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The Impact of Government Education Expenditure on Higher Education Enrollment and Educational Equity in China (2010–2019)

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Abstract. While higher education has entered the stage of popularization in China, the issue of uneven educational opportunities across regions and genders is still prominent. Using methods such as fixed effects model, grouped regression, and test of convergence, this study systematically investigates the overall effect of government education investment on the popularization of higher education, based on provincial data of 31 provinces in China from 2010 to 2019. It focuses on examining the heterogeneity of gender and regional dimensions. The study found that the percentage of annual budgetary spending on education to Gross Domestic Product (GDP) is stable at more than 4%, but the regional structure is unbalanced; the regional disparities in the popularization of higher education are gradually narrowing, but the internal imbalance within the western region is still prominent; the gender equity index continues to be greater than 1, which means that the admission opportunities of girls are better than those of boys. However, after 2016, there was a disparity between input growth and gender equity improvement. This study reveals the heterogeneity of the government's investment effect on education, which provides an empirical basis for the optimization of financial resource allocation in higher education and promoting regional coordination and gender equity.

Keywords: Government education expenditure, higher education enrollment, educational equity, regional imbalance, gender equity

1. Introduction

Since the gross enrollment ratio exceeded 50% in 2019, higher education in China has officially entered the stage of popularization. This historic leap marks the transition from elite selection to mass participation in higher education, but the rapid expansion of scale does not automatically bring about a balanced distribution of educational opportunities. There is still a significant gap in higher education enrollment opportunities between the western, central, and eastern regions, as well as between urban and rural areas, and between males and females. How to promote equity in higher education through financial means has become a common concern in the academic and policy arenas.

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Existing research explores that the influence of government education expenditure on the accessibility and equity of higher education is not linearly homogeneous, but there is obvious regional and group heterogeneity. The growth of the total amount of financial input is not automatically transformed into the equity of interregional and intergender higher education, and there are differences in the degree of benefit from the growth of input in different regions and genders [1]. However, there are still the following gaps in existing studies: most studies analyze the educational equity of a certain dimension alone and lack a systematic comparison of gender and regional equity; research focuses on the total amount of input, and the discussion on how the input structure affects equity is insufficient; on the question of "whether the growth of popularization is synchronized with the improvement of equity," the direct inspection is still blank.

To this end, this study constructs provincial panel data from 2010 to 2019, covering 31 provinces except Taiwan, Macao and Hong Kong, and uses methods such as fixed effects model, grouped regression and test of convergence to systematically examine the overall effect of government education investment on the popularization of higher education, and focus on analyzing the heterogeneity of gender and regional dimensions. By revealing the dynamic evolution of regional differences in input effects and gender equity, this study aims to offer an empirical foundation for the modern-day optimization of equity policies in higher education.

2. The impact of government education expenditure on higher education and equity

2.1. The impact of government education expenditure on the enrollment ratio of higher education

It is generally believed in the academic community that financial investment is the material basis for the development of higher education. In the Chinese context, the rise in individual higher education opportunities and the development of fiscal spending on higher education reveal a synchronous pattern. China's gross enrollment ratio for higher education rose to 54.4% between 2010 and 2020, with the country's fiscal spending on higher education climbing at an average annual rate of 10.22% [2].

2.2. The impact of government educational expenditure on educational equity

In China's higher education system, the impact of government education funding on equity is mainly reflected in three dimensions, namely gender, urban–rural status, and geography.

From a historical perspective, following the reform and opening up, gender equity has gradually come into the focus of the research on educational equity [3]. The study discovered that although the gender gap in the enrollment ratio of higher education has been reversed (the enrollment rate of girls exceeds that of boys), there is still a significant gender separation in professional selection and resource allocation - women are more concentrated in the fields of humanities and social sciences, while the proportion is low in "male-dominated" majors such as engineering and computers [4].

