residents. In recent years, scholars have mainly studied the relationship between social security expenditure and the income gap between urban and rural areas from the following three perspectives. Firstly, the specific ways that social security expenditure affects the income gap between urban and rural areas.

Wang and He. (2014) argue that social security mainly narrows the income gap between urban and rural areas from the link of redistribution. Still, the function of redistribution fails to be exerted effectively. Secondly, the empirical analysis of the impact of the social security expenditure in urban and rural areas on the income gap between urban and rural areas. Tao (2008) conducted a comparative analysis of the items and level of social security in urban and rural areas in China and proposed that the social security expenditure in urban and rural areas has a significant impact on the income gap between urban and rural areas. Thirdly, the relationship between social security expenditure and the income gap between urban and rural areas.

Hu et al. (2011) contend that the regional differences in social security expenditure do not significantly narrow the income gap between urban and rural areas.

Over the years, multiple studies have explored the relationship between educational level and urban-rural income distribution (Marginson, 2019). The prior literature showed that several factors widen the urban-rural income disparities. This new trend has made the government adopt development strategies to accelerate the country's fiscal development (Wang et al., 2019). The objective of the social security expenditure is to promote the country's economic freedom by significantly decreasing the income gap. Social security provides financial assistance to rectify the increasing inequalities. However, various studies show that social security positively impacts urban-rural income equality. One study claims that social security expenditure contributes to the residents' long-term happiness and the country's economic stability (Zhang et al., 2019). The social security expenditure reforms progressively work towards reducing income inequality. As such, another study states that social security expenditure decreases the effect of the income gap in urban-rural areas (Yu & Li, 2021).

Significantly, the effect of the social security expenditure has become a worthy topic for today's researchers and economists. By bridging the income gap among the varied regions, China has made remarkable achievements in the global economy. In contrast, over the past decades, the urban-rural disparity has impaired resource efficiencies, thus influencing the economic prosperity of the world's countries. However, in this regard, the socio-economic problems caused by the increasing income inequality pose risks to high-economic countries. As an impact of social security policies, the government should reduce the resource differences among the regions. For example, the social security system in India works to improve human wellbeing (Drèze & Khera, 2017). In Vietnam and Southern Africa, social security assistance has significantly reduced poverty. Hence, similar results have been found in other areas. Indeed, the impact of social security expenditure policies has helped countries to minimize resource inequality. The research finds that the global economies should focus on decomposing income inequality among various regions (Azam & Bhatt, 2018).

Educational investment and social security expenditure mainly derive from the government's tax revenue, and there is intergenerational transfer. Kaganovich & Zilcha (1999) analyzed the relationship between public education investment and social security expenditure and conducted an empirical test on the role of government tax revenue in economic growth with the aid of the overlapping generations model. Pecchenino & Utendorf (1999) found that social security expenditure reduced economic growth and social welfare. Pecchenino & Pollard (2002) pointed out that, to ensure the quality of education, an increase in educational investment and a decrease in social security expenditure could boost economic growth.

Glomm & Kaganovich (2003) argue that increasing public educational investment may lead to unfair income distribution. Glomm & Kaganovich (2008) found that social security expenditure is inversely proportional to the income gap. Still, the impacts of educational investment and social security expenditure on economic growth are both non-monotonicity.

Rojas (2004) analyzed the relationship between education investment and social security expenditure. Qiu (2009) demonstrated that social security could narrow the income gap by means of numerical simulation. However, from this viewpoint, social security has emerged as the most profound tool stimulating the country's urban-rural income gap. The social security system is a mechanism that helps countries manage their economic resources (i.e., wealth inequality) (Catherine et al., 2020).

This system narrows down the effect of the income gap on human civilization. It reduces future uncertainty, thus stimulating the country's economic freedom. In explaining this notion, the study states that the social security system reduces future socio-economic variability, thus substantially narrowing the income gap (Deng et al., 2019). In terms of the security reforms, China has been successful in ceaselessly advancing its economic activity. Similarly, these reforms have also been initiated in other countries, thus making the influence of social security expenditure meaningful. (Liu & Chen, 2012) study showed that public education investment and social security significantly impact the income gap between urban and rural areas.

