



Allocation Structure of Educational Funds in China

Based on Panel Analysis on Gini Coefficient of Educational Expenditure from 2005 to 2018

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Abstract. In this paper, the data of educational funds at all levels in China were divided into five groups for comparison and evaluation by Gini coefficient with respect to the allocation structure by researching the allocation structure of educational funds at the four-stage education in regular primary schools, regular junior secondary schools, regular senior secondary schools and general institutes of higher education based on the educational expenditures at all levels of governments in 31 provinces, municipalities and autonomous regions in China from 2005 to 2018. The study found that with the increase of years, the overall Gini coefficient of all levels of education showed a downward trend; the results of regional comparison showed that the central region had the best level of fairness in all levels of education, followed by the western region and the eastern region the worst; in the four-stage education, the contribution of regional differences in regular senior secondary schools is the largest, and that of general institutes of higher education is the smallest. Suggestions are put forward to optimize the allocation structure of educational funds, including further exploring the structural role of educational financial investment while maintaining it at all levels; realizing the transition from equal access to education at all levels in a small region to nationwide; continuing to optimize educational fairness at all levels, focusing on improving the equal access to regular senior secondary schools; strengthening the radiation capacity of Beijing, Shanghai and Guangzhou and improving the equal access to education at all levels in the eastern region.

Keywords: Allocation Structure of Educational Funds · Gini Coefficient · Four-Stage Education · Regional Education

1 Introduction

The change in the proportion of public educational funds to financial revenue and expenditure directly reveals the position of education in the national financial arrangement, and reflects the degree of support of the national finance for education to some extent. Under the conditions of fixed public educational funds, the allocation structure of educational funds is the primary factor affecting the proportion of all forms of education funds at

all levels and the investment of education funds in all provinces and regions. Therefore, optimizing the educational allocation structure is an important means to promote the fair development and quality improvement of education. Education resources system mainly includes human resources, material resources and financial resources, in which human resources and material resources are converted from financial resources, i.e. education funds. Therefore, without adequate guarantee of educational funds, it is impossible to have human resources and material resources with quality and quantity guaranteed [14]. The research on the allocation structure of educational funds includes three aspects: the first is the allocation structure of educational funds among all forms of education at all levels, the second is the allocation structure of educational funds among regions, and the third is the allocation structure of educational funds among schools [13]. In this paper, the first two aspects are mainly discussed.

In the issue of allocation structure of all forms of education at all levels, Ye Jie (2017) proposed that colleges and universities have the greatest contribution to the provincial differences in the total expenditure per capita of students, but their contribution ability decreases year by year, contrary to that of primary and secondary schools based on the expenditure data of per capita educational funds of students in regular primary schools, regular secondary schools and regular institutions of higher learning [15]. Si LB et al. (2017) put forward that the most effective way to improve the performance of basic educational expenditure is to improve the quality of resource allocation of investment elements according to the results of performance evaluation in pre-school, primary, junior and high school stages [11]. Kim B and Park N (2018) analyzed the total expenditure on higher education in Korea, and considered that financial support is still poor compared with the financial support for K-12 education [7]. It is common in the existing research literature to merge regular junior high school and regular senior high school into ordinary middle school to form a three-level education mode of regular primary school, regular 1 middle school and regular high school. Due to the differences of teaching modes and enrollment modes between junior high school and senior high school, it is necessary to analyze their structure of educational funds respectively.

Scholars have done a lot of research on the allocation of educational funds among regions. De Gregorio J and Lee J W (2002) explained that educational factors play an important role in the fair distribution of regional income using the national education data from 1960 to 1990 [4]. Coady D and Dizioli A (2017) found a positive correlation between average years of education and income inequality across regions [2]. Some scholars are concerned about the regional differences in the average student expenditure for a specific level of education, in terms of the allocation of basic education resources. Gu Jiafeng (2008) found that the introduction of spatial-related variables strengthen the convergence of inter-provincial funds [5]. Si LB et al. (2017) evaluated the quality of preschool teaching in rural areas in fixed areas and found out some problems such as uneven distribution of educational resources and unbalanced quality of education [12]. Kafumbu F T (2020) assessed the impact of educational funding programmes on the equity and efficiency of secondary education in Malawi [6]. In terms of higher education, Bruce C and Doris Aedín (2019) analyzed the feasibility of financing higher education in Ireland by simulating student loans from Irish graduates [1]. Ngo V L (2019) held that the reconstructed government higher education revenue plan serves both the rights

and efficiency objectives [9]. In the analysis of the structure of educational expenditure, scholars mostly make a single-dimensional analysis on all forms of education at all levels and regional education, but seldom combine the two to make a two-dimensional analysis.