Another major issue that limits the equity of higher education in China is the urban-rural gap. According to the study, there are notable distinctions between urban and rural areas in terms of the distribution of educational resources, the quality of education, and the return on education [5]. Rural students are at a disadvantage in the compulsory education stage due to family economic difficulties and a lack of educational resources. This disadvantage will continue into the higher education stage, forming a cumulative effect of inequity of educational opportunities. The dual structure of urban and rural areas caused by the household registration system has further exacerbated this inequality.

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Although digital education resources have alleviated the physical isolation of urban and rural education resources to a certain extent, they may also exacerbate the new "digital divide" due to insufficient infrastructure and teacher training [6].

Besides, regional differences are also a key dimension of understanding the equity of higher education. Research demonstrates that higher education resources are distributed in the "northeast-southwest" direction. When it comes to the amount of money spent on higher education, the effectiveness of its inputs, and the availability of high-quality resources, the disparity across the central, western, and eastern regions is significant [7-9]. In terms of governance mechanisms, although the paired assistance plan has realized the cross-regional flow of resources, the cultivation of "blood-making (self-sustaining) capacity" still requires long-term efforts [10]. A comparative study of OECD countries observed that the higher the proportion of central government spending, the stronger the regional education equity, which provides an international reference for China to optimize fiscal decentralization [11].

3. The current situation and challenges of the enrollment ratio of higher education and equity in light of government investment in education

3.1. Growth trend and structural characteristics of government education investment

The changes in the total amount and structural characteristics of the government's expenditure in education in China mainly show the basic characteristics of continuous total growth and steady optimization of the structure.

Figure 1 shows the changes in the total amount and structural characteristics of the money the Chinese government spends on education from 2010 to 2019. The percentage of GDP allocated to annual budgetary spending on education fluctuated from 3.49% in 2010, broke through 4% for the first time in 2012, and reached a peak of 4.30%, remaining stable in the range of 4.0%-4.3% for the next ten years. From the structural point of view, the ratio of national spending on higher education to overall spending on education increases by about 0.14 percentage points per year. This structural change reflects the enhancement of higher education's priority in the distribution of public education resources and provides a financial guarantee for the popularization of higher education.

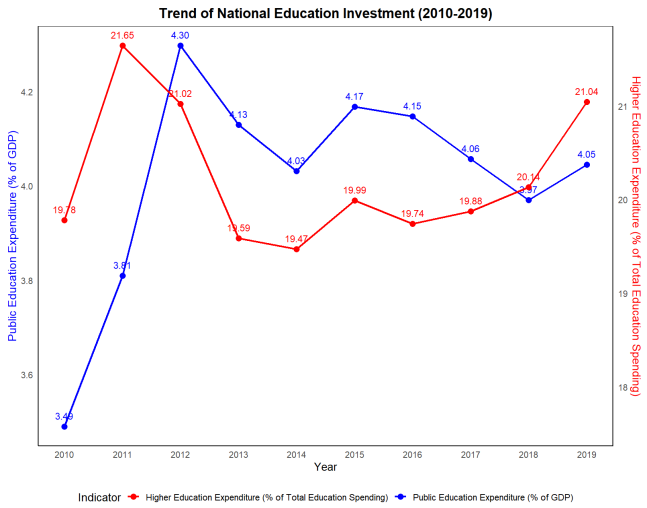

Figure 1. Trend of national education investment, 2010-2019

Data source: China Educational Finance Statistical Yearbook (2010-2019)

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China's national policy has always emphasized regional coordinated development. However, the current allocation of funds for higher education still shows the characteristics of "rich in the east, backward in the west, and insufficient in the central region."

In 2012, China's annual budgetary spending on education accounted for more than 4% of GDP, but the three major regional structures were significantly differentiated: annual budgetary spending on education in the west accounted for a high proportion of GDP, while higher education expenditure accounted for a low proportion of total education expenditure; while the eastern region presented a low proportion of the total amount and a high proportion of higher education.

