

Performance Analysis of Public Investment in Chinese University Education Based on Regional Differences and Influencing Factors

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Abstract: *The main purpose of the research is to assess the current condition of public investment in higher education in various regions of China and identify the elements that influence the effectiveness of public investment in higher education. The objective is to propose recommendations for enhancing the performance management of public investments in higher education, balancing the financial expenditures of higher education in various regions, and fostering sustainable economic and social growth. This article presents the academic research findings of relevant researchers on higher education, public investment, performance, and educational performance, as well as performance management, public finance, regional economic growth, new public management, and human capital. Using the DEA data envelopment analysis model and the panel Tobit regression model, this article empirically analyzes the regional differences and influencing factors of the comprehensive efficiency (including pure technical efficiency and scale efficiency) of public investment in higher education in China from both dynamic and static perspectives, based on 29 provinces and cities and relevant statistical data from 2005 to 2017. Based on an analysis of current public investment in higher education in the eastern, central, and western regions of China, the article demonstrates that while the total amount of public investment in higher education has increased year by year, there are still significant differences between the total amounts of public investment in higher education in the eastern, central, and western regions. The scale of public investment in higher education is higher in the eastern region and lower in the central and western regions. Regarding the performance level of public investment in higher education, there is a significant gap among the three regions of eastern, central, and western China, with the central region being the highest, the eastern region being the second highest, and the western region being the lowest. There are differences in the factors affecting the performance of the public investment in higher education in the East, Central, and West. The Tobit panel regression model analysis shows that per capita regional GDP, human capital level, urbanization level, and the efficiency of public education in higher education are all positively correlated. In contrast, the student-teacher ratio and government financial resources are adversely correlated. Distinct variables influence Eastern, central, and western areas geographically. The article concludes with a summary of the research findings and policy recommendations, namely, improving the performance evaluation system of public investment in higher education, increasing government investment in higher education, balancing the financial expenditures of higher education in different regions, accelerating the reform of the higher education investment system, and expanding the sources of public investment in higher education.*

Keywords: public investment in higher education, achievements, regional differences, influencing factors.

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1. Introduction

Public investment in higher education is the investment of national governments at all levels in higher education institutions. The state provides the financial condition for universities, which is manifested in material aspects, to provide the fundamental guarantee for the comprehensive, coordinated, and sustainable development of higher education undertakings. Since the expansion of universities and the massification of higher education in China, the spatial structure and layout of higher education have changed significantly. At the same time, regional differences in the performance of public investment in higher education in China face problems in the following aspects: The imbalance of China's economic development level directly affects the development level of higher education in different regions, and the uneven distribution of public investment resources in higher education due to the different levels of economic development and infrastructure construction in different regions leads to significant differences in the development level and competitiveness of universities, which, to a certain extent, lead to the unbalanced development of regional economies and societies; some localities pay excessive attention to the scale expansion in the field of higher education while neglecting the quality and efficiency issues within colleges and universities, and there are inefficiencies and wastes in the utilization of these public investment funds by higher education institutions lacking clear strategic planning and performance management mechanisms, therefore, in view of the above-mentioned problems, it is necessary to conduct an in-depth analysis and research on the performance of regional differences in the performance of public investment in higher education in China and the influencing factors.

Based on the review and analysis of relevant literature studies, the purpose of this paper is to investigate the performance of the public investment in higher education and its influencing factors from a regional perspective, measure the regional differences in the scale and performance of the public investment in higher education across regions in China using a data envelopment model, and analyze the influencing factors of regional differences in the performance of the public investment in higher education across regions in China. These objectives will be accomplished by investigating the performance of the public investment in higher education and its influencing factors. In addition, the study uses a panel Tobit regression model to determine what makes public investments in higher education vary from region to region. The findings of this study indicate that public investment in higher education in China plays a crucial role in encouraging the comprehensive, coordinated, and sustainable development of the higher education sector. To ensure that public investment funds are used efficiently to promote the growth of higher education in China's central and western regions, it is necessary to address the unequal distribution of regional resources, inefficiencies, and resource waste. By taking an innovative and strategic approach to the use of public investment funds, promoting cooperation between academic institutions and industry and the overall development of higher education in China, reducing regional disparities, and promoting sustainable development of higher education, China's higher education can become more competitive, contribute more to the country's social and economic development, and serve as a model for other countries.

2. Literature Review

Chinese scholars generally believe that the concept of educational performance includes the efficiency of government financial input in higher education, the output of universities in various aspects such as student personal development, social services, and national development under comprehensive resource input, as well as the improvement of internal structural management and construction of universities, and the potential for future long-term development. Feng Hui and Wang Qi (2012) believe that university education performance is more evident in the multi-dimensional system architecture of the higher education system or institutions' input, teaching, and output throughout time. Huang Jianyuan and Wang Jingmei (2015) believe that higher education investment performance is diverse, lagged, and long-term. Chi Yeguo (2019) thinks that educational performance management should respect the value orientation of educational performance, distinguish between explicit and implicit performance based on how performance is shown, and build a management system based on educational values and missions that is suited to the different kinds of educational activities.