In terms of the application of time series panel data, Languille S analyzed the rapidly expanding fiscal budget for secondary education in Tanzania from 2004 to 2012 and the impact of political factors on its educational budget allocation [8]. Ni Hai (2014) and others measured the difference of educational expenditure between 2000 and 2011 in the three regions of east, middle and west [10]. In these studies, only educational fund data for a certain period of time are selected, but less internal comparison and reference comparison are used for time series. Especially for China's investment in education funds, since the proportion of national fiscal expenditure of education to GDP exceeded 4% for the first time in 2012, it has remained above 4% for 7 consecutive years. "Only after stabilizing the investment in education, can the investment structure be 'optimized' to promote fair development and quality improvement of education, and ensure the healthy and sustainable development of all forms of education at all levels [16]." Therefore, in this paper, in terms of data time series dimension, 2012 is taken as the middle point, and seven years are selected forward and backward to form the horizontal dimension of 2005–2018, and the data analysis of 2005–2011 is taken as the reference group for data analysis of 2012–2018.

In summary, the existing relevant studies have quantified the differences in the allocation structure of educational funds in different periods of education or different regions with the help of different technologies and indicators, preliminarily studied and speculated the possible reasons for the differences in the allocation of educational funds, and put forward relevant suggestions for optimizing the allocation structure of educational funds. On this basis, in this paper the general education is divided into four stages of regular primary school, regular junior high school, regular senior high school and regular institutions of higher learning, which are combined with different regions to analyze the change and trend of the proportion of educational expenditure allocated by the government from 2005 to 2018 under the data of five different groups of regional representatives by taking 2012 as the center of the time series, and finally the general rules of the changes in the distribution structure of investment in four-stage education in China are summarized and the relevant suggestions for optimizing the allocation structure of educational funds are proposed.

2 Methods

2.1 Research Objects and Data Collection

Since inter-provincial differences in general education reflect most of the information on inter-provincial differences in education in China, it is selected as the research object in this paper. The general public budget educational operating expenses per student in 31 provinces, municipalities and autonomous regions (hereinafter referred to as provinces, cities and regions) from 2005 to 2018 in the regular primary schools, regular junior high schools, regular senior high schools and regular institutions of higher learning are taken as the operational index of average student expenditure of educational funds, in which

the sum of the above data is taken as the data of general education. The general public budget educational operating expenses per student at all levels of education refer to the appropriations that schools (units) obtain from the financial departments at the same level, which are included in the General Public Budget 205 categories of “Educational Expenses” in the Classified Subjects of Government Income and Expenditure, and do not include capital construction funds and extra charges of education funds. Starting from 2017, the term “public finance budget educational operating expenses per student” has been changed to “general public budget educational operating expenses per student”. In terms of data sources, the data of per student educational expenditure for all levels of education in all provinces and cities are derived from the the Statistical Yearbook of Education Funds in China (2006–2019) covering 2005 to 2018 and the Statistical Table of the Implementation of National Educational Funds in 2005–2018 published by the Ministry of Education of China.

According to the regional division criteria of relevant statistical data, the eastern region includes 11 provinces and cities of Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan, and the sum average of which is taken as the representative value of the eastern region; the central region consists of 8 provinces including Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei and Hunan, and the sum average of which is taken as the representative value of the central region; and the western region includes 12 provinces and cities of Inner Mongolia Autonomous Region, Guangxi Autonomous Region, Chongqing City, Sichuan Province, Guizhou Province, Yunnan Province, Tibet Autonomous Region, Shaanxi Province, Gansu Province, Qinghai Province, Ningxia Hui Autonomous Region and Xinjiang Uyghur Autonomous Region, and the sum average of which is taken as the representative value of the western region. The data in this paper are divided into five groups for analysis: the first group expressed as Group A is directly analyzed with all levels of education data of 31 provinces and cities; the second group expressed as Group B is directly analyzed with all levels of education data of representative values of eastern, central and western regions; the third group expressed as Group C is analyzed with all levels of education data of 11 provinces and cities in eastern region; the fourth group expressed as Group D is analyzed with all levels of education data of 8 provinces and cities in central region; and the fifth group expressed as Group E is analyzed with all levels of education data of 12 provinces and cities in western region.

2.2 Analytical Method

2.2.1 Wide Applicability of Gini Coefficient in Educational Research

As a common statistical analysis method, Gini coefficient is mostly used to analyze income distribution and equilibrium degree. In practical application, Gini coefficient, introduced into the field of education, has become a common index reflecting the difference of educational access between countries or regions, and is a very effective measuring tool in research of problems. Therefore, it is logical and empirical to measure the provincial difference and regional comparison of educational expenditure per student using Gini coefficient as a technical tool.