Figure 2 shows the evolution of the proportion of annual budgetary spending on education in the East, Central, and Western regions to GDP and the proportion of higher education spending to the total education spending from 2010 to 2019. In terms of the proportion of annual budgetary spending on education to GDP, the western region has consistently had a higher level compared to the eastern and western areas. Between 2010 and 2019, the average value of the proportion in the west was 5.32%, while the average value in the east and central region was 3.29% and 4.02%, respectively. Judging from the changing trend, the proportion in the east and the middle tended to stabilize after 2012, while the west fell slightly after reaching its peak in 2012.

In terms of the ratio of higher education spending to overall education spending, the eastern area clearly spends more on higher education than the central and western regions. The average percentage in the east was 18.09% between 2010 and 2019, compared to 15.98% and 13.09% in the central and western areas, respectively. This pattern reflects the strategic positioning of the priority development of higher education in the eastern cities and its advantages in the accumulation of higher education resources [7].

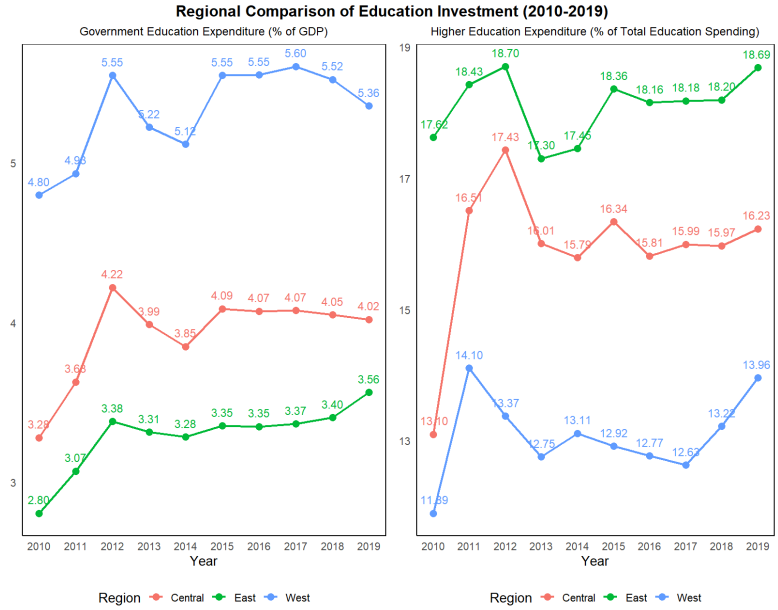

Figure 2. Regional comparison of education investment, 2010-2019

Data sources: China Educational Finance Statistical Yearbook (2010-2019) and Statistical Communiqué on the National Economic and Social Development on the provincial level from 2010 to 2019 (the same below).

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3.2. The improvement of higher education enrollment ratio and regional differences

Nationwide, the gross enrollment ratio of higher education has reached the popularization stage, but there are obvious differences in the starting point and growth rate among the eastern, central, and western regions; the eastern region is leading, and the gap is slightly widening, while the western region is rapidly catching up.

Figure 3 shows the distribution characteristics and evolution trajectory of the total number of higher education students per 100,000 people in the three major regions from 2010 to 2019 in the form of a violin diagram. The width of the violin reflects the density of the distribution of each province, and the dotted line represents the regional average. Judging from the overall trend, the prevalence of higher education in the three major regions has shown a continuous upward trend, and the gross enrollment rate in the country has exceeded 50%. The growth rate is the largest in the western region, with an average annual increase of about 2.3 times that of the eastern region and 1.2 times that of the central region. In terms of regional gaps, the eastern region is always leading, the central region is the second, and the western region is the lowest. The significant narrowing of the East-China gap is particularly prominent, indicating that the central region has shown a strong catch-up trend in the process of popularization of higher education [12]. With regard to the internal regional differences, the distribution of the eastern and central provinces is relatively concentrated, while the substantial disparities in the degree of economic growth and the distribution of resources for higher education across the western provinces are reflected in the comparatively large internal dispersion.