As for the current situation of differences in how resources are given to higher education by region, experts have done much more research on how resources are given to education from preschool to higher education in the 21st century. Metcalfe (2009) determined that, despite improving higher education institutions and expanding university enrollment opportunities in British Columbia, Canada, there is still an unreasonable distribution of university education resources that does not promote expanding enrollment opportunities for native residents and a lack of university education. Kavrouidakis et al. (2013) examine the social equity and spatial imbalance of higher education resources under different economic conditions. They also examined how students' enrollment opportunities, economic development, and geographical factors affect resource allocation and use. Results reveal that higher education access varies by resource allocation. Du Peng and Gu Xin (2019) came to this conclusion after doing an empirical analysis of panel data about how much China spends per person on higher education. They found that universities and regions in China spend different amounts per person on education. Wang Shanmai et al. (2013) believe that the difference in inter-provincial educational resource allocation in China shows an expanding trend. Ye Jie (2015) believes that the gap between provincial expenditure and China's university education stage is widening.

The discussion in Schultz, T.W. (1961) "Investment in Human Capital" marked the formal formation of the human capital theory, concluding that education enhances human capabilities. It is essential in economic growth and introducing quantitative cost-benefit analysis in education management. According to Chatterton P. and Goddard J. (2000), higher education responds to regional demand through a combination of drivers and barriers. Governments can minimize barriers by supporting interregional cooperation and establishing interregional partnerships. Petrakis and Stamatakis (2002) argued that primary and secondary education is crucial for economic growth in poor countries. However, higher education has a more significant impact on economic growth in affluent countries. Papageorgiou (2003) argues that secondary and higher education play a greater role in science and technology innovation and technology application, whereas primary education has a larger role in product production. Regional stakeholders must work closely together to improve the region's competitiveness in the global economy. According to Hudson (2006), the Swedish Regional Growth Partnership can be viewed as a tool and a regional governance mechanism in which regional stakeholders must collaborate to develop strategies.

Chinese academics hold the following positions: Cheng Jing (2012) found that regional economic development is the material foundation for the high-quality development of higher education, that higher education drives the development of science and technology, which in turn promotes regional economic development, and that higher education institutions and local governments should strengthen cooperation to promote the coordinated development of both. Using data from 1996 to 2001 and a panel data model, Hu Yongyuan and Liu Zhiyong (2004) calculated the benefits of higher education on economic growth in each region. The empirical analysis revealed that the benefits of higher education development on regional GDP were distributed from high to low in the eastern, central, and western regions. Based on the statistical data of the eastern, central, and western regions from 1999-2009, Liu Guoqing (2012) discovered that the total effect of higher education investment on economic growth after 2004 was greatest in the central region, followed by the east, and lowest in the west, with significant regional differences. Li Ping et al. (2012) analyzed the investment effectiveness of higher education in each region of China from input and output perspectives using data from 1997 to 2008 and a dynamic panel data model. They discovered that the investment effectiveness of higher education is generally higher in economically developed regions.

Zhang Wenyao (2012) established a correlation model to measure the relationship between the efficiency of higher education development in the more backward regions and the regional economic development, using the western provinces of China as an example. They discovered a long-term significant cointegration relationship between higher education development in the western regions and the level of regional economic development in China, but there is no significant correlation. Using panel data from 2000-2010, Gao Yao (2013) empirically examined the relationship between higher education and the regional economy in 107 large cities in China and showed that the general relationship between higher education development and the regional economy has diminished. Zhong Wuya (2014) constructed a revised neoclassical economic growth model based on statistical data from three provinces: Beijing, Shanghai, and Guangdong, and applied the Granger causality test and the ECM model based on cointegration to conduct a regional comparison of educational investment and economic growth performance. In Beijing, the association between educational investment and economic growth performance was found to be non-significant, although Shanghai and Guangdong provinces exhibited a favorable relationship. Economic growth has a consistently strong positive effect. Guo Liqiang (2018) empirically analyzed the coordination relationship

between higher education and economic development levels in 31 provinces and municipalities (districts) across China in 2005 and 2015 by establishing a coordination degree model and found that the coordination relationship between the two had improved between 2005 and 2015. However, there was a significant “Matthew effect” between the higher education and economic systems.

There is still a dearth of literature research on the factors that influence the public investment performance of higher education, which is primarily based on university scale and university education development. Mao Jianqing (2009) found using Granger regression analysis and linear regressions that the population size, Engel ratio, per capita GDP, and proportion of tertiary industry production value had a long-term, constant, and balanced relationship with tertiary education. Wang Jianhong and Liu Yirong (2015) used the cointegration test and a one-time linear regression model to estimate China's medium- and long-term development and determine the effect of per capita GDP and tertiary industries on higher education. Zhang Yunxia and Wang Shoulan (2014) used the log-average decomposition method to analyze the structure of higher education funds, the intensity of higher education funds, and the influence of economic development on the development of higher education. Zhang Shuhui & He Juanjuan (2015) utilized a panel data model to examine the influence of urbanization on the Chinese higher education system between 2005 and 2011. They found that urbanization had a considerable impact, and regional inequalities were evident.

