Research on Empirical Analysis of the Equity of Compulsory Education in Rural Areas of China

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Abstract: *The Educational equity is an important cornerstone of social equity. Based on the per capita education expenditure of rural ordinary junior high school and primary school students in 31 provinces, municipalities and districts in China from 2000 to 2021, this paper uses Dagum Gini coefficient method to calculate the per capita education expenditure of students in China. The study found that the Gini coefficient of per capita education expenditure for junior high school students in China showed an "S" fluctuating downward trend in the range of 0.245-0.324 over the years, and the per capita education expenditure of rural junior high school students was relatively fair on the whole. The Gini coefficient of per capita education expenditure for primary school students fluctuated between 0.223 and 0.315 over the years, and the education expenditure was relatively fair on the whole. Based on this, policy suggestions are put forward: further improve the reform of the public finance system, increase the guarantee of compulsory education funds in rural areas, and realize the high-quality development of rural compulsory education and rural revitalization at the same frequency and in the same direction; Promote the balanced development of compulsory education when optimizing the allocation of educational funds and resources; Pay attention to the balanced allocation of education funds in the region.*

Keywords: Rural areas, Compulsory education, Education funding per pupil, Dagum Gini coefficient method, Educational equity

1. Introduction

The report of the 20th National Congress of the Communist of China pointed out that we should accelerate the construction of a high-quality education system, develop quality education, and promote educational equity. Educational equity is an important cornerstone of social equity, and it is also the meaning of building a strong country in education. Educational equity is the key to China's escape from the "middle-income trap", stimulate innovation and promote economic development[1]. According to the Ministry of Education, the National Bureau of Statistics, and the Ministry of Finance on the statistical announcement of the implementation of national education funds in 2022, the per capita general public budget education expenditure in Beijing in 2022 is 4.98 times and 5.82 times that of Henan Province, respectively. The fairness of compulsory education is related to the necessary conditions for the development of members of a country's society, and the fairness of compulsory education is inseparable from sufficient educational resources as a guarantee, especially the investment of education funds, sufficient investment in education funds can improve the conditions for running schools and attract more outstanding talents to teach, but the inequality of education funding investment will inevitably bring about the inequality of the starting point and the process of education, and ultimately lead to the inequality of educational results. In addition, per capita education expenditure reflects the average amount of educational resources available to a student, and ultimately affects equity in the quality of education and equity in access to higher education.From the perspective of per capita education funding for compulsory education, this study aims to clarify the development context of the current situation of compulsory education funding in China, sort out the temporal evolution characteristics of the fairness of compulsory education funding in China, and identify the reasons for the inequality of education funding per student in China.

2. Literature review

Scholars at home and abroad have studied the issue of educational equity from different perspectives.

From the perspective of research methods, there are two methods to measure educational inequality, such as the range rate, Gini coefficient, coefficient of variation, generalized entropy index, and Theil index. Based on the Gini coefficient and Theil index, Geng Lele calculated the trend of the equity of China's basic education expenditure per student, and found that the fairness of China's basic education expenditure from 1995 to 2018 was generally at the level of "relatively fair" and "relatively reasonable". [2] .Zhang Wei et al. used the Gini coefficient to calculate and compare the Gini coefficient of the total expenditure of education at all levels and the Gini coefficient of the expenditure of business funds between provinces in China from 1996 to 2006, and found that in the past ten years, the regional expenditure of education expenditure in China has the characteristics of stable changes in the compulsory education stage, the increasing degree of unfairness in the high school funding, and the equalization of higher education expenditure under cost sharing. [3] In terms of index selection, different researchers adopt different measurement indicators, and Wang et al. selected the per capita budgeted education expenses and the per capita budgeted public funds as the research indicators[4]; Zhang Wanming constructed the education Gini coefficient based on the per capita years of education, and found that the per capita years of education in all provinces in China increased to varying degrees in 2000 and 2010, the education Gini coefficient generally declined, and the situation of education equity was improved.[5]In terms of research objects, Xu Ling et al. took secondary vocational education as the research object, and analyzed the change trend of the inter-provincial differences in the per capita expenditure of secondary vocational education from 2009 to 2019 by measuring the average value of education expenditure per student, Gini coefficient and total Theil index per student, and found that the Gini coefficient of per capita education expenditure of secondary vocational education in China from 2009 to 2019 was between 0.207 and 0.263. [6]   Zhao Yuhan et al. calculated the Gini coefficient of per capita education expenditure in ordinary junior high schools and primary schools in China's compulsory education stage, and found that from 2006 to 2015, they showed a downward trend. [7]

