Research on Measuring the Quality and Balanced Development of Basic Public Education in China:A Case Study of Hubei Province

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Abstract: *China is currently at a crucial stage of transitioning from a major educational country to a powerful educational nation. Promoting the high-quality and balanced development of basic public education is the core task, yet there are still disparities in the distribution of high-quality educational resources between regions and between urban and rural areas. This paper takes Hubei Province as the research subject and, based on the three theories of educational equity, equalization of basic public services, and high-quality development, constructs an evaluation index system encompassing economic scale, population size, school size, funding investment, and teacher resource guarantee. Utilizing the Theil index method and based on relevant statistical data from 2005 to 2024, this paper measures the level of high-quality and balanced development of basic public education. The measurement results show that from 2005 to 2023, the Theil index of GDP, population size, funding investment, and teacher resources in Hubei Province exhibited an overall downward trend, indicating that the overall differences in the impact of various factors on the high-quality and balanced development of basic public education have gradually decreased, and resource allocation is tending towards equilibrium.This study provides a reference for assessing the high-quality and balanced development of basic public education nationwide and offers data support for formulating and adjusting relevant policies.*

Keywords: *Basic public education; High-quality and balanced developmen; Financial security mechanism*

1. Introduction

China is currently at a crucial stage of transitioning from a major educational player to a formidable educational powerhouse.Despite the continuous increase in educational investment,with the Chinese central government allocating 158.2 billion yuan in 2024 to guide and support local governments in further consolidating and improving the funding guarantee mechanism for compulsory education that is unified across urban and rural areas,with a focus on rural areas,the distribution of educational resources,especially high-quality resources,remains uneven among regions.Has the gap in the high-quality and balanced development of basic public education between regions and urban-rural areas in China significantly narrowed?How effective is the national financial investment in basic public education?Both depend on effective measurement of the high-quality and balanced development of basic public education.Hubei Province,located in central China,is a major educational province.Measuring the degree of high-quality and balanced development of basic public education in Hubei Province helps us understand the overall situation of high-quality and balanced development of basic public education in China.

2. Literature Review

The "Education Status" report released annually in the United States starts with approximately 50 indicators in three major categories:demographic characteristics and education participation,educational resources and learning environment,and academic achievement and educational outcomes,providing a comprehensive method for measuring the balanced and high-quality development of education in the United States.The UNESCO educational measurement indicator

system focuses on measuring and statistics for developing countries,mainly including five primary indicators and 22 secondary indicators in the areas of educational demand,educational supply,enrollment participation,internal efficiency of education,and educational output.

The indicator system for high-quality and balanced education primarily encompasses four aspects:the popularization and consolidation of basic public education,the balanced allocation of educational resources,the high-quality and balanced development of education between urban and rural areas,and the high-quality and balanced development of education among schools (Yao Jijun, 2014).Utilizing the Fisher's four-dimensional policy evaluation framework can also aid in exploring practical approaches for the high-quality and balanced development of basic public education in China (Huo Cuifang,Shi Ying,2025).

The specific measurement methods for the high-quality and balanced development of education mainly include principal component analysis,factor analysis,cluster analysis,analytic hierarchy process,Delphi method,TOPSIS method,regression analysis,and so on.

Xiong Xiaoyan and Xu Yaobin(2015) constructed a measurement model for the development balance of compulsory education based on the MEM-GAHP method,and verified the feasibility of this method through case studies;Cai Yingqi and Zhang Chunyan(2023) utilized provincial panel data from 2010 to 2020 to measure the development level of preschool education across all provinces,municipalities,and autonomous regions in China.Yang Lingping and Fan Lianhua(2025) established a multi-level,multi-user,three-dimensional and open measurement and evaluation system in the era of intelligence.They formed a technical perspective of data governance thinking and intelligent measurement,effectively enhancing the evaluation efficiency of high-quality and balanced development in compulsory education.

In summary,when it comes to measuring the high-quality and balanced development of public education,developed countries pay more attention to racial or class differences,while China focuses more on regional and urban-rural differences.Most relevant measurement indicators at home and abroad provide quantitative information,with less information on education quality. There are more measurement indicators related to the balanced development of education,but fewer related to the high-quality development of education.In conclusion,the abundant research results at home and abroad not only lay a foundation,provide references and guidance for this study,but also point out the direction for it.