2.2.2 Gini Coefficient

The statistical index reflecting the degree of fairness calculated from the Lorenz curve is equal to the ratio of the area enclosed by the absolute fairness line and the Lorenz curve to the area of the right triangle under the absolute fairness line. Let A be the area of the direct triangle under the absolute mean line and $f(x)$ be the Lorenz curve, then the formula of Gini coefficient G is

$$G = A - \frac{\int_0^1 f(x)dx}{A}. \quad (1)$$

2.3 Data Processing and Analysis

According to the educational data at all levels of cities, provinces and regions contained in each group of data, the per student public budget educational expenses in primary schools, junior middle schools, senior middle schools, colleges and universities and general education of each group is sorted out according to the absolute value in years, and then the ratios of per student public budget educational expenses are added up, and the grouping ratio is calculated. With the function of scatter plot in EXCEL, the five-order Lorenz fitting curve $f(x)$ of all forms of education in each year is simulated, and its Gini coefficient is calculated according to formula (1). In view of the principle of allocation of educational resources and the requirement for educational fairness, the criterion of Gini coefficient proposed by Dai Wenjing et al. was adopted in this evaluation: Gini coefficient below 0.1 indicates that the allocation of educational resources is highly uniform; between 0.1 and 0.2 indicates that the allocation of educational resources among regions is relatively average and relatively fair; over 0.2 means that the regional disparity in allocation of educational resources is large, which goes against educational fairness [3].

3 Results

3.1 Lorenz Curve Result Analysis

As shown in Fig. 1, Lorenz curve is calculated and plotted with Group A data. It is found by comparing the Lorenz curve of all levels of education in 2008 and 2016 taking 2012 as the median that the Lorenz curve of all levels of education from 2008 to 2012 is close to the absolute average curve, indicating that the continuous increase of national fiscal expenditure of education in 2008 is conducive to educational fairness at all levels; the 2012 and 2016 curves of all levels of education, except for the general primary school stage, almost coincide, indicating that it has no significant effect to improve educational fairness at all levels by relying solely on the growth of fiscal expenditure of education.

3.2 Gini Coefficient Result Analysis

3.2.1 Result of Group A

The Gini coefficient for all levels of education in 31 cities, provinces and regions from 2005 to 2008 is shown in Fig. 2. The Gini coefficient of all levels of education ranges

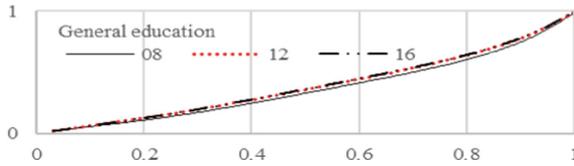


Fig. 1. Lorenz curve fitting for General education in 2008, 2012 and 2016

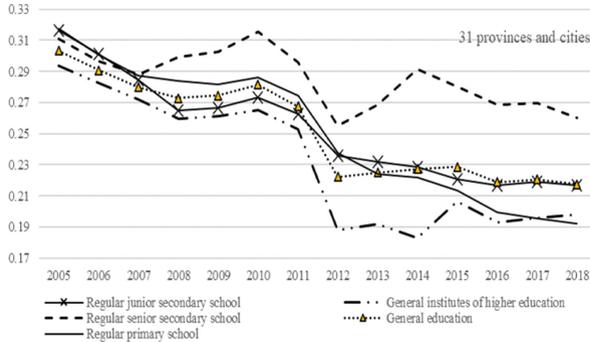


Fig. 2. Broken line chart of Gini coefficient of education at all levels in 31 provinces and cities from 2005 to 2018

from 0.17 to 0.28, with the highest in regular senior secondary school and the lowest in general institutes of higher education, which shows that in all levels of education in 31 cities, provinces and regions, the fairness of regular primary school is the lowest and that of regular senior secondary school is the highest.

3.2.2 Result of Group B

As shown in Fig. 3, the Gini coefficient for all levels of education ranges from 0.07 to 0.24. Similar to Fig. 3, the Gini coefficients of regular senior secondary schools and general institutions of higher learning are the highest and lowest values, respectively; the difference is that after 2014, the Gini coefficients of general primary schools reach the lowest.