The existing studies have carried out in-depth theoretical and empirical research on educational equity, and the research conclusions have important theoretical and practical value, which has laid a foundation for subsequent research. However, the research conclusions based on different measurement indicators are inconsistent. Second, most studies still have a long time to measure the Gini coefficient of China's education expenditure, and most of the studies measure the year before 2016; Third, there is no research on the fairness of compulsory education in China based on the per capita education expenditure of rural compulsory education in China. The possible innovation of this paper is to supplement and improve the empirical research on educational equity in China, and to use the new education Gini coefficient measurement method to better identify the causes of the inequality of education expenditure per student in China.

3. Data sources and research methods

3.1 Research objects and data sources

This paper takes local rural primary schools and local rural junior high schools in 31 provinces (municipalities and autonomous regions) in China (excluding Hong Kong, Macao and Taiwan) as the research objects, and the per capita education expenditure of all types of schools comes from the (China Education Expenditure Statistical Yearbook) (2001-2022).

3.2 Research Methods

Compared with the traditional Gini coefficient and Theil index, the Dagum Gini coefficient [9] can decompose the overall Gini coefficient into three parts: intra-group differences, between-group differences, and supervariable density, which can analyze the sources of the overall difference level and overcome the problem of cross-overlap between sample data.It is calculated as follows:

$$G = G_w + G_{nb} + G_t \tag{1}$$

$$G = \frac{\sum_{j=1}^{k}\sum_{h=1}^{k}\sum_{i=1}^{n_j}\sum_{r=1}^{n_h}|y_{ji} - y_{hr}|}{2n^2 u} \tag{2}$$

Among them, G is the overall difference, G_w means the contribution degree to the regional

difference, G_t means the contribution to the inter-regional difference, and the supervariable density. n is the number of provinces (municipalities and autonomous regions), u is the average of the national per capita education expenditure, k is the number of national regions, and n_j (n_h) is the number of provinces in the region (j (h).

$$G_{jj} = \frac{\frac{1}{2u_j}\sum_{i=1}^{n_j}\sum_{r=1}^{n_j}|y_{ji} - y_{hr}|}{n_j^2} \tag{4}$$

$$G_w = \sum_{j=1}^{k} G_{jj} p_j s_j \tag{5}$$

$$G_{jh} = \frac{\sum_{i=1}^{n_j}\sum_{r=1}^{n_j}|y_{ji} - y_{hr}|}{n_j n_h (u_j + u_h)} \tag{6}$$

$$G_{nb} = \sum_{j=2}^{k}\sum_{h=1}^{j-1} G_{jh}(p_j s_h + p_h s_j)D_{jh} \tag{7}$$

In the above equation, G_{jj} isthe Gini coefficient of the region j , G_{jh} is the Gini coefficient of the region and the inter-region, $p_j = n_j / n$, $s_j = n_j u_j / nu$ $s_j = n_j u_j / nu$, D_{jh} is the relative impact of the education expenditure per student of the region j and the region h .

where G_t is the contribution degree of supervariable density, F_j (F_h) is the distribution function of region j (h).