3. Theoretical Basis and Methodology

3.1 Theoretical Basis

3.1.1 Theory of educational equity

The theory of educational equity aims to ensure that everyone enjoys equal educational rights and opportunities.Its core revolves around the fairness of educational resource allocation,process participation,and achievement outcomes.The theory of educational equity has evolved continuously with social development,from the initial emphasis on equal opportunity,to focusing on the fairness of educational quality,and then to emphasizing respect for individual development potential in education.It embodies a deep pursuit of social fairness and justice and serves as an important theoretical basis for educational measurement and policy formulation.

3.1.2 Theory of equalization of basic public services

The theory of equalization of basic public services is rooted in the concepts of fairness and justice,as well as social contract theory.It holds that the government has the responsibility to achieve a balance of basic rights among members of society through the provision of public services.The government must adhere to the bottom-line guarantee principle centered on "ensuring the basic and covering the bottom line",the coordinated development principle of urban-rural and regional resource allocation,and the sustainable principle of dynamic adjustment based on the level of economic and social development.

3.1.3 High-quality development theory

The theory of high-quality development is an inheritance and development of Marxist development theory.High-quality development not only promotes reasonable quantitative growth but also emphasizes effective qualitative improvement.Guided by the goal of addressing imbalances and

inadequacies in development,and led by the new development philosophy, high-quality development focuses on enhancing the quality and efficiency of development.

3.2 Research Methods

The main measurement methods for the high-quality and balanced development of public education include the Gini coefficient method,the coefficient of variation method,the Theil index method,the factor analysis method,and the comprehensive evaluation method.Among them,the Theil index method is an important method for measuring regional balanced development,income distribution inequality,or resource allocation differences.The Theil index method is not only applicable to the analysis of economic development balance,but also to multidimensional balance analysis in education,healthcare, environment,etc.,just by adjusting the definitions of relevant indicators.

When the Theil index is used to measure the degree of equilibrium in resource allocation in the field of education, its core formula and variable meanings are as follows:

$$T = \sum_{i=1}^{n} \left[y_i \cdot ln\left(\frac{y_i}{p_i}\right) \right] \qquad (1)$$

In formula(1),i represents the ith group divided by region,urban-rural area,school type,and so on;yi represents the proportion of the indicator share of educational resources such as education funding,number of teachers,and teaching facilities per student in the ith group to the total;pi represents the proportion of the number of students in the ith group to the total;ln is a natural logarithmic function used to quantify the deviation degree between the share of educational resources and the population proportion.

The Theil index can be further decomposed into inter-group difference $T_{between}$ and intra-group difference T_{within} ,that is, $T = T_{between} + T_{within}$ .The inter-group difference is used to measure the disparities in the allocation of educational resources among different groups,and its formula is:

$$T_{between} = \sum_{i=1}^{n} \left[p_i \cdot ln\left(\frac{\bar{y}_i}{y_i}\right) \right] \qquad (2)$$

In formula (2), $\bar{y}_i$ represents the average educational resource share for the ith group,while y_i denotes the overall average educational resource share.

The within-group variance T_{within} is used to measure the degree of inequality in the distribution of educational resources within each group,with the formula:

$$T_{within} = \sum_{i=1}^{n} p_i \cdot T_i \qquad (3)$$

In formula (3), T_i represents the Theil index within the ith group,and its calculation method is consistent with the basic formula (1).

The value range of the Theil index is typically [0, +∞),meaning from 0 to positive infinity. When the Theil index is 0,it indicates complete equality or no difference in development status; when the Theil index is greater than 0,it indicates inequality or differences in development status, and the larger the Theil index value,the higher the degree of inequality.

4. Measurement and Analysis of High-quality and Balanced Development of Basic Public Education:Taking Hubei Province as an Example

4.1 Evaluation index system

The evaluation index system for the high-quality and balanced development of basic public education primarily encompasses gross domestic product(GDP),expenditure on basic public education,total permanent resident population,number of teachers in basic public education,and total number of basic public education schools(see Table 1).