3.2.3 Result of Group C

As shown in Fig. 4, the Gini coefficient from 2005 to 2018 for all levels of education ranges from 0.2 to 0.35. Among them, the Gini coefficient of regular senior secondary schools is the highest over the years, and that of regular primary school is the lowest in 2016. The change of Gini coefficient in general junior high school and general education has the highest consistency, and that in general institutes of higher education is larger.

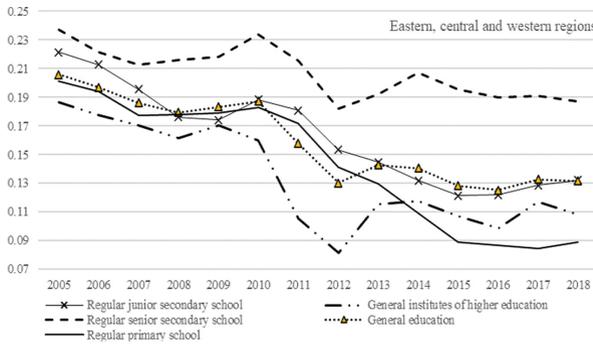


Fig. 3. Broken line chart of Gini coefficient of education at all levels in eastern, central and western regions

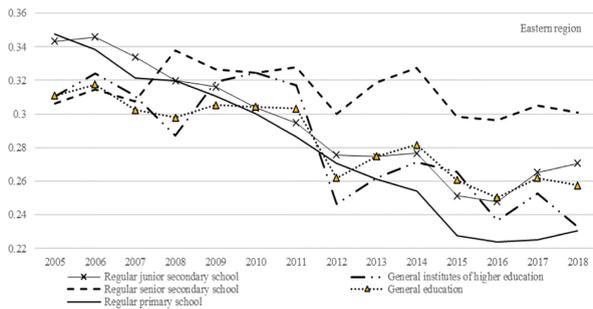


Fig. 4. Broken line chart of Gini coefficient of education at all levels in the eastern region

3.2.4 Result of Group D

As shown in Fig. 5, the Gini coefficient from 2005 to 2018 for all levels of education ranges from 0.04 to 0.2. Among them, the Gini coefficient of regular primary schools is the highest over the years, and that of general institutes of higher education is the lowest in 2014. The change of Gini coefficient in general junior and senior high schools and general education has the highest consistency, and that in general institutes of higher education has a largest drop.

3.2.5 Result of Group E

As shown in Fig. 6, the Gini coefficient from 2005 to 2018 for all levels of education ranges from 0.1 to 0.24. Among them, the variation lines of Gini coefficient at all levels of education are interlaced with each other, without obvious highest and lowest values.

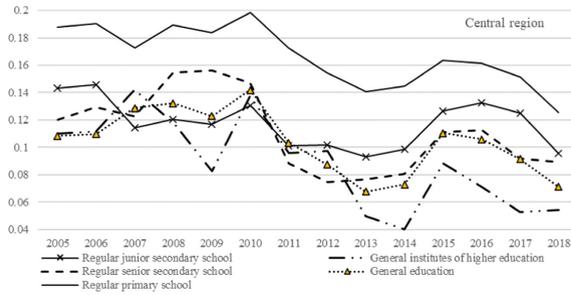


Fig. 5. Broken line chart of Gini coefficient of education at all levels in the central region

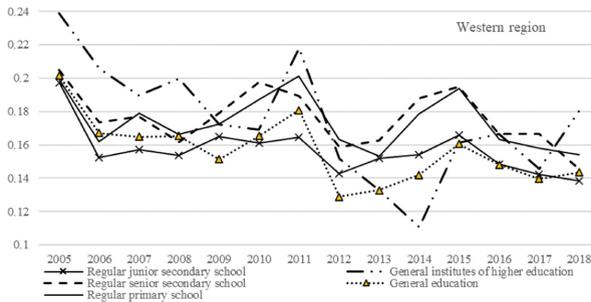


Fig. 6. Broken line chart of Gini coefficient of education at all levels in the western region

4 Discussions and Conclusions

4.1 Conclusions

With the increase of the year, the overall Gini coefficient of all levels of education shows a downward trend, with 2012 as the segment point, and the downward trend from 2008 to 2012 is relatively uniform and non-repetitive. The Gini coefficient is the highest in 2008 and the lowest in 2012, which indicates that the continuous increase of educational financial investment is conducive to the reduction of Gini coefficient of all levels of education. From 2012 to 2018, education at all levels showed an overall downward trend, but the Gini coefficient of individual education stages remained unchanged or increased, which shows that while maintaining the proportion of national financial educational funds in GDP exceeding 4%, the growth effect of education financial investment in reducing the Gini coefficient of education at all levels is not significant, and it is necessary to further explore the structural role of education financial investment.