4. Data results and analysis

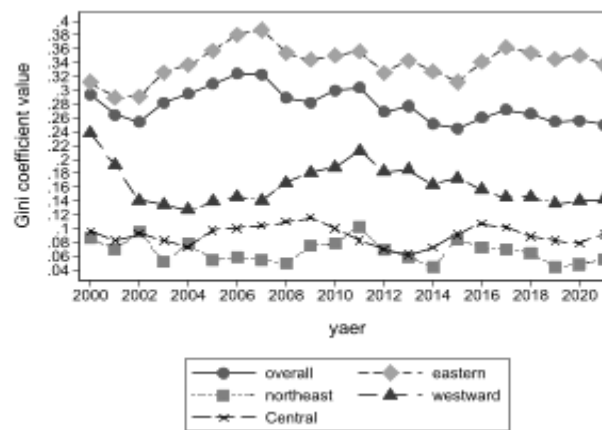### 4.1 Regional differences in per capita education expenditure and their decomposition

Figure 1: Overall differences in education expenditure per junior high school students and regional differences

According to the Dagum Gini coefficient, there are certain regional differences in the per capita education expenditure of junior high school students in China (see Figure 1), and the overall Gini coefficient from 2020 to 2021 showed an "S" fluctuating downward trend in the range of 0.245-0.324, and decreased from 0.294 in 2000 to 0.25 in 2021. Hu Yaozong divided the Gini coefficient to measure

the fairness of education expenditure, with less than 0.1 indicating high fairness, 0.1-0.2 indicating relatively fairness, 0.2-0.3 indicating relative fairness, and above 0.3.In addition, 2007 was the year with the highest Gini coefficient value (0.323) and 0.245 in 2015, which was the lowest in all years.

As can be seen from Figure 2,the Gini coefficient of the average per student education expenditure in primary school in China fluctuated between 0.223 and 0.315. From the perspective of change trend, the Gini coefficient showed an upward trend from 2000 to 2006, that is, from relative fairness to unfairness, from 2007 to 2015, the Gini coefficient began to show a slow downward trend, and from 2016 to 2021, it showed a slow trend of inverted "U". In addition, compared with junior high school, the Gini coefficient of per capita education expenditure in primary school is lower than that of junior high school.
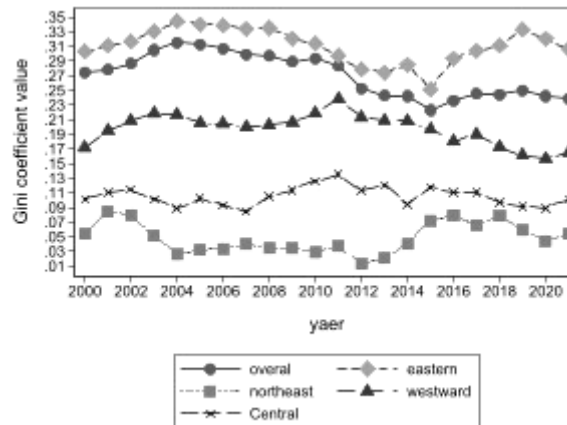

Figure 2: Overall and regional differences in per capita education expenditure of primary school students

4.2 Intra-regional differences

Compared with the differences in the Gini coefficient within the four major regions of China, the Gini coefficient of education expenditure per student in junior high school and primary school is the Eastern Gini coefficient> the overall Gini coefficient> the Western Gini coefficient> the Central Gini coefficient > the Northeast Gini coefficient.

In terms of specific values, The Gini coefficient range in the eastern part of China fluctuates between 0.289-0.387 in the junior high school stage, and the average Gini coefficient of per student education expenditure from 2000 to 2021 is 0.34, that is, the education funding in the eastern region of China is in an unfair state, and the Gini coefficient value in the eastern region is lower than 0.3 in 2001 and 2002, and the Gini coefficient value is higher than 0.33 in 18 other years, that is, although the average per capita education expenditure in the eastern region is much higher than the national average education expenditure and higher than the central and western regions, the difference in regional funding is large, for example, the Gini coefficient value in the eastern region in 2007 was as high as 0.387, which is in a highly unfair state, the eastern region presents a mismatch pattern with sufficient funds but lack of equity. For example, in 2007, among the 11 provinces in the eastern region, the per capita education expenditure of Beijing and Shanghai was 18,193 yuan and 14,463.38 yuan, respectively, while the provinces of Hebei, Guangdong and Hainan with lower per capita expenditure were 2,726.99 yuan, 2,731.81 yuan and 2,863.50 yuan respectively, and the ratio of higher and lower provinces was between 5.1-6.7, and the highest and lowest ratio of per capita education expenditure in 2021 was also 7.2.From the perspective of the change trend, the Gini coefficient of per capita education expenditure in the eastern region showed an upward trend of "M" fluctuation, from 0.312 in 2000 to 0.337 in 2021, with a growth rate of 8%, that is, the equity of education funding has been deteriorating. The Gini coefficient of the eastern region of primary school ranged from 0.251 to 0.345, the average Gini coefficient of per capita education expenditure was 0.311 from 2000 to 2021, and the Gini coefficient of most years in the eastern region was higher than 0.3, that is, the education expenditure of primary school in the eastern region was also unfair.