Scholars have conducted extensive research on higher education investment performance from various perspectives, such as resource allocation and the relationship between higher education and regional economic development and have produced numerous reference research results. However, there is a dearth of in-depth empirical research on the characteristics and influencing factors of regional differences in higher education and public investment performance. This paper will help quantify and clarify regional differences in the performance of the public investment in higher education in China and its influencing factors. Moreover, it will propose a mechanism path for structural optimization and corresponding countermeasure suggestions, which can serve as an essential theoretical foundation and policy reference for China to improve the efficiency of financial resource allocation and promote the comprehensive, coordinated, and sustainable development of higher education.

This study has the following hypotheses:

H1: *There is an uneven distribution of the performance of the public investment in higher education across regions in China.*

H2: *There are significant regional differences in the scale of public investment in higher education in China, and it is related to the level of regional economic development.*

H3: *There are differences in the scale of public investment in higher education in different provinces within the same region of China.*

H4: *The factors affecting the performance of the public investment in higher education vary across regions in China.*

3. Research Methodology

3.1 Selection of Research Methods and Indicators. This research uses the data envelopment analysis (DEA) model to measure the performance of the public investment in higher education, decomposes the combined efficiency into scale efficiency and pure technical efficiency through its DEA-BCC model with variable scale payoffs, and then analyzes the effects of various economic and social factors on the performance of the public investment in higher education in various regions. In order to comprehensively and accurately measure and analyze the performance level of public investment in higher education, this paper selects five indicators based on the input-output analysis method, including the allocation of education expenses, the allocation of infrastructure, the allocation of research funds, the allocation of other funds, and the additional allocation of education as input indicators, and four indicators, including the number of college graduates, the number of published papers, the number of invention patents and the fixed assets of colleges and universities as output indicators. This research employs a relatively appropriate panel Tobit regression model for empirical analysis to examine further the effects of various economic and social factors on the performance of the public investment in higher education in different locations. This study examines the key factors influencing the performance of the public investment in higher education in Chinese provinces and cities by combining the existing literature with an empirical analysis based on the Tobit model (districts).

The model's typical shape is as follows:

$$Y = \begin{cases} Y^* = \alpha + \beta X = \varepsilon, Y^* > 0 \\ 0, Y^* \leq 0 \end{cases} \quad (1)$$

Y^* – the explained quantity of the model; α – the constant term; X – the explanatory variable; β – the regression parameter; ε – the random disturbance term.

To investigate the impact of different socio-economic factors on the performance of public investment in higher education in China, this study takes the comprehensive efficiency level of public investment in higher education as the dependent variable. Using panel data from 29 provinces and cities (districts) from 2005 to 2017, the independent variables include per capita regional gross domestic product (GDP), human capital level, urbanization level, student-to-teacher ratio in higher education, the proportion of fiscal expenditure to regional GDP, and the level of regional industrial development. A regression model is established as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon \quad (2)$$

Y denotes the DEA composite efficiency value, $X_1 \sim X_6$ denotes the six influencing factors, $\beta_1 \sim \beta_6$ denotes the regression coefficients of the explanatory variables of each influencing factor, α is a constant term, and ε is a random disturbance term.

3.2 Data Source. This paper selects data related to nine variables from 29 Chinese provinces from 2005-2017. It uses DEAP 2.1 and STATA software to conduct empirical analysis and research on their public investment performance in higher education. The original data were obtained from the China Education Expenditure Statistical Yearbook, the China Education Statistical Yearbook, and the website of the National Bureau of Statistics of China in previous years. The data from Qinghai and Hainan provinces were excluded from this paper because of the severe missing data on education, additional allocation, and insufficient comparability. In contrast, some missing data from other provinces were estimated by the linear estimation method.

4. Data Analysis and Findings

4.1 Analysis of Public Difference in Higher Education in China. In this paper, the data of public investment funds for higher education are selected from the China Education Funding Statistical Yearbook for a total of five indicators, such as the allocation for educational undertakings, the allocation for infrastructure, the allocation for scientific research, the allocation for other funds, and the allocation for additional education. As can be seen from Figure 1, the average public investment funds for higher education by the province in each region showed an overall stable growth trend during 2005-2017. The average public investment funds for higher education by province in the eastern region increased from RMB 6.091 billion in 2005 to RMB 30.795 billion in 2017, a fourfold increase with an average growth rate of 14.79%; the average public investment funds for higher education by province in the central region increased from RMB 2.958 billion in 2005 to RMB 19.650 billion in 2017, a 5.5-fold increase with an average growth rate of 18.22%; the average public investment expenditure on higher education by province in the western region rose from RMB 1.553 billion in 2005 to RMB 11.402 billion in 2017, an increase of 6.3 times and an average growth rate of 18.80%; the average public investment expenditure on higher education by province nationwide rose from RMB 3.534 billion in 2005 to 20.616 RMB billion in 2017, an increase of 4.8 times, with an average growth rate of 16.38%.