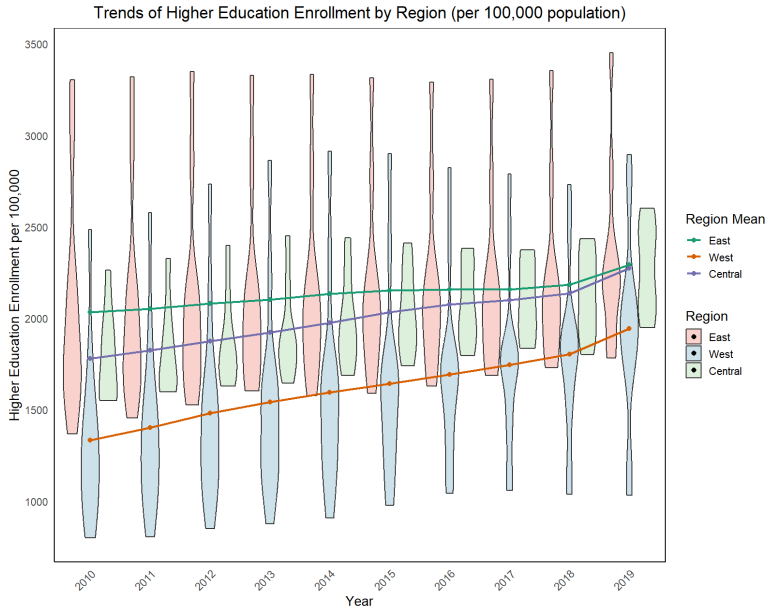

Figure 3. Trends of higher education enrollment by region (per 100,000 population), 2010-2019

The progress of higher education in China is not a "one-size-fits-all" divergence or convergence. In order to test whether there are beta convergence characteristics in the progress of higher education in China, that is, whether provinces with lower initial levels have faster growth rates, this study draws on the theory of economic growth convergence and conducts regression analysis at the national and eastern, central, and western regional levels, respectively. The research sample comes from the data of 31 provinces in China from 2010 to 2019, and the data comes from Educational Statistics Yearbook of China and China Population & Employment Statistical Yearbook. The

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interpreted variable is the average annual growth rate of the number of students per 100,000 people in each province from 2010 to 2019. The core explanatory variable is the logarithm of the initial level in 2010. The regression results are shown in Table 1. Generally, the whole country has converged significantly, and the overall gap has narrowed; the eastern region has converged significantly, and the internal balance has improved; the central region has shown weak convergence; the western region has not converged, which is due to the large gap between the economy and universities in the provinces. From the national level, provinces with low initial enrollment rates have achieved faster growth in the next ten years, showing significant beta convergence characteristics, and the overall gap in the development of interregional higher education tends to narrow. Further sub-regional investigation shows obvious heterogeneity in different regions. There is a strong catch-up effect in the eastern provinces. Provinces with low enrollment rates are growing faster, and the gap in the region is significantly narrowing. There is also a certain convergence trend in the central region, but the strength of evidence is relatively weak. The western region does not show obvious beta convergence characteristics, and there is insufficient evidence of narrowing the internal gap.

Table 1. β convergence test results for higher education enrollment per 100,000 population by region

Variables	Nation	East	Central	West
Initial level (ln_HE_2010)	-0.0418***	-0.0351**	-0.0499*	-0.0317
	(0.00787)	(0.00795)	(0.0253)	(0.0197)
Constant	0.3351***	0.2803***	0.3979*	0.2652
	(0.0581)	(0.0603)	(0.1890)	(0.1411)
Number of observations	31	11	8	12
Adjusted R^2	0.4759	0.6494	0.2927	0.1256

*Notes: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.1$; standard errors are reported in parentheses.

3.3. Gender differences in educational equity

China's higher education has achieved significant advancement in gender equity. However, the fairness of resource allocation is still constrained by disciplinary differentiation, family background differences, and the expectations of gender roles. The Gender Equity Index (GPI) is the core indicator of the equality of higher education opportunities for men and women. When GPI > 1, it means that girls have a higher chance of admission than boys.