The Gini coefficient of per capita education expenditure for junior high school students in the western region ranged from 0.127 to 0.237, and the average Gini coefficient per student education expenditure from 2000 to 2021 was 0.163, indicating that the fairness of education expenditure at the junior high

school level in the western region of China was relatively fair, and from the perspective of the change trend, the Gini coefficient of per capita education expenditure in the western region decreased sharply from 0.238 in 2000 to 0.127 in 2004, a decrease of 46.63%, and then showed an inverted "U" shaped fluctuation trend. In 2021, the Gini coefficient was 0.142, a decrease of 41.74% compared with 2000, indicating that the equity of education funding continues to improve. The per capita education expenditure for primary school students ranged from 0.157 to 0.238, and the average Gini coefficient of per capita education expenditure from 2000 to 2021 was 0.197, indicating that the equity of education funding for primary schools in western China was relatively fair, but the degree of equity was lower than that of junior high school in western China. The Gini coefficient decreased from 0.171 in 2000 to 0.165 in 2021, a decrease of 3.5%, and the equity of education funding has improved slightly.

The Gini coefficient of the average junior high school students in the central region is between 0.062-0.116, and the average Gini coefficient of the per capita education expenditure from 2000 to 2021 is 0.09, that is, the degree of education equity in the central region of China is highly equitable, but it is just the opposite of the east, although the Gini coefficient in the central region is in a highly equitable state, the per capita education expenditure in the central region is insufficient, and there is still a large gap with the average education expenditure in the eastern region and the whole country, for example, the average per capita education expenditure in the central region in 2021 is 16,653 yuan, while the average per capita education expenditure in the eastern region is 33,798 yuan, which is more than twice that of the eastern regionThe central region needs to continue to increase the per capita education expenditure while taking into account equity. The Gini coefficient of per capita education expenditure for primary school students in the central region ranged from 0.084 to 0.135, and the average Gini coefficient from 2000 to 2021 was 0.106, that is, the education expenditure in the central region was relatively fair, and the degree of equity was lower than that of junior high school.

The Gini coefficient of per capita education expenditure for junior high school students in Northeast China is between 0.103-0.045, and the average Gini coefficient of per capita education expenditure from 2000 to 2021 is 0.067, that is, the degree of education equity in Northeast China is highly equitable, and from the perspective of change trend, the Gini coefficient of per capita education expenditure in Northeast China decreased from 0.086 in 2000 to 0.056 in 2021, a decrease of 34.88%, and its peak Gini coefficient occurred in 2011. The trough came in 2019. The Gini coefficient of primary education expenditure in Northeast China ranged from 0.013 to 0.084. From 2000 to 2021, the average Gini coefficient of per capita education expenditure was 0.048, which was lower than that of the Gini coefficient of per capita education expenditure at the junior high school level, that is, the fairness of primary education funding in Northeast China was highly equitable.From the perspective of change trends, the Gini coefficient of education expenditure per student at the primary school stage showed a fluctuating trend, and the education expenditure coefficient almost unchanged in 2000 and 2021, and the equity of education funding at the primary school level did not change.

