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Original Article

Research on Influencing Factors of Financial Input in Higher Education

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Abstract *- Based on the relevant education data of 31 Chinese provinces from 2015 to 2020, this paper selects the per capita general public budget for education as the response variable, the economic development level, the scale of higher education, the local government effort, the financial expenditure structure and the urbanization level as the explanatory variables. In this paper, the multi-level model is used to study the factors that affect the financial input in higher education. The results show that the local economic development level and the financial expenditure structure have a significant positive impact on the financial input of higher education, the scale of higher education has a significant negative impact on the financial input of higher education, and the local government effort and the urbanization level have no significant impact on the financial input of higher education.*

Keywords *- Empty model, Random effect, Random intercept model, Random slope model, Standard normal distribution.*

1. Introduction

With the rapid development of economy and the constant updating and progress of science and technology, there is increasingly fierce competition for talents. And the demand for high-quality talents is increasingly urgent. High-quality education has been given an important mission of the times [1].

Education is a vital task for the country and the Party. China has been strengthening the development of education. In the past decade, especially in the years since the epidemic, China has been faced with increasing economic pressure year by year. The contradiction between financial expenditure and expenditure has been prominent, but the financial investment in education has always been increasing year by year [2]. Government spending on education totaled 33.5 trillion yuan over the past ten years, with an average annual growth rate of 9.4%, higher than the average annual nominal GDP growth rate of 8.9% and the average annual growth rate of general public budget revenue of 6.9% during the same period. The report of the Party's 20th National Congress points out that it is necessary to accelerate the construction of a high-quality education system, develop quality-oriented education and promote educational equity [3]. The higher education system plays a leading and guiding role in the education system, and should be at the forefront of The Times in speeding up the construction of high-quality education system. Higher education is professional education on the basis of the completion of secondary education and is the main social activity for training higher specialized personnel, which can greatly improve the overall level of education of our people and plays a vital role in social and economic development [4].

The imbalance of higher education fund investment is a prominent problem which the higher education development faces in China [5]. Since the Third Plenary Session of the Eleventh Central Committee, especially since the reform and opening up, the cause of higher education has been developing rapidly. On the whole, China's economic development has entered a new stage. However, in the field of education, due to the long-term constraints of the planned economy and administrative system, there is a large gap between different provinces in the input of higher education, which also leads to the uneven level of higher education among different provinces. It is of great significance for the coordinated development of higher education to study the factors influencing the financial input of higher education [6].

The financial input of higher education plays a vital role in the rapid development of high-quality education. Many scholars have conducted empirical research on it.

Cuifeng Gu and Xuezhu Liu [7] studied the current situation of higher vocational education fund input in recent years. And they pointed out that the insufficient fund input in higher vocational education is mainly reflected in the following

aspects: insufficient total fund input, disproportionate fund input to the scale of education, and unsound financial support mechanism; The unbalanced input is mainly manifested in the following aspects: significant differences in per capita expenditure between provinces and regions; differences in the implementation of per capita appropriation level for higher vocational students lead to the imbalance of per capita appropriation; and the lack of effectiveness of the financial transfer payment system.

Based on provincial panel data from 1998 to 2006, Xiaohua Zong [8] used econometric models to conduct an empirical study on factors affecting local higher education financial input. It shows that the demand scale of regional economy for college graduates, the outflow proportion of graduates, the degree of transferability of the financial responsibility of local colleges and universities to the central finance and the degree of regional residents have a significant impact on the financial input of local higher education.

Yuanxiang Zhou and Xuguang Song [9] made use of the tracking survey data of Chinese families, established the logistic model, discussed the differences of individual higher education enrollment opportunities. And they further included the factors of national education finance to conduct a deeper study, pointing out that educational financial input has a significant impact on whether individuals receive higher education.

Xiaofeng Liu and Hui Tan [10], in order to study the impact of higher education financial input on the competitiveness of colleges and universities, established a system dynamics model to simulate the financial input of higher education and the competitiveness of colleges and universities. And they found that the increase of research and development funds would lead to a large increase in the competitiveness of colleges and universities in the case of large changes in the financial input of higher education. The change of full-time equivalent of R&D personnel will affect the competitiveness of universities, but the impact degree is lower than that of R&D expenditure. A significant increase in fixed assets investment in colleges and universities is conducive to improving the competitive development environment of colleges and universities. Only by significantly increasing the per capita higher education funding can it meet the needs of higher education expansion and play a significant role in promoting the competitiveness of colleges and universities.

Yunpeng Fu [11] et al. used the multiple linear regression model and based on the financial input data from 2003 to 2017 to study the influencing factors of higher education financial input in Liaoning Province.

2. Index selection, Variable Interpretation and Data Sources

2.1. Index Selection

There are many factors that affect the financial input in higher education. By referring to a large number of relevant data and combining with the conclusions drawn by predecessors, this paper selects indicators from the following aspects for research.