In terms of inter-provincial comparison, in 2017, for example, Beijing had the highest public investment in higher education in the eastern region, with 70.686 billion yuan. Fujian Province has the lowest public investment in higher education with 15.662 billion yuan; in the central region, Hubei Province has the highest public investment with 30.205 billion yuan, and Shanxi Province has the lowest public investment in higher education with 11.088 billion yuan. In the western region, Shaanxi Province has the highest public investment in higher education with 25.225 billion yuan, and Tibet Autonomous Region has the lowest public investment in higher education with 1.718 billion yuan. The public investment fund for higher education in eastern China is significantly higher than in central and western China. The public investment fund for higher education in the central region is higher than that of the western region. The level of public investment in higher education in the central area is similar to the national average. There have been large differences in the size of public investment in higher education between the eastern and western regions of

China, and these differences do not diminish the overall trend, with the highest level of investment in the east, the second highest in the middle, and the lowest level of investment in the west (Figure 1).

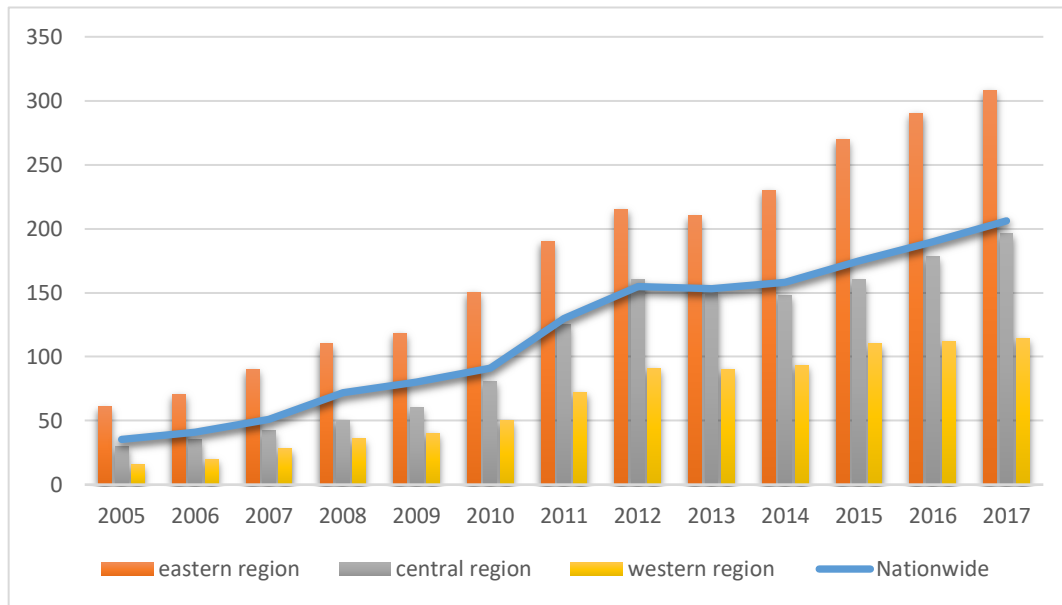


Figure 1. Average Public Investment Scale of Higher Education in Each Region (RMB 100 million)

Source: Compiled by the author

4.2 Empirical Analysis of the Performance Difference of Public Investment in Higher Education in China

4.2.1 Dynamic Analysis of the Performance of Public Investment in Higher Education in China. This paper analyzes the input-output performance of higher education in 29 provinces and three regions in China with the help of DEAP 2.1 software to measure the trend of public investment performance in higher education in China from both time and regional perspectives. The relevant results are shown in Figure 2.

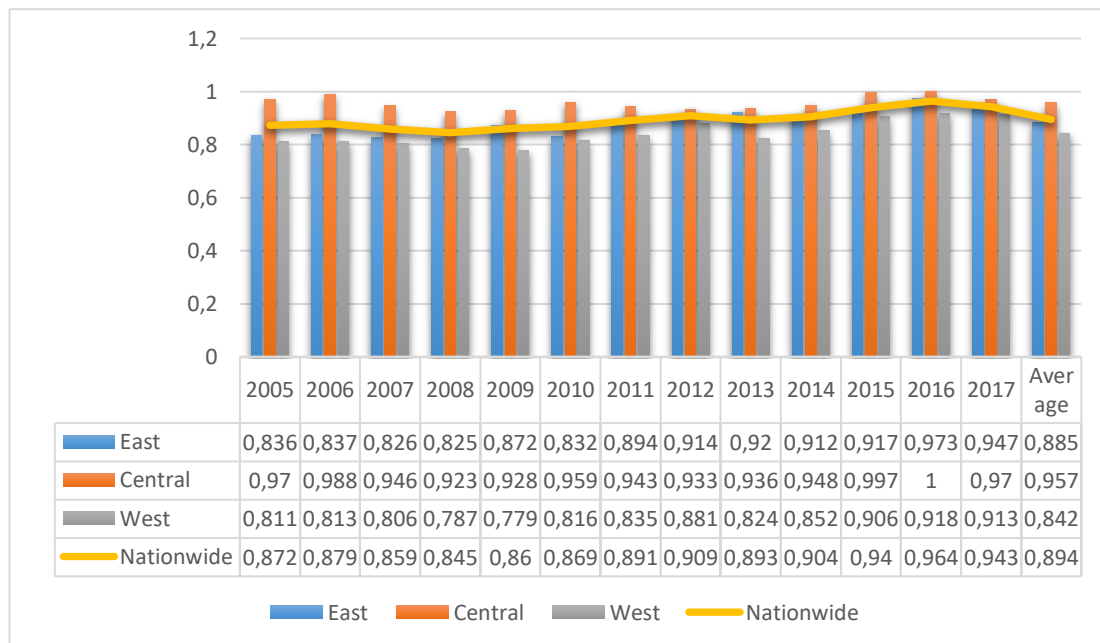


Figure 2. Performance of Public Investment in Higher Education in China from 2005 to 2017 (Comprehensive Efficiency)