4.3 Interregional Gini coefficients

Figure 3 shows that in terms of the differences in the Gini coefficient of per capita education expenditure between the groups in the eastern region and the other three regions, the difference between the groups in the eastern region and the other three regions is greater than that between the other regions, and the Gini coefficient between the groups in the eastern region and the central region is the largest, indicating that compared with the differences between other regions, the difference between the eastern and central regions is the largest, for example, in 2021, Beijing with the highest per capita education expenditure in the eastern region is 5.2 times that of Shanxi, which has the highest per capita education expenditure in the central region, and the difference between the groups in the northeast and the western region is the smallest. From 2000 to 2021, the differences between other regions are decreasing, except for the difference between the Northeast and Middle Regions, which indicates that the gap in education funding between most regions is gradually decreasing. In terms of the decrease range, the Gini coefficient decreased by 37.83% between the Northeast-West groups, 25.13% between the West-Middle Group, 14.63% between the East-West groups, 12.22% between the East-Northeast groups, 9.5% between the East-Middle Group, and 0.3% between the Northeast-Middle Group.
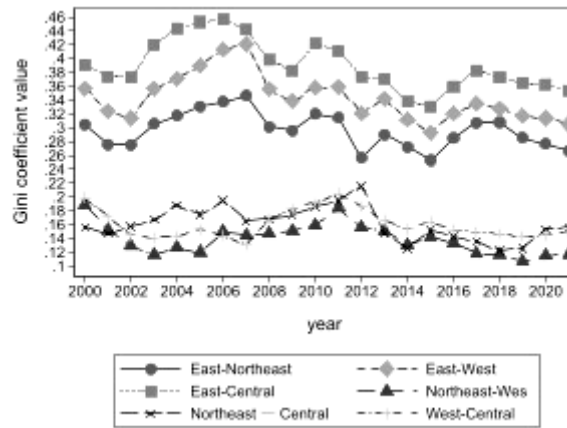
Figure 3: Gini coefficient between junior high school regions

As shown in Figure 4, in terms of the difference in the Gini coefficient between the groups in the primary school and the central region, the Gini coefficient between the eastern and central regions is still the largest in the middle school stage, followed by the Gini coefficient between the east-west groups, and the Gini coefficient between the groups is the smallest in the northeast-west. From 2000 to 2004, the Gini coefficients between groups in East-Central, East-West, Northeast-Central, East-Northeast, and Northeast-West all showed a fluctuating downward trend, while the Gini coefficient between groups in West-Middle showed a fluctuating upward trend. From 2000 to 2021, the Gini coefficient between groups in the eastern region and the other three regions decreased by 21.7%, while the Gini coefficient between groups in the Northeast-West, Northeast-Central, and West-West regions did not decrease from 2000 to 2021, but increased to varying degrees, among which the Gini coefficient between groups in the Northeast-Middle increased the most, increasing by 12.55%.
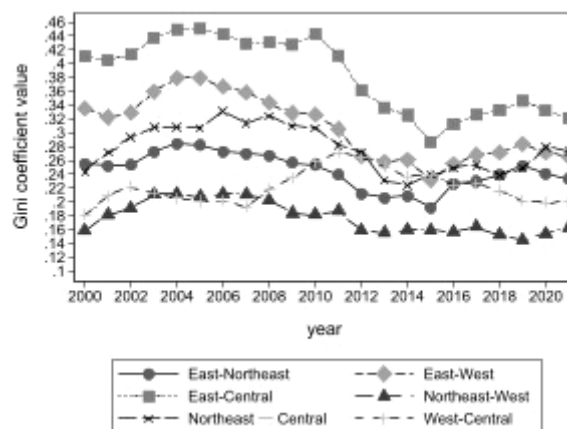