Taking Hubei Province as an example, Wang (2017) conducted an empirical analysis on the impact of years, quality, and structure of education on the income of the poor in rural areas. Zeng and Jiang (2020) examined the effects of population age structure and social security level on the urban-rural income gap using provincial panel data from 2000 to 2017 in China, integrating systematic GMM estimation methods and panel threshold regression models.

A significant negative effect of the child dependency ratio on the urban-rural income gap was found, and that an increase in social security expenditure strengthens the impact of the child dependency ratio on reducing the urban-rural income gap. The significant positive effect exerted by social security expenditure

on the urban-rural income gap was apparent. No significant linear relationship exists between the old-age dependency ratio and the urban-rural income gap, but there is a significant threshold effect.

Li (2020) analyzed the moderating effect of social security expenditure on the income gap between urban and rural residents through the regional panel data of Xinjiang from 2007 to 2018. The results indicated that there was a significant threshold effect on the regulation of social security expenditure on the income gap between urban and rural residents in Xinjiang, and the increase in social security expenditure showed a change from non-significant "inverse regulation" to significant "positive regulation". According to Song and Gao (2022) believe that education investment and service sector development narrow the urban-rural income gap. Meanwhile, education investment has an inverted "U" shape on the urban-rural income gap, while service sector development has a positive "U" shape. This non-linear relationship is mainly reflected in the existence of a threshold effect.

By reviewing the existing literature, it is evident that scholars have reached a consistent conclusion on the impact of social security expenditure on the income gap between rural and urban areas. Social security expenditure significantly impacts the income gap between rural and urban areas. At the same time, some scholars believe that the main reason for the income gap between urban and rural areas is the increase in educational investment. At present, there is extensive literature on the influence of educational investment on income and social security expenditure on the urban-rural income gap. However, there is little research on the interaction between educational investment and social security expenditure on the urban-rural income gap. This paper intends to conduct an empirical analysis of the influence of educational investment and social security expenditure on the income gap between urban and rural areas to provide a reference for the government to make budget decisions.

3 Model setting, data sources, and estimation method

3.1 Model setting

The Theil index, which is an index to measure the income gap between urban and rural areas of groups, individuals, or regions, is sensitive to the changes in income of different classes and conforms to the current situation of the income gap between rural and urban areas in China (Long et al., 2015). Therefore, this paper uses the Theil index to measure the income gap between urban and rural areas in China.

To examine the level of educational investment and the influence of social security expenditure of different provinces and cities on the income gap between urban and rural areas in

this region, this paper constructs the following inter-provincial panel data model:

$$Theil = \sum_{i=1}^{2} \frac{Y_{it}}{Y_t} \ln\left(\frac{Y_{it}}{Y_t} \Big/ \frac{P_{it}}{P_t}\right)$$

$$= \frac{Y_{1t}}{Y_t} \ln\left(\frac{Y_{1t}}{Y_t} \Big/ \frac{P_{1t}}{P_t}\right) + \frac{Y_{2t}}{Y_t} \ln\left(\frac{Y_{2t}}{Y_t} \Big/ \frac{P_{2t}}{P_t}\right) \quad (1)$$

$$theil_{it} = \beta_0 + \beta_1 \ln theil_{it-1} + \beta_2 \ln edu_{it} + \beta_3 \ln sc_{it} + \beta_4 X + \mu_i + \varepsilon_{it} \quad (2)$$

In the formula, edu_{it} represents educational investment, which is measured by the proportion of education expenditure to GDP of provinces and municipalities. sc_{it} represents social security expenditure, which is measured by the ratio of social security expenditure items to GDP in the same period. X represents the control variable. i represents the province, t represents the date, β_0 represents the intercept term, β_1, β_2, β_3, and β_4 represent the coefficients of explanatory variables, μ_i represents the individual effect, and ε_{it} represents the stochastic disturbance term.