Source: Compiled by the author

From the perspective of time, according to the data in Figure 2, from 2005 to 2017, the overall level of public investment performance in higher education in China was above 0.85, which shows the high efficiency of the utilization of higher education funding resources in China and that its input-output benefits are strong. From a regional perspective, according to the data in Figure 2, the performance of public

investment (comprehensive efficiency) in China's higher education is the highest in the central region, and the eastern region is the second, which is not different from the national average, and the western region is the lowest. There are significant differences in the scale of public investment in higher education in east, central, and western China, with the highest in the east, the second in the central part, and the least in the west, which further reflects the unbalanced performance of the public investment in higher education in the three regions.

This paper further decomposes the comprehensive efficiency of public investment performance in Chinese higher education into pure technical and scale efficiency (see Figure 3). Public investment performance in Chinese higher education fluctuates in comprehensive, purely technical, and scale efficiency. From 2005-2017, comprehensive efficiency improved. The total efficiency declined to 0.845 in 2008, peaked in 2012, and reached 0.964 in 2016. The “W-shaped” fluctuation trend of China's public investment allocation mechanism in higher education shows that reform and development of relevant systems improve public investment performance as resource investment increases. However, the scale efficiency of public investment performance in higher education in China is the same as the development trend of comprehensive efficiency, showing a trend of increasing fluctuation. In addition, the pure technical efficiency of China's public investment performance in higher education is in the high-efficiency range of above 0.929 from 2005 to 2017. The volatility is small, indicating that the existing public investment structure in higher education can effectively allocate resources and promote the high-quality use of resources.

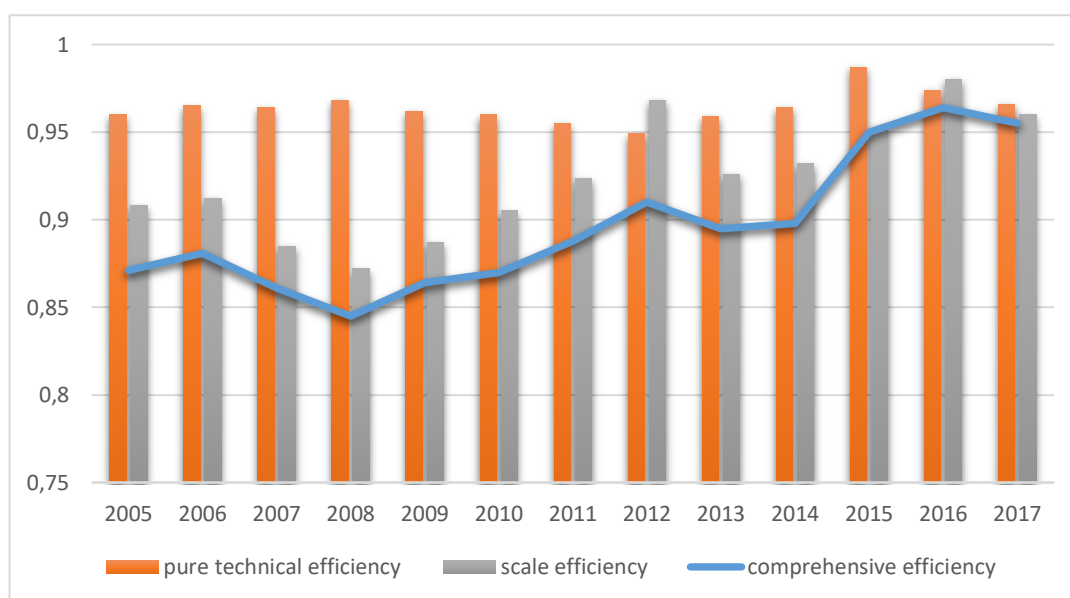


Figure 3. Changing Trend of Public Investment Efficiency in Higher Education in China

Source: Compiled by the author

4.2.2 Static Analysis of the Performance of Public Investment in Higher Education in China. The DEA-BCC model was used in this study to further divide the comprehensive efficiency of the public investment performance in higher education into pure technical efficiency and scale efficiency and to analyze the situation of scale return. The relevant indicators from 29 Chinese provinces in 2017 were chosen as the research samples (Table 1).