Figure 4: Gini coefficient between primary school regions

4.4 Decomposition and contribution of regional differences

As shown in Figure 5,the contribution of the difference in the overall Gini coefficient of per capita education expenditure for rural junior high school students in China is inter-regional, intra-regional and super-variable density from high to low. The contribution rate within the region remained basically unchanged during the study period, and the contribution rate of the difference between regions increased first and then decreased from 2000 to 2008, but the supervariable density showed an opposite trend during the time period, and then the contribution rate of the two showed slight fluctuations. The average contribution rate within the region was 27.05%, the average contribution rate between regions was 60.37%, and the average contribution rate of supervariable density was 12.59%. The specific results are shown in Figure 5.
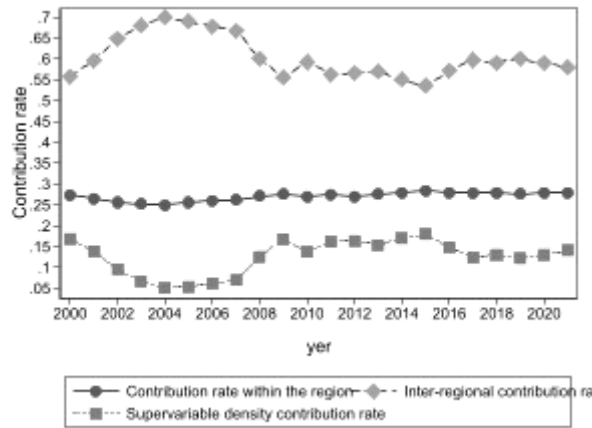
Figure 5: Decomposition of the contribution rate of the overall Gini coefficient difference in junior high school

As shown in Figure 6,from 2000 to 2013, the contribution of the first stage from 2000 to 2013 was inter-regional, intra-regional, and intra-regional, the second stage from 2014 to 2017, and the third stage from 2018 to 2021. From the perspective of the change trend, the contribution rate of regional differences remained basically unchanged, and the contribution rate of inter-regional differences fluctuated and decreased from 2000 to 2015, and then the contribution rate of inter-regional differences increased year by year, and the contribution rate of inter-regional differences decreased on the whole, indicating that the equity of inter-regional education funding in rural communities in China is constantly improving. The contribution rate of supervariable density increased from 9.98% in 2000 to 26.23% in 2021. The average contribution rate within the region was 26.98%, the average contribution rate between regions was 52.64%, and the average contribution rate of supervariable density was 20.38%. The specific results are shown in Figure 6.
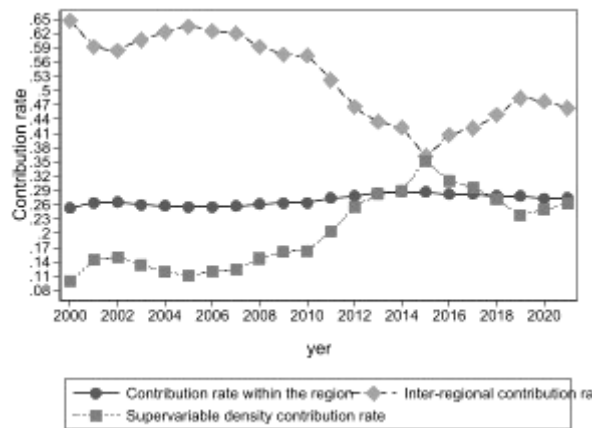

Figure 6: Contribution rate of the difference in the overall Gini coefficient of primary schools

5. Conclusion

Based on the data of per capita education expenditure in rural compulsory education from 2000 to 2021, this study used Dagum Gini data to analyze the fairness of per capita education expenditure of primary and junior high school students in China. The main conclusions are as follows:

First, the Gini coefficient of per capita education expenditure for junior high school students in China has shown an "S" fluctuating downward trend in the range of 0.245-0.324 over the years, and the per capita education expenditure of rural junior high school students is relatively fair on the whole. The Gini coefficient of per capita education expenditure for primary school students fluctuated between 0.223 and 0.315 over the years, and the education expenditure was relatively fair on the whole.