Table 1: Evaluation Indicator System for the Quality and Balanced Development of Basic Public Education

Indicator	Indicator Symbol	Indicator Meaning	Indicator Unit
economic scale	Y	GDP	100 million yuan
population size	X_1	Year-end permanent resident population of the region	ten thousand people
school size	X_2	Number of local basic public education schools	quantity
funding input	X_3	Local basic public education budget expenditure	100 million yuan
faculty support	X_4	Number of teachers in local basic public education	number of people

4.2 Data sources

This article takes Hubei Province in China as an example and employs the Theil index method to measure the high-quality and balanced development of public education.To ensure the accuracy and reliability of the data required for the study,the data in this article primarily comes from the "China Statistical Yearbook","China Education Statistical Yearbook","China Education Funding Statistical Yearbook","Hubei Provincial Statistical Yearbook" and "Statistical Communique on the National Economic and Social Development of the People's Republic of China in 2024" and "Statistical Communique on the National Economic and Social Development of Hubei Province in 2024" from 2005 to 2024.These materials cover various aspects of basic public education in Hubei Province,and statistical methods are used to organize and analyze the collected data.

4.3 Measurement results

Taking the natural logarithm of each variable,we obtain the following results(see Table 2).

Table 2: Statistical Analysis of the Measurement and Quantification of Factors Affecting the High-quality and Balanced Development of Basic Public Education in Hubei Province

year	lnY	$\ln X_1$	$\ln X_2$	$\ln X_3$	$\ln X_4$
2004	8.751550	8.647871	9.768870	4.218501	13.147743
2005	8.774879	8.649974	9.676524	4.347079	13.274826
2006	8.926889	8.646993	9.608176	4.549187	13.310422
2007	9.153917	8.648046	9.502562	4.950036	13.345881
2008	9.349881	8.650149	9.424564	5.218860	13.382837
2009	9.487376	8.651724	9.351579	5.329033	13.420274
2010	9.694428	8.652388	9.269741	5.473407	13.459016
2011	9.900606	8.658693	9.229947	5.759860	13.499418
2012	10.025302	8.662332	9.139167	6.165503	13.540935
2013	10.141638	8.665268	9.036225	6.106821	13.583392
2014	10.248570	8.668368	9.005528	6.219949	13.626674
2015	10.320354	8.674197	8.990442	6.386008	13.670636
2016	10.414903	8.680162	8.990317	6.523256	13.715178
2017	10.525004	8.683385	8.991562	6.585441	13.760262
2018	10.645947	8.685585	8.996776	6.540548	13.80485
2019	10.723905	8.687273	8.999866	6.614209	13.849781
2020	10.669060	8.661345	9.002578	6.652625	13.895056
2021	10.821601	8.670772	9.001962	6.660898	13.940618
2022	10.891818	8.673171	8.995041	6.723115	13.986375
2023	10.929594	8.672149	8.985445	6.784794	14.032227
2024	11.002316	8.671539	8.960853	6.857113	13.991082

Next,we calculated the variance of GDP measures for Hubei Province and obtained the following results(see Table 3).

Table 3: Measurement Variance of GDP in Hubei Province

lnY				
	Percentiles	Smallest		
1%	8.903176	8.903176		
5%	8.903176	9.057653		
10%	9.057653	9.257816	Obs	17
25%	9.542125	9.422001	Sum of Wgt.	17
50%	10.35471		Mean	10.14297
75%	10.67922	10.73266	Largest Std. Dev.	0.6367713
90%	10.89182	10.82004	Variance	0.4054777
95%	10.90536	10.89182	Skewness	-0.6238668
99%	10.90536	10.90536	Kurtosis	2.110247

Then,the variance of the total population of Hubei Province was calculated,and the results are as follows(see Table 4).

Table 4: Variance of Total Population Measurement in Hubei Province

$\ln X_1$				
	Percentiles	Smallest		
1%	8.653122	8.653122		
5%	8.653122	8.655737		
10%	8.655737	8.659039	Obs	17
25%	8.663369	8.661294	Sum of Wgt.	17
50%	8.685754		Mean	8.687942
75%	8.71062	8.715716	Largest Std. Dev.	0.0254588
90%	8.726806	8.721113	Variance	0.0006481
95%	8.731982	8.726806	Skewness	0.2484084
99%	8.731982	8.731982	Kurtosis	1.761518

By calculating the variance of the total number of basic public education schools in Hubei Province,the following results were obtained (see Table 5).