Table 1. Efficiency Decomposition of Public Investment Performance in Higher Education in China in 2017

Province	Combined efficiency	Pure technical efficiency	Scale efficiency	Payoffs for scale	Province	Combined efficiency	Pure technical efficiency	Scale efficiency	Payoffs for scale
Beijing	1.000	1.000	1.000	—	Henan	1.000	1.000	1.000	—
Tianjin	0.940	1.000	0.940	drs	Hubei	1.000	1.000	1.000	—
Hebei	1.000	1.000	1.000	—	Hunan	1.000	1.000	1.000	—
Liaoning	1.000	1.000	1.000	—	Inner Monggol	0.912	0.950	0.960	irs
Shanghai	1.000	1.000	1.000	—	Guangxi	0.950	1.000	0.950	irs

Table 1 (cont.). Efficiency Decomposition of Public Investment Performance in Higher Education in China in 2017

Jiangsu	1.000	1.000	1.000	—	Chongqing	1.000	1.000	1.000	—
Zhejiang	0.901	0.901	1.000	irs	Sichuan	1.000	1.000	1.000	—
Fujian	0.796	0.915	0.870	irs	Guizhou	0.910	1.000	0.910	irs
Shandong	1.000	1.000	1.000	—	Yunnan	0.930	1.000	0.930	irs
Guangdong	0.801	0.910	0.880	irs	Xizang	0.724	0.832	0.870	irs
Shanxi	1.000	1.000	1.000	—	Shaanxi	1.000	1.000	1.000	—
Jilin	0.917	0.936	0.980	irs	Gansu	0.868	0.904	0.960	irs
Heilongjiang	0.970	1.000	0.970	irs	Ningxia	0.901	0.969	0.930	irs
Anhui	0.954	0.954	1.000	irs	Xinjiang	0.902	0.960	0.940	irs
Jiangxi	1.000	1.000	1.000	—	nationwide	0.944	0.973	0.969	—

Note: Combined efficiency = pure technical efficiency \times scale efficiency, - indicates constant scale payoff, irs indicates increasing scale payoff, and drs indicates decreasing scale payoff.

Source: Compiled by the author

The Pure Technical Efficiency and Scale Efficiency of Public Investment in Higher Education in China. In 2017, the average value of pure technical efficiency of public investment in higher education in Chinese provinces was 0.973, which is non-technical efficient and indicates poor management, wasteful use, and a low input-output conversion rate. The mean value of its scale efficiency is 0.969; it is lower and non-scale efficient than pure technical efficiency, indicating that public investment resources for higher education have problems with improper inputs or outputs and unjustified resource allocation. The eastern, central, and western regions have 19 provinces with a pure technical efficiency of 1, and the eastern and central regions have 16 provinces with a scaling efficiency of 1. A province with a pure technical efficiency of 1 can fully utilize public investment funds in higher education. In contrast, provinces with less-than-optimal pure technical efficiency must improve pure technical efficiency by improving management, resource allocation, and input-output transformation. A scale efficiency of 1 indicates that the province has achieved the optimal scale of public investment in higher education, while provinces with less-than-optimal scale efficiency have a mismatch between the allocation of public investment and the demand for higher education development, as well as too much or too little investment.

Compensation for the Scale of Public Investment in Higher Education in China. In 2017, 14 provinces in China had constant compensation for the scale of public investment in higher education. Fourteen provinces have increasing compensation for the scale of public investment in higher education, with most provinces in the western region, indicating that these provinces need to increase the investment of public investment resources in higher education, introduce many talents, and optimize the allocation of resources to achieve the optimal scale state. It is worth noting that Tianjin is in a state of diminishing returns on the scale of public investment in higher education, which indicates that Tianjin invests too much and wastes resources in allocating higher education funds and resources. In the future development, attention should be paid to improving the efficiency of the use of resources, focusing on "qualitative" output rather than quantitative input.

4.3 Analysis of Influencing Factors of Public Investment in Higher Education in China. It is evident from the preceding study that the geographical performance of public investments in higher education is not uniform. This paper employs a panel Tobit regression model to conduct empirical analysis based on the influence of various economic and social factors on the performance of regional public investments in higher education and the available research. In this study, a quantitative analysis is undertaken utilizing panel data for 29 provinces across the country from 2005 to 2017, using the following indicators and definitions for the explanatory variables: The first is each province's per capita GDP (*lnrgdp*), which shows local economic development; the second is the percentage of employed people with college or higher education (*pec*), which shows local human capital; the third is urbanization (*ul*), which shows regional economic development; and the fourth is the student-teacher ratio of colleges and universities (*str*), which shows regional faculty allocation; the fifth is the proportion of fiscal expenditure to regional GDP (*fe*), which represents the government's financial power, Chinese higher education mainly relies on state fiscal expenditure, so the government's financial power has a certain influence on the funding of public investment in higher education; the sixth is each province's tertiary industry production value to GDP (*ind*), which indicates regional industrial development. The empirical results based on the panel Tobit regression model are shown in Table 2.