Second, the Gini coefficient of per capita education expenditure in China's compulsory education

stage is in the east, west, central, and northeast regions from high to low. In addition, the Gini coefficient of per capita education expenditure in the compulsory education stage in the eastern region increased in 2021 compared with 2000, and the education equity situation in the eastern region deteriorated. On the contrary, the central region has the least investment in education funding, but the difference in funding within the region is small, and on the whole, the equity of education funding in junior high school in central China is highly equitable, and the education funding in primary school is relatively fair. The fairness of education funding in the compulsory stage in the western region is relatively fair, and the Gini coefficient of compulsory education in 2021 shows a convergence trend compared with the Gini coefficient in the beginning year, and the fairness of education funding in the western region has not improved. The Gini coefficient of per capita education expenditure in Northeast China is the smallest among the four major regions, and the Gini coefficient per capita of education expenditure in the compulsory education stage is less than 0.1, indicating that the fairness of education funding in Northeast China is highly equitable.

Thirdly, the Gini coefficient of per capita education expenditure of rural junior high school students was significantly greater than that between groups in the eastern and other three regions, and the Gini coefficient between the Middle East and Middle groups was the largest, and the Gini coefficient between the northeast and west groups was the smallest. In addition, from the perspective of change trend, from 2000 to 2021, except for the difference between the Northeast and Middle China groups, the differences between other regions are decreasing, indicating that the gap in junior high school education investment between regions in China is gradually decreasing. At the primary school level, the Gini coefficient was the highest between the eastern-middle group and the smallest between the northeastern-western groups, and the difference between the eastern region and the other three regions was narrowing, but the difference between other regions is widening.

Fourthly, the contribution of the difference in the overall Gini coefficient of per capita education expenditure of rural junior high school students from high to low is inter-regional, intra-regional and super-variable density. From 2000 to 2013, the contribution degree of the first stage was inter-regional, intra-regional, and intra-regional, the second stage from 2014 to 2017, and the third stage from 2018 to 2021.

Based on the above conclusions, in order to further improve the fairness of the per capita education funding of compulsory education in China and promote the high-quality, balanced and sustainable development of compulsory education, this paper puts forward the following policy suggestions:

First, first of all, all provinces (municipalities and autonomous regions) should continue to strictly implement the "three increases" stipulated in the newly revised Compulsory Education Law, namely, the increase in public financial expenditure on education, the increase in public budget expenditure on education at all levels, and the increase in public expenditure on public funds per student at all levels[13]. Secondly, we will further improve the reform of the public finance system, increase the guarantee of compulsory education funds in rural areas, and realize the high-quality development of rural compulsory education and rural revitalization. Finally, it is necessary to further improve the system of transfer payments between the central and local governments for education expenditures. In view of the current situation of uneven investment in education per student in compulsory education, it is necessary to pay attention to the transfer of funds from the central government and the governments of developed areas to poor and backward areas under the circumstance that local government expenditure in poor areas is limited.

Second, it is an important measure to promote the balanced development of compulsory education when optimizing the allocation of educational funds and resources. At the regional level, in addition to continuing to give more policy preferences to the western region, special attention should be paid to the phenomenon of "central collapse". According to the "Notice of the General Office of the State Council on Issuing the Reform Plan for the Division of Fiscal Powers and Expenditure Responsibilities between the Central and Local Governments in the Field of Education", the current per capita public funds for compulsory education students adopt a unified national standard, which is shared by the central and local governments, with the western region basically following 8:2 and the central region basically following 6:4. To speed up the improvement of the "central collapse" situation, it is necessary to increase the proportion of central financial sharing in the central region, and increase the proportion of central and local governments from the current 6:4 to 7:3 in Henan, Jiangxi, Hunan and other provinces where compulsory education is extremely weak in a pilot way, so as to solve the problem of central collapse [9].

Third, we should pay attention to the balanced allocation of education funds in the region. As concluded above, the per capita education expenditure in the eastern region is unreasonable as a whole,

especially in the eastern regions of Hebei, Hainan, Guangdong and other provinces, which should make full use of the advantages of regional development to promote the provincial governments to coordinate and promote the responsibility of the rural compulsory education funding gap in various regions, so as to alleviate the situation of the widening gap in per capita education funding in the eastern region.

Acknowledgements

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