Table 5: Variance Measurement of the Total Number of Basic Public Education Schools in Hubei Province

$\ln X_2$				
	Percentiles	Smallest		
1%	10.06858	10.06858		
5%	10.06858	10.08797		
10%	10.08797	10.10757	Obs	17
25%	10.14808	10.12775	Sum of Wgt.	17
50%	10.25115		Mean	10.25184
75%	10.35482	10.37552	Largest Std. Dev.	0.1161203
90%	10.41796	10.39678	Variance	0.0134839
95%	10.43902	10.41796	Skewness	0.0197252
99%	10.43902	10.43902	Kurtosis	1.787554

Similarly,by calculating the variance of the expenditure on basic public education in Hubei Province,the following results were obtained(see Table 6).

Table 6: Variance of Basic Public Education Funding Expenditure Measurement in Hubei Province

$\ln X_3$				
	Percentiles	Smallest		
1%	5.299517	5.299517		
5%	5.299517	5.583421		
10%	5.583421	5.589904	Obs	17
25%	5.875155	5.639812	Sum of Wgt.	17
50%	6.651585		Mean	6.528799
75%	7.11068	7.201007	Largest Std. Dev.	0.6661165
90%	7.294819	7.274639	Variance	0.4437112
95%	7.429835	7.294819	Skewness	-0.4464148
99%	7.429835	7.429835	Kurtosis	1.911283

Finally,the variance of the measure of basic public education teacher numbers in Hubei Province was calculated,and the results are as follows (see Table 7).

Table 7: Variance measurement of the number of basic public education teachers in Hubei Province

$\ln X_4$				
	Percentiles	Smallest		
1%	13.27482	13.27482		
5%	13.27482	13.31042		
10%	13.31042	13.34588	Obs	17
25%	13.42027	13.38283	Sum of Wgt.	17
50%	13.62667		Mean	13.63676
75%	13.84978	13.89505	Largest Std. Dev.	0.2391952
90%	13.98637	13.9406	Variance	0.0572143
95%	14.03222	13.98637	Skewness	0.1006035
99%	14.03222	14.03222	Kurtosis	1.772809

Through the aforementioned series of analyses,it was found that the data distribution of GDP and basic public education expenditure in Hubei Province is relatively dispersed,whereas the data distribution of total population, number of basic public education teachers,and total number of schools is more concentrated.Except for the total population all other variables exhibit a certain degree of skewness,indicating that their distributions are not completely symmetrical.Except for the total number of schools,the kurtosis of all other variables is greater than 3,indicating that their distributions are relatively sharp and contain certain extreme values.By calculating the Theil index, the following results were obtained (see Table 8).

Table 8: Theil index analysis of factors affecting the high-quality and balanced development of basic public education in Hubei Province

year	T_Y	T_X_1	T_X_2	T_X_3	T_X_4
2005	-0.9948846	-0.9842011	-0.9999914	-0.9996753	-0.999867
2006	-0.9950576	-0.9857669	-0.9999914	-0.9996771	-0.9998675
2007	-0.9952691	-0.9857999	-0.9999914	-0.9996788	-0.999868
2008	-0.9954325	-0.9860501	-0.9999914	-0.9996805	-0.9998685
2009	-0.9955468	-0.9871453	-0.9999914	-0.9996823	-0.999869
2010	-0.9957413	-0.9880097	-0.9999914	-0.9996842	-0.9998696
2011	-0.9959534	-0.9891255	-0.9999914	-0.9996861	-0.9998701
2012	-0.9961157	-0.9897274	-0.9999914	-0.999688	-0.9998707
2013	-0.9962183	-0.9905358	-0.9999914	-0.9996899	-0.9998712
2014	-0.9962386	-0.9901943	-0.9999914	-0.9996939	-0.9998722
2015	-0.9961877	-0.9896909	-0.9999914	-0.9996939	-0.9998722
2016	-0.9962386	-0.9901943	-0.9999914	-0.9996939	-0.9998722
2017	-0.9963262	-0.9904958	-0.9999914	-0.9996978	-0.9998732
2018	-0.9963781	-0.9914432	-0.9999914	-0.9996998	-0.9998738
2019	-0.9964799	-0.9909737	-0.9999915	-0.9997017	-0.9998742
2020	-0.9964446	-0.9919621	-0.9999915	-0.9997036	-0.9998748
2021	-0.9965366	-0.9912243	-0.9999915	-0.9997056	-0.9998752
2022	-0.996582	-0.9916618	-0.9999915	-0.9997075	-0.9998758
2023	-0.9965906	-0.9916155	-0.9999915	-0.9997094	-0.9998763