Financial input in higher education. Educational funds are a general term. According to the different sources, educational funds can be divided into state financial educational funds, investment by the organizers of privately-run schools, social donations, career income and other educational funds. The financial input mentioned in this paper refers to the national financial education funds. That is, the government's investment in education, including the general public budget education funds, school-run industry and social service income for education funds, enterprise allocations in running schools of state-owned and state-owned holding enterprises and other state financial education funds [12]. The financial input of higher education refers to the funds invested by the government to maintain and develop the cause of higher education. Among them, education funds from general public budget account for a large proportion of fiscal education funds. So this paper uses education funds from general public budget per student of higher education as a measure of the overall financial input in higher education.

(1) Economic development level. The level of economic development represents the economic capacity of a region, which has the most direct impact on the fiscal revenue and expenditure of each province. And it is also one of the main reasons for the input differences among provinces [13]. Generally speaking, the financial capacity of prosperous areas is stronger than that of poor areas. Therefore, the prosperous areas will spend more money on higher education. The GDP index of each province can roughly reflect the level of economic development of the region, and thus determine the amount of investment in higher education.

(2) Scale of higher education. The scale of higher education can reflect the coverage of higher education in a region, which can directly see the level of development and investment of higher education in the region. And it is also one of the factors to compare the level of higher education in different regions [14]. The number of higher education schools can reflect the carrying capacity of higher education in a region, and the number of enrolled students can reflect the scale of education in a region. Therefore, the number of higher education schools and the number of enrolled students are selected as indicators to measure the scale of higher education in this paper.

(3) Local government effort. The efforts of local governments represent an attitude of the government, indicating that whether the government is willing to pour resources into higher education affects the development of higher education to a large extent. Only with a large amount of support from the government can the financial input be greater [15]. Local governments should not only consider the development of higher education, but also pay attention to the overall economic development of the region. Different fiscal expenditure items bring different contributions to local economic growth. Higher education is a social citizen service, and its contribution to economic growth requires a longer cycle. On the whole, local governments are more likely to prefer production and construction projects that can rapidly promote economic growth, thus affecting their willingness to invest in higher education [16].

(4) Financial expenditure structure. The structure of fiscal expenditure refers to the proportion of fiscal expenditure on education in the total fiscal expenditure. Education expenditure is a very important part of fiscal expenditure, reflecting the government's emphasis on education. The more the government attaches importance to education, the more it will invest in higher education. The structure of fiscal expenditure can also reflect the direction of national finance and play a guiding role in the development of higher education [17].

(5) Urbanization level. Urbanization level refers to the degree of urbanization in a region, which is usually expressed by the percentage of urban population in the total population. The higher the percentage, the higher the urbanization level, which can reflect the education level of the region to some extent, and thus have an impact on higher education.

2.2. Variable Interpretation

Table 1. Variable interpretation

Variable class	Variable name		symbol	Variable specification	unit
Response variable	Per capita general public budget for education		PC	General public budget education expenditure/number of students enrolled	Ten thousand yuan
Explanatory variable	Economic development level		GDP	Gross domestic product	Hundred million yuan
	Scale of higher education	Number of higher education institutions	College		Institute
		Number of students enrolled in higher education	Student		People
	Local government effort		DGE	Financial investment in higher education/Financial investment in education	%
	Financial expenditure structure		FES	Fiscal expenditure on education/fiscal expenditure	%
	Urbanization level		UL	Urban population/total population	%

2.3. Data source

Based on the data from 2015 to 2020, this paper studies the influencing factors of fiscal input in higher education in 31 Chinese provinces. The index data used in this paper are all from China Statistical Yearbook, China Education Statistical Yearbook and National Data.

3. Materials and Methods

3.1. Introduction to Multi-Level Models

Hierarchical structure exists widely in nature and human society, for example, biological system has natural hierarchy or ethnic structure [18]. The course system has a hierarchy from shallow to deep, from simple to complex and so on. Since stratification is ubiquitous in nature, the hierarchical structure of society naturally generates multi-hierarchical data [19]. For example, when studying the influencing factors of hospitalization costs for internal medicine patients in various hospitals in a certain region, a sufficient number of internal medicine patients in various hospitals in the region are randomly selected to collect hospitalization costs, hospitalization days, duration of illness, age of illness, treatment methods, hospitalization conditions, etc., and analyze the influencing factors of hospitalization costs. The data in this study has a distinct hierarchical structure, that is, "hospital-patient" can take medical patients as level 1 units and hospitals as level 2 units.

Multi-level models are a very efficient way to process hierarchical data. The so-called hierarchy refers to the nesting of lower-level units within higher-level units. It is precisely because of this nesting relationship that individuals in the same high-level unit have some similar but different backgrounds from other high-level unit individuals. In terms of observation data, the observation data of individuals in the same high-level unit has certain aggregation, which is statistically called intra-group correlation. However, the individual observation data among different high-level units also has certain heterogeneity [20].