3.2 Selection of control variables and data declaration

This paper refers to the article by Lv. (2017) on the method of selecting control variables that affect the income gap between urban and rural areas to select the control variables. The degree of opening to the outside world is expressed by the proportion of the total import and export volume of each province to the GDP of the region. The urbanization rate is expressed by the proportion of urban population to the total population of each province. The capital formation rate is expressed by the proportion of the total capital formation of each province to the GDP. Human capital is expressed by the proportion of the number of college students in each province to the total population. Population aging is expressed by the proportion of the population aged 65 years and over to the total population of each province.

3.3 Data sources and declarations

In light of the starting time of statistics on medical and health expenditure, pension and social welfare expenditure, retirement expenditure of administrative institutions and social security subsidy expenditure, and major changes in the field of education in China, the sample interval of this paper is defined as the period from 1999 to 2015. Based on the panel data of 30 provinces, autonomous regions, and municipalities directly under the Central Government (excluding the Tibet Autonomous Region with missing data), this paper divides 30 provinces, autonomous regions, and municipalities directly

under the Central Government into eastern, central, and western regions by referring to the sample division method of (Xin Liu, 2013). Among them, the eastern region includes Beijing, Tianjin, Hebei, Liaoning, Shandong, Jiangsu, Zhejiang, Shanghai, Guangdong, Fujian, and Hainan; the central region includes Inner Mongolia, Heilongjiang, Jilin, Shanxi, Henan, Anhui, Hubei, Hunan, and Jiangxi; and the western region includes Guangxi, Shaanxi, Gansu, Sichuan, Guizhou, Chongqing, Yunnan, Xinjiang, Ningxia, and Qinghai[1]. The data in this paper comes from the China Statistical Yearbook, China Population Statistics Yearbook, and provincial statistical yearbooks. The statistical declarations of the variables are shown in Table 1.

3.3.1 Estimation method

In this paper, the Generalized Method of Moments (GMM) is used to analyze the relationship between education investment, social security expenditure, and the income gap between urban and rural areas, which involves a panel unit root test, panel cointegration test, and GMM estimation.

3.3.2 Panel unit root test

The LLC test and Breitung test are applicable If it is assumed that each cross-section sequence in the panel data has the same unit root. The IPS, Fisher-ADF, and Fisher-PP tests are also applicable. To make the test results more robust, this paper uses LLC, Fisher-ADF, and Fisher-PP tests.

3.3.3 Panel cointegration test

The cointegration test is composed of seven test statistics proposed by Pedroni et al. (1999) and ADF statistics proposed by Kao (1999), among which Panel v, Panel ρ , Panel PP and Panel PP, and Panel ADF are described by the joint intra-group dimension, while the group dimension describes Group, Group PP, and Group ADF. Pedroni pointed out that when the test results are inconsistent, Panel ADF and Group ADF statistics should be used as the standard (Liu and Liu, 2010). Considering robustness, this paper adopts the methods proposed by Pedroni and Kao to carry out the panel cointegration test.

3.3.4 Generalized Method of Moments

Since the least square method cannot eliminate the endogenous nature of variables, this paper uses the GMM proposed by Marino-Buslje et al. (1998) to solve the endogenous problem.

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1 Liu Xin, Liu Wei. Combined Effects on the Income Gap of Eastern, Central and Western Education Investment and Social Security Spending (J).Northwest Population Journal. 2013, (7).

TABLE 1 Statistical characteristics of sample variables.

Variable name	Variable declaration	Mean	Standard deviation	Maximum	Minimum
Theil	Theil index of the income gap between urban and rural areas	2.5641	0.6785	4.7600	1.1400
Edu	Educational investment	29.0652	15.4687	85.4267	11.5174
Sc	Social security expenditure	221.3682	188.1491	927.9500	4.5933
Open	Degree of opening to the outside world	0.3782	0.4421	1.7032	0.0753
Cit	Urbanization rate	0.5736	0.1625	1.3440	0.1625
Inv	Capital formation rate	0.4896	0.1415	0.8069	0.1364
Hum	Human capital	0.1624	0.0507	0.3975	0.0852
Age	Population aging	0.0528	0.0591	0.1485	0.0519

TABLE 2 Panel unit root test.