Figure 4 shows the evolution trend of GPI in the three major regions of the country and the East, Central, and West from 2010 to 2019. From a national level, girls' opportunities for admission to higher education have always been superior to those of boys, and the advantage continued to expand between 2010 and 2016 and narrowed slightly after 2016. It is worth mentioning that GPI only reflects the fairness of opportunities. At present, women are mainly concentrated in the field of humanities and social sciences, while the proportion of majors in engineering is relatively low. Therefore, there are still gender differences in the fairness of the process and the results in education. In terms of regional differences, the west has the highest growth rate and a substantially higher GPI than the east and central areas. It is worth noting that the eastern GPI continued to decline after 2015, and in 2019, it was lower than the level of 2010.

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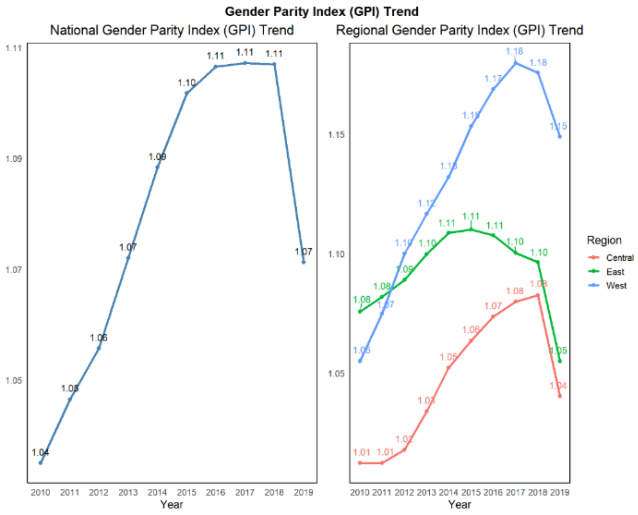

Figure 4. Gender parity index (GPI) trend, 2010-2019

3.4. Comprehensive impact analysis: the dynamic relationship between investment, enrollment and equity

While promoting the expansion of the scale of higher education and the improvement of financial investment, China also needs to pay attention to the fairness of resource allocation. Figure 5 shows the dynamic correlation between the average cost of higher education, the number of students in school per 100,000 people and the gender equity index. With respect to the relationship between investment and the degree of popularization, from 2010 to 2019, the average yearly growth of higher education spending per capita student in the country was 7.3%; the average annual growth of school students per 100,000 people increased by 3.0% in several years. The two curves' simultaneous increasing trend indicates that financial investment growth contributes to the continuous development of higher education's scope. In terms of the relationship between input and gender equity, the GPI index synchronized with the growth of per capita funding between 2010 and 2016; but after 2016, the per capita funding continued to rise, while GPI fell slightly.

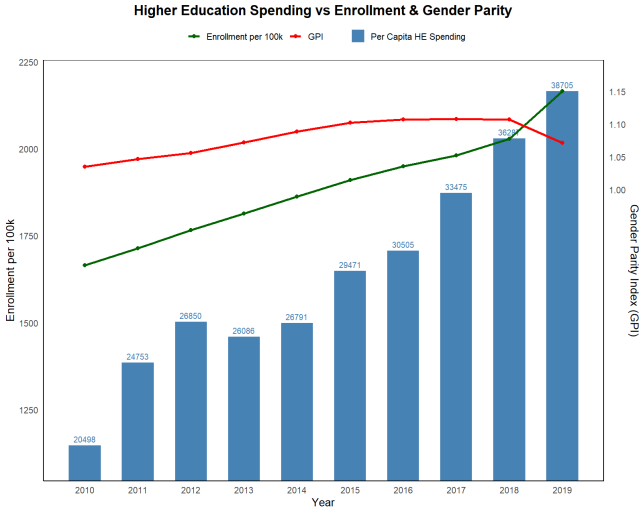

Figure 5. Higher education spending versus enrollment and gender parity index, 2010-2019

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Data sources: Educational Statistics Yearbook of China (2010-2019), China Educational Finance Statistical Yearbook (2010-2019) and China Population & Employment Statistical Yearbook (2010-2019)