From 2005 to 2023,the Theil index(T_Y) of Hubei Province's GDP exhibited an overall downward trend,decreasing from -0.9948846 to -0.9965906.This indicates that the overall disparity in the impact of Hubei Province's GDP on the high-quality and balanced development of basic public education is gradually decreasing,with overall development tending towards equilibrium.The Theil index (T_X1) of Hubei Province's population size also showed a downward trend,decreasing from -0.9842011 to -0.9916155.This suggests that the overall disparity in the impact of Hubei Province's population size on the high-quality and balanced development of basic public education is also gradually decreasing,with a more balanced per capita allocation of high-quality educational resources.

The Theil index (T_X2) of the scale of basic public education schools in Hubei Province remained stable from 2005 to 2018,and then began to slowly decline,from -0.9999914 to -0.9999915,indicating that the overall disparities in the scale of basic public education schools in Hubei Province have also begun to slowly decrease.The Theil index (T_X3) of basic public education funding investment gradually decreased from -0.9996753 in 2005 to -0.9997094 in 2023, indicating that the overall disparities in the impact of basic public education funding investment on the high-quality and balanced development of basic public education in Hubei Province are also gradually decreasing,and the allocation of funds for high-quality basic public education is becoming more balanced.The Theil index (T_X4) of teacher resource guarantee gradually decreased from -0.999867 in 2005 to -0.9998763 in 2023,indicating that the overall disparities in the impact of teacher resource investment in basic public education on the high-quality and balanced development of basic public education in Hubei Province are also showing a gradual decreasing trend,and the allocation of high-quality teacher resources for basic public education in Hubei Province is also becoming more balanced (see Figure 1).

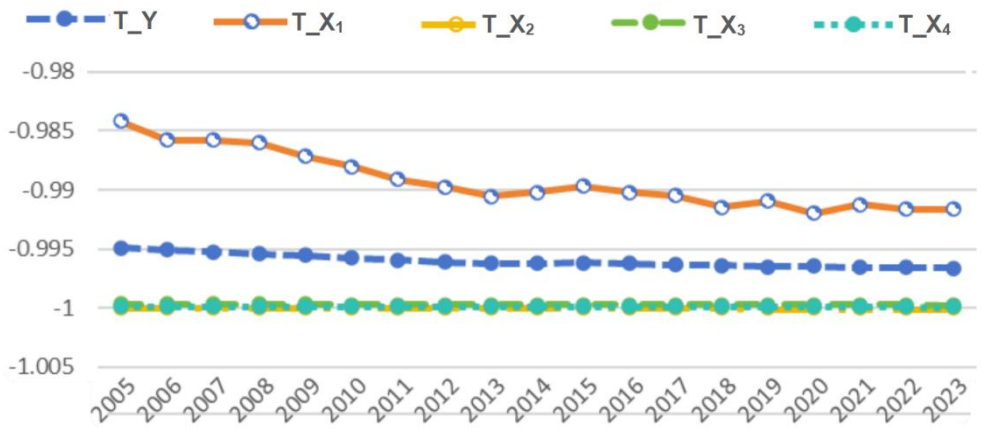

Figure 1: Measurement and Analysis of High-quality and Balanced Development of Basic Public Education in Hubei Province Based on Theil Index

4.4 Brief conclusion

After analyzing using the same analytical method,it can be found that the impact of inter-group differences on the high-quality and balanced development of basic public education in Hubei Province is relatively small,but it cannot be ignored.Overall,if there are significant intra-group differences,it is necessary to increase investment in basic public education within the region and improve the allocation efficiency of basic public education resources;if there are significant inter-group differences,it is necessary to vigorously implement a regional coordinated development strategy,allocate or share high-quality education resources,and promote the high-quality and balanced development of basic public education between regions.

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