Variable	Method of panel unit root test		
	LLC	Fisher-ADF	Fisher-PP
Edu	−1.7727 (0.5759)	36.5930 (0.5289)	42.4382 (0.4219)
Dedu	−14.5598 (0.0000)***	287.0765 (0.0000)***	446.0589 (0.0000)***
Sc	−3.6564 (0.0003)	68.5218 (0.1186)	65.8891 (0.1378)
Dsc	−20.6583 (0.0000)***	437.0296 (0.0000)***	474.0643 (0.0000)***
X	−1.1093 (0.8719)	62.7728 (0.3742)	100.0555 (0.0002)
DX	−17.1859 (0.0000)***	371.0817 (0.0000)***	602.0419 (0.0000)***
Theil	−0.7575 (0.6717)	61.3320 (0.2003)	43.0745 (0.4788)
Dtheil	13.9423 (0.0000)***	239.0500 (0.0000)***	405.0897 (0.0000)***

Notes: *** represents the 1% significance level.

TABLE 3 Panel cointegration test.

Variable	Cointegration test
Panel v-statistic	−1.97 (0.6451)
Panel ρ- statistic	−3.21 (0.000)***
Panel PP- statistic	−15.64 (0.325)
Panel ADF- statistic	−9.27 (0.000)***
Group ρ- statistic	0.24 (0.641)
Group PP- statistic	−19.64 (0.674)***
Group ADF- statistic	−9.25 (0.000)***
Kao ADF	−4.51 (0.000)***

Notes: *** represents that the original hypothesis is rejected at the 1% significance level.

4 Empirical results

4.1 Stability of variables

The LLC, Fisher-ADF, and Fisher-PP methods were used to test the unit root of each variable. As can be seen from Table 2, the original sequence of each variable is non-stationary. Still, the sequence after the first-order difference is stationary, and thus there may be a cointegration relationship between variables.

According to the foregoing estimation method, panel co-integration tests were carried out for eight variables, such as Panel v-Statistic. As can be seen from Table 3, the Panel ADF and Group ADF statistics of all variables reject the original hypothesis at the 1% significance level. As a result, it is believed that there is a long-term co-integration relationship between educational investment, social security expenditure, and the income gap between urban and rural areas in China.

Due to the superiority of GMM estimation in solving endogenous problems, this paper adopts the GMM to conduct an empirical analysis of the impact of education investment and social security expenditure on the income gap between urban and rural areas in the eastern, central, and western regions. The results are shown in Table 4.

The logarithm of the Theil index in the eastern region did not pass the significance level test, indicating that the income gap between urban and rural areas in the previous period did not affect the income gap between urban and rural areas in the current period. The logarithms of educational investment and

TABLE 4 Empirical results among educational investment, social security expenditure, and the income gap between urban and rural areas.

Item	Eastern GMM	Central GMM	Western GMM
Intheil	0.0492 (0.21)	1.5901* (1.91)	0.0259 (0.34)
Inedu	0.0246** (2.19)	0.1729* (1.84)	0.0068* (1.67)
Insc	−0.2293** (−2.25)	−2.2172* (−1.95)	0.0314* (1.79)
Open	0.0026 (0.05)	−1.3788 (−1.64)	0.0406*** (2.94)
Cit	−0.9873*** (−5.17)	−4.6229** (−2.37)	−2.2544*** (−3.98)
Inv	−0.0611 (−0.04)	−16.5396* (−1.67)	−0.4060*** (−2.77)
Hum	0.0505 (0.75)	4.9196 (1.63)	−0.3124** (−2.39)
Age	0.2951 (0.15)	−18.5995 (−1.47)	2.7146 (1.94)
Hausman	72.47***	13.70	26.32***
Wald	5,956.26***	856.68***	602.19***
AR (1)	0.5206 (0.5357)	0.5111 (0.6290)	−0.3062 (0.7544)
AR (2)	0.3677 (0.7507)	0.4171 (0.6676)	−0.2176 (0.7980)
Sargan	0.5224 (1.0000)	2.7814 (1.0000)	2.3982 (1.0000)

Notes: ***, **, * represent the significance at the statistical levels of 1%, 5% and 10% respectively.

social security expenditure significantly affected the income gap between urban and rural areas. Except for the urbanization rate, other control variables did not pass the significance level test, which shows that the urbanization rate is an important factor affecting the income gap between urban and rural areas in the eastern region.