4. Policy path and system optimization to improve the fairness of higher education

4.1. Optimizing resource allocation and strengthening regional coordination

On the basis of ensuring a reasonable ratio of annual budgetary spending on education to GDP and a reasonable ratio of higher education expenditure to total government investment in education, a dynamic adjustment mechanism should be established to link economic development and population structure. China has issued relevant plans to implement the "National Basic Ability Construction Project of Western and Central China" and invest 10 billion yuan during the "Twelfth Five-Year Plan", focusing on supporting 100 local general undergraduate high schools in central and western regions, and tilted resources such as schools, disciplines and talents. This study suggests continuing to deepen and expand the scope of support for this special project, and use the "Factor Analysis Approach" to allocate funds to focus on supporting the discipline construction, talent team, and digital resource sharing of western universities. At the same time, people should build a multi-dimensional performance evaluation system, including the average output efficiency and local contribution of services into the assessment indicators, and gradually increase the proportion of performance allocation.

In the face of the reality that the internal development base of the western provinces is very different and the prevalence of higher education is significant, a dynamic funding mechanism of "A different approach for each province" should be established, the population structure, industrial layout, financial capacity and development planning of each province should be comprehensively considered, and differentiated and accurate resource investment strategies should be adopted to avoid resource mismatch caused by simple equalization. Deepen the "blood-making (self-sustaining)" function of paired assistance and cultivate the core capabilities of recipient universities to independently develop through building discipline teams and training graduate students jointly and sharing scientific research platforms.

4.2. Innovating governance mechanisms and deepening gender equity

Gender equity monitoring should include key dimensions such as major selection distribution, academic completion rate, employment rate and starting salary, mid-term salary and promotion ratio in career development, especially tracking the proportion of female students in the STEM field. At the same time, the "Talent Cultivation Program for Women in STEM" should be systematically implemented through diverse projects. Meanwhile, cooperate with enterprises to establish internships, green employment channels and career mentor mechanisms to help students smoothly transition to the workplace and cope with potential gender bias.

4.3. Promoting the transformation of the model and realizing the equal emphasis of quality and fairness

Ensure that fair output indicators such as the employment quality of graduates, the academic enrollment rate and graduation rate of students from disadvantaged groups, and the regional balance are included in the quality assessment of college construction, and universities can be guided to internalize fairness into the pursuit of quality. According to the institutional design of the Measures for the Administration of the Fund for Supporting the Reform and Development of Local

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Universities (Cai Jiao [2021] No. 315), the weight of development and reform factors has been clarified to be 30%, mainly considering regional differences, the scale of special enrollment plans, subject construction and other indicators that reflect the fairness of regional education. On this basis, the fairness indicators should be further refined in order to provide high-quality and dignified learning opportunities for all students.

5. Conclusion

This study systematically examines the influence of government education investment on the popularization of higher education by using Chinese province panel data from 2010 to 2019, and using methods such as fixed effects model, grouped regression and test of convergence, and focuses on analyzing the heterogeneity effect of gender and regional dimensions.

This study found that although the proportion of annual budgetary spending on education to GDP has risen significantly since 2012, the regional structural imbalance still exists. Besides, the internal imbalance in the western region is still prominent, while the gap in the popularization of education between regions has narrowed. In addition, although women's admission opportunities are advantageous, there is a disconnection between investment growth and gender equity improvement after 2016.

Based on the above findings, this study suggests optimizing the structure of financial investment and deepening the self-sustaining ability of the paired assistance. Meanwhile, establish a full-cycle gender equity monitoring system and implement relevant supporting plans. Furthermore, establish a multi-dimensional performance evaluation system, integrating equity indicators into the assessment.

The contribution of this study is to fill the gap in the comparison of gender and regional equity systems and provide an empirical basis for precise policy intervention Future research can further explore the micro-mechanism of the urban-rural dimension and gender segregation in professional selection, so as to promote the deep transformation of higher education from scale expansion to quality and fairness.

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