On the one hand, the data of Group A and Group B reflect the situation of the whole region. Although the trends of Gini coefficients at all levels of education in both groups are consistent, the absolute value of Gini coefficients at all levels of education in Group B are lower than those of Group A, indicating that reducing the Gini coefficient values of all levels of education in the 31 provinces and cities in the eastern, western and central regions is beneficial to the reduction of Gini coefficient values and the realization of national educational fairness. On the other hand, the data of Group C,

Group D and Group E reflect the situation in local areas. The comparison shows that all levels of education in the central region have the best degree of fairness, and the values of Gini coefficient of all levels of education are within 0.13 in 2018, indicating that the distribution of educational resources at all levels is relatively average and fair, followed by the western region. Referring to the Gini coefficients of all levels of education in 2018 controlled within 0.2, all levels of education in the eastern region have the worst educational fairness, with Gini coefficients all above 0.22 in 2018, indicating that the regional disparities in the distribution of educational resources are large.

In the comparison of education at all levels, the Gini coefficient value of regular senior secondary school from 2005 to 2018 is the maximum value in both Group A and Group B data reflecting the overall regional situation, which indicates that the worst degree of fairness in regular senior secondary schools nationwide is caused by the high Gini coefficient in the eastern region, highlighting the high unequal access to regular senior secondary schools in the eastern region. The data of Group A and Group B of general institutes of higher education indicate that it is the most fair education stage in all levels of education nationwide, which is inseparable from their extended enrollment and connotative development. The Gini coefficient of regular primary school is basically equal to that of general institutes of higher education from 2016 to 2018. However, according to the Gini coefficient data in the central region, the Gini coefficient values of regular primary schools are about 0.05 larger than those of other education stages, indicating that the equal access to regular primary schools is better nationwide, but it is in a “depression” situation in the central region. Under the national data, the fairness degree of regular junior middle school has the highest consistency with the performance of the eastern, western and central regions, indicating that there is no “depression” trend in the fairness degree of regular junior middle school.

4.2 Suggestions on Optimizing the Allocation Structure of Educational Funds

While maintaining educational financial investment at all levels, its structural role should be further explored. On the premise of a certain total amount of educational financial investment, the Gini coefficient value of all levels of education will be generally reduced by optimizing the proportion of financial investment to all levels of education. In order to improve the equalization level of educational expenditure in each province and city, it is necessary to grasp the macro-control and optimize the proportion of educational expenditure at all levels from the national level and the level of the Ministry of Education, because from the reality of China, the educational investment in each province and city depends on their per capita financial income level.

The nationwide fairness can be achieved by realizing the fairness of education at all levels in the region as a transition. The comparison between Group A and Group B shows that, firstly, the reduction of Gini coefficient at all levels of education in the eastern, central and western regions is conducive to the realization of equity at all levels of education at the national level. Therefore, China should continue to carry out the development strategies of the western development, the rise of the central part and the revitalization of the northeast, and take the national strategic development as an opportunity to realize the fairness of education at all levels in the region, thus promoting the improvement of the fairness of education at all levels in the whole country.

While continuing to optimize educational fairness at all levels, emphasis should be placed on improving equal access to regular senior secondary schools. According to the calculation of Gini coefficients of five groups of data, the national regular senior secondary schools have the highest value of Gini coefficient and the greatest contribution to regional differences. Especially in the eastern region, the Gini coefficient of regular senior secondary schools shows that they have the highest level of fairness difference. At present, the enrollment rate from regular junior high school to regular senior high school is controlled at about 50%, resulting in uneven development level and high regional difference of regular senior high school in each province. Therefore, focus should be laid on improving the equal access to regular senior high schools.

The radiation capacity of Beijing, Shanghai and Guangzhou should be strengthened to improve the equal access to education at all levels in the eastern region. According to the comparison results of Group C, Group D and Group E, the Gini coefficient of education at all levels in the eastern region is the highest. As the economic development of the 11 provinces and cities that constitute the eastern region differs greatly, resulting in the lowest level of educational fairness in the eastern region at all levels, the eastern region can be divided into three radiation zones centered on Beijing, Shanghai and Guangzhou, respectively the area centered on Beijing and Tianjin, radiating Hebei and Liaoning provinces, the area centered on Shanghai and radiating Shandong, Jiangsu and Zhejiang provinces, and the area centered on Guangdong and radiating Fujian and Hainan provinces, to improve the educational fairness of education at all levels in the eastern region by gradually realizing the reduction of Gini coefficient values of education at all levels in the three small areas.

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