Table 2. Panel Tobit Regression Models

model variable	I(nationwide)		II(east)		III(central)		west	
	Coef	Std.E	Coef	Std.E	Coef	Std.E	Coef	Std.E
lnrgdp	0.1808***	0.0897	0.4943*	0.3294	-0.3399	0.3168	-0.0023	0.0058
pec	1.3715***	1.0718	-1.0974	1.0507	1.1183	1.5613	-0.1186**	1.2548
ul	0.6916***	0.5910	0.4724**	0.3003	0.2553**	0.3203	0.0075	1.4317
str	-0.0468**	0.0260	-0.0740*	0.0444	-0.3348*	0.4157	0.7263	0.5858
fe	-0.8419**	0.2783	0.0230	2.7484	2.5679	1.7433	-0.3018*	0.1633
ind	-0.5662	0.5674	0.0991	0.1279	-0.3765***	0.1384	-0.1592*	0.0933

Note: ***As a p < 0.01; **As a p < 0.05; *As a p < 0.1.

Source: Compiled by the author

From the comprehensive analysis of the above indicators, it can be found that the local economic development, the level of local human capital, the level of urbanization, the student-teacher ratio of colleges and universities, and the financial power of the government mainly influence the performance of the public investment in higher education in China. Local economic development, human capital, and urbanization boost public investment in higher education, but the student-teacher ratio and government financial resources of colleges and universities negatively affect them. Since the turn of the century, China's economy has grown rapidly, and its ability to produce higher education has grown. Through empirical research, Wei Mei (2012) found that regional economic development has a positive spillover effect on higher education, that economic development is one of the main factors influencing and restricting higher education, and that rapid economic development has laid a solid foundation for efficient higher education development. China's economy and higher education are booming in the 21st century.

China has long acknowledged that economic development and education development are intertwined. In 2015, it suggested the “Double First Class” strategy, another national higher education strategy in China, following the “211 Project” and “985 Project”. Through an empirical study of 286 Chinese cities, Zhang Zhenhan (2013) discovered that higher education and urbanization support and impacted each other in a spiral. Higher education promotes urbanization through cultivating talents, fostering technological progress, guiding industrial upgrading, and enhancing population quality for urban socio-economic development, while urbanization provides the basic support for the development of higher education and influences its positioning. China's higher education is mostly funded by government public finance, yet a lack of understanding of resource allocation has led to inefficient resource allocation and low input-output levels.

For the eastern region, GDP per capita, urbanization level, and student-teacher ratio have significant effects on public investment performance in higher education. The per capita GDP and urbanization level have a positive relationship, and the student-teacher ratio has a negative relationship with each other. As the most economically developed region in China, the economic development of the eastern region is the basis for the more effective development of higher education, so the economic development of the eastern region promotes the development of higher education. Liu Qian and Wang Yongzhe (2019) observed that economic development strongly influenced the development of higher education from 1978 to 2016. As China's economic heartland, the eastern area has the highest urbanization, higher education, and talent demand. Due to the developed economy, eastern China pays enough attention to education. Teachers' welfare is generally higher than that of the central and western regions; educational resources are abundant; and faculty allocation is high; but the student-teacher ratio is too low, wasting faculty resources and affecting universities' social benefits.

The level of urbanization, faculty allocation, and regional industrial development mainly influences the performance of public investment in higher education in the central region. Among them, the level of faculty allocation and the level of regional industrial development have a negative effect on public investment performance in higher education. The overall shortage of teachers has resulted in more teaching assignments per teacher, which not only increases the burden on teachers but also directly affects the quality of their teaching. Although the level of industrial development in the central region has been significantly improved with the implementation of the Central Rising Strategy, the development of the tertiary industry needs to be improved, and the service industry needs to be higher, which creates a significant gap between the eastern region and internationally. The low level of industrial development cannot provide high-quality employment on the one hand. It cannot generate effective demand on the other, which in turn cannot drive the

development of higher education. For example, Lv Jian (2014) explores the development of higher education from the perspective of urbanization and argues that, except for the western region, the increase in urban income level has promoted the development of higher education to a certain extent. Therefore, the central region should pay attention to urbanization, continuously improve the level of urbanization, increase the policy of introducing talents, actively promote the interaction between cities, establish city belts, and promote the development of linkages and higher education.

There is a considerable negative correlation between human capital, government financial resources, regional industrial growth and higher education in the western area. The regression coefficient of the human capital level in the model is negative and meets the 5% significance threshold. Due to the slow growth of local businesses and difficulty retaining local talent, the weak economic foundation and low level of human capital in the western region have resulted in talent migration. The administration of the western area needs more financial resources and adequate support for higher education, preventing it from effectively supporting the growth of higher education. Location, low-end industrial development, lack of cultivation of industries with specific advantages, and restructuring of the industrial and economic structures are disadvantages of the western area. Future economic development, particularly the implementation of the Western Development Strategy, should adhere to the policy of adopting the development of higher education to industrial and economic development, promote the development of higher education, and offer strong talents and technical support for the economic and social development of the Western region.

5. Conclusions and Recommendations

5.1 Study Conclusions. This study first reviews the theoretical and empirical analysis of higher public education investment performance. It clarifies the connotation and scope of the core concepts of higher education public investment and performance. Secondly, it examines the current situation of higher education public investment scale in China's east, central, and western regions. Finally, it employs the DEA method to conduct a more comprehensive and detailed empirical regional differences analysis. In addition, by developing a Tobit panel regression model, we evaluated the factors impacting regional inequalities in the performance of public investments in higher education in China. The three following conclusions are reached.