The logarithm of the Theil index in the central region passed the significance level test, indicating that the income gap in the current period was significantly affected by that of the previous period. The income gap between urban and rural areas was significantly affected by the logarithms of educational investment and social security expenditure. Among the control variables, the urbanization and capital formation rates passed the significance level test. The coefficients were negative, indicating that the urbanization capital formation rate reduced the income gap between urban and rural areas in the central region.

The logarithms of educational investment and social security expenditure in the western region passed the significance level test, which shows that education investment and social security expenditure widened the income gap between urban and rural areas in the western region to a certain extent. The control variables of the degree of opening to the outside world, urbanization rate, capital formation rate, and human capital all passed the significant level test, among which the degree of opening to the outside world enlarged the income gap between urban and rural areas in the western region. In contrast, urbanization rate, capital formation rate, and human capital narrowed the income gap between urban and rural areas.

5 Conclusion

Based on the GMM and the inter-provincial panel data of China from 1999 to 2015 as samples, this paper conducted an empirical analysis of the relationship between educational investment, social security expenditure, and the income gap between urban and rural areas.

Educational investment greatly impacts the income gap between urban and rural areas because the main source of income for urban residents in China is wages, and human capital is the main factor affecting employment. In China, the long-term implementation of the policy of preferential investment in education funds in cities is not conducive to the accumulation of human capital for residents in rural areas, thus eventually widening the income gap between urban and rural residents (Chen et al., 2010). The income gap between urban and rural areas was significantly affected by educational investment and social security expenditure, mainly because families had to undertake the educational expenditure of their children. Even if the government does not increase social security expenditure, the urban residents will invest in their children's education. However, due to the lack of social security, low family income, and the lack of the concept of poverty alleviation through education, the residents in rural areas spend less on their children's education, which, to some extent, restricts the accumulation of human capital in rural areas. The income gap between urban and rural areas in the eastern and central regions was significantly narrowed due to educational investment, but that in the western region was still enlarged. The main reason for this is that a majority of students from the western region choose to stay in the eastern or central regions after graduating from university, which leads to a lack of talent in the western region and enlarges the income gap between urban and rural areas. The income gap between urban and rural areas in the western region was not narrowed as in the eastern region due to the impact of social security expenditure since the funds were less invested in social security expenditure in rural areas of the western region.

5.1 Policy recommendations

Based on the above conclusions, the following recommendations should be implemented to narrow the income gap between urban and rural residents in China:

First, the government should strengthen education investment in poverty-stricken areas. Efforts should be made to improve the quality of education and the conditions for running schools in poverty-stricken areas, enabling poor students to access compulsory education in a comprehensive way. At the same time, the government should cooperate with enterprises, institutions, and social organizations to build a diversified educational investment mechanism.

Second, the government should optimize the rational allocation of educational resources. Expenditures on various types of education funds at all levels in various regions must be refined and implemented, supervised, and managed by special personnel to effectively solve the problem of uneven distribution of educational resources.

Third, the government should establish a growth mechanism for social security expenditure. According to the level of economic development, it is necessary to devise a growth mechanism of social security expenditure to meet the living needs of residents to realize the full coverage of social security in poverty-stricken areas.

Fourth, the government should improve the social security systems in urban and rural areas. The equalization of social security expenditure between urban and rural residents should be gradually realized at multiple levels and through multiple channels. Efforts should be made to eliminate the differences between urban and rural residents in social security expenditure.

Data availability statement

The original contributions presented in the study are included in the article/supplementary materials, further inquiries can be directed to the corresponding author/s.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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