First, from the perspective of the scale of public investment in higher education, the public investment in higher education in the eastern, central, and western regions varies greatly, and there are obvious differences in the three regions. The public investment in higher education in the eastern regions is relatively high, while that in the central and western regions is low. Second, there are obvious regional differences in the performance of public investment in higher education. Third, different regions affect the performance of public investment in higher education: for the whole country, The level of local economic development, human capital, and urbanization has a positive impact on the performance of a public investment in higher education. The university student-teacher ratio and the government's financial resources have a negative impact on it. For the eastern region, the student-teacher ratio is too low. The level of teacher allocation has a negative impact on the performance of a public investment in higher education. The level of local economic development and urbanization positively impact it. For the central region, the lack of teacher allocation levels and the restriction of regional industrial development levels have a negative effect on the performance of the public investment in higher education. Urbanization level has a positive effect on it. Since the level of human capital, government financial resources, and regional industrial development in the western region are relatively low, these factors have a negative impact on the public investment efficiency of higher education.

5.2 Policy Recommendations. Through the analysis of the current situation of public investment in higher education and its performance level in east, central, and west China, the scale of expenditure and performance level of public investment in higher education in the three significant regions differ significantly. Various factors are responsible for the differences. Based on the above analysis, corresponding countermeasures are proposed to reduce the differences in the scale of regional public investment in higher education and improve investment performance.

Improving the Performance Evaluation of Public Investment in Higher Education. Establish a set of performance evaluation standards for public investment in higher education that can be universally applicable across the country, and regularly evaluate the performance of each province and city/district to supervise and urge various regions to improve the public investment efficiency of higher education. China still needs to create evaluation standards for the performance of public investments in higher education.

There is no set limit for measuring the investment effectiveness of public investments in higher education. Existing performance evaluation standards are singular and unrepresentative, preventing them from guiding higher education reform effectively. It is not conducive to the efficient use of public investment funds in higher education. At the same time, local governments disregard the quality of higher education development in their jurisdiction, resulting in growing regional disparities and the waste of public investment funds in higher education.

Thus, it is beneficial to set performance evaluation criteria for public investments in higher education tied to local governments' organisational success. By urging regions to improve their public investment performance and evaluating their higher education public investment performance achievement status, it is possible to significantly increase the motivation of local governments in higher education and significantly improve the overall performance of higher education investments.

Enhance Government Funding for Higher Education and Balance Regional Spending. Domestic higher education has made some progress but still lags developed nations and cannot support high-quality economic development. China's late start to higher education growth partly explains its sluggish development. So, to improve higher education's function as an economic and social driver, the public investment must be increased. China's uneven economic development has led to differing expenditure initiatives for higher education development in each region, especially between the eastern and western regions. The eastern region's position and rapid economic and social development allow the government to establish higher education. However, the western region is in a disadvantageous location with limited natural conditions and resources compared to the eastern region, resulting in the backward development of the local economy, and the government needs more financial resources to support and improve higher education development quickly.

Hence, we should boost public investment in higher education financing, materials, and teachers in rural areas of central and western China and provide quality education resources for local students. It should also stick to the western development plan, actively promote economic development links between developed eastern coastal areas and western cities, and boost talent introduction to draw more promising talents to build and develop in western regions. The government should strengthen the theoretical understanding of public investment mechanisms in higher education, study and develop a strategy for the integrated development of regional higher education, continuously narrow the gap between different regions in the scale of higher education funding, achieve a balanced allocation of higher education resources so that more people can access higher education, and shorten the gap between regions by strengthening regional cooperation.

Accelerate the Reform of the Investment and Financing System and Expand the Sources of Public Investment Funds in Higher Education. According to the current state of higher education growth in China, even if public investment in higher education has increased each year, it is still insufficient to satisfy actual needs. Therefore, it is of utmost importance to widen the sources of public investment money in higher education and to encourage the creation of diverse investment topics and financing structures. Innovative investment channels in higher education should actively use diverse fiscal, tax, and financial policies, absorb more social capital into higher education and form diversified investment subjects, including the government, enterprises, the public, and foreign investors. We will continue prioritizing government investment, direct private capital to invest in government-oriented higher education buildings, maximize public investment in higher education's performance, and promote economic and social growth. Concurrently, increase the innovation of the higher education investment mechanism, develop multi-channel and various investment patterns, and raise the scale and benefits of higher education investment.

6. Research Prospects

Through the study, this paper illustrates the issues associated with using public investment funds for higher education in China, derives the performance evaluation results and influencing factors based on the empirical analysis of relevant statistical data from 2005 to 2017, and proposes targeted policy recommendations. The findings of this paper provide certain references for the state and government to enhance the investment in public investment funds for higher education and improve its performance level. However, there are also several limitations, and the following recommendations are made: first, continue to extend and update the number of relevant sample statistics, increase the number of relevant higher education panel data at the prefectural and municipal levels, conduct more precise and extensive analyses, and derive more applicable conclusions. Second, we will continue to pay close attention to the most recent research

results on evaluating the public investment performance of higher education in academia, develop innovative research ideas and methodologies, and construct a more scientific and objective evaluation system.

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