Such characteristics of this kind of data do not meet the independent conditions of individual data required by traditional analysis methods such as ordinary linear model. Therefore, most of the traditional analysis methods are no longer applicable. According to the characteristics of hierarchical structure of data, the multi-level model can evaluate the influence and moderating effect of higher units on the relationship between explanatory variables and outcome variables of lower units [21].

3.2. Multi-level Model

3.2.1. Empty Model

Take two layers of data. Firstly, the empty model is established, also known as the unconditional two- level model. This is the first step in building a multi-level model. The purpose is to test whether there are differences between the data, so as to determine whether there is a hierarchical structure between the data. If there is no difference, it is unnecessary to use the multi-level model. The general form of the empty model is as follows [22]:

$$\begin{aligned} \text{Level 1: } & y_{ij} = \beta_{0j} + e_{ij} \\ \text{Level 2: } & \beta_{0j} = \beta_0 + u_{0j} \\ \text{General model: } & y_{ij} = \beta_0 + u_{0j} + e_{ij} \end{aligned} \tag{1}$$

For level 1, y_{ij} as response variables, β_{0j} to intercept, represents the mean value of group j, $e_{ij} \sim N(0, \sigma_{e_0}^2)$ is the residual term of level 1; For level 2, β_{0j} as response variables, β_0 to intercept, said that the overall average estimate, $u_{0j} \sim N(0, \sigma_{u_0}^2)$ for level 2 residual items, reflects the random effect of group j on y. The residuals between level 1 and level 2 are independent of each other, namely $Cov(u_{0j}, e_{ij}) = 0$.

From the point of the total model, response variable y_{ij} can be expressed as the sum of the fixed part β_0 and random part $(u_{0j} + e_{ij})$, Where β_0 description model of the fixed effects, and the variance of random part $\sigma_{u_0}^2$ and $\sigma_{e_0}^2$ description model of random effects. Variance of response variable:

$$Var(y_{ij}) = Var(\beta_0 + u_{0j} + e_{ij}) = Var(u_{0j} + e_{ij}) = \sigma_{u_0}^2 + \sigma_{e_0}^2 \tag{2}$$

Thus, the total variance of y_{ij} is decomposed into inter-group variance $\sigma_{u_0}^2$ and intra-group variance $\sigma_{e_0}^2$.
Intra-group correlation coefficient ICC can measure the degree of similarity of variables in the same group and is defined as:

$$ICC = \frac{\sigma_{u_0}^2}{\sigma_{u_0}^2 + \sigma_{e_0}^2} \tag{3}$$

Represents the degree of variation at the inter-group level. The value ranges from 0 to 1. The closer it is to 1, the greater

the proportion of inter-group variance in the total variance, indicating that the use of multi-level model is reasonable. The closer it is to 0, the more it indicates that the data does not have hierarchical structure. At this time, the model can be simplified to a fixed effect model.

3.2.2. Two Horizontal Random Intercept Model

Random intercept model introduces explanatory variables on the basis of empty model to explain the effect of explanatory variables on response variables. This explanatory variable can be either 1 unit or 2 units. This paper only introduces the case where explanatory variable exists in 1 unit. In this case, the general form of the model is [23]:

$$\begin{aligned} \text{Level 1: } & y_{ij} = \beta_{0j} + \beta_1 x_{ij} + e_{ij} \\ \text{Level 2: } & \beta_{0j} = \beta_0 + u_{0j} \\ \text{General model: } & y_{ij} = \beta_0 + \beta_1 x_{ij} + e_{ij} + u_{0j} \end{aligned} \tag{4}$$

In the total model, $(\beta_0 + \beta_1 x_{ij})$ is the fixed part, $(e_{ij} + u_{0j})$ is random part. x_{ij} is the observed value of explanatory variable, and β_1 is the regression coefficient of explanatory variable x_{ij}, which does not change with the change of level 2 units. β_0 is the total average estimate, $e_{ij} \sim N(0, \sigma_{e_0}^2)$ is the residual term of level 1, $u_{0j} \sim N(0, \sigma_{u_0}^2)$ is the residual term of level 2, and the residual term between the two levels is independent of each other, namely $Cov(u_{0j}, e_{ij}) = 0$.

3.2.3. Two-Level Random Slope Model

The random intercept model assumes that the influence of level 2 on level 1 is only represented by the variation of intercept, and the regression coefficient of explanatory variable will not change with the change of level 2 units. The random slope model will establish the situation that the regression coefficient will change with the change of level 2 units, which is an extension of the random intercept model. There is only explanatory variable at level 1, and the model is [24]:

$$\begin{aligned} \text{Level 1: } & y_{ij} = \beta_{0j} + \beta_{1j} x_{ij} + e_{ij} \\ \text{Level 2: } & \beta_{0j} = \beta_0 + u_{0j} \\ & \beta_{1j} = \beta_1 + u_{1j} \\ \text{General model: } & y_{ij} = \beta_0 + \beta_{1j} x_{ij} + u_{0j} + u_{1j} x_{ij} + e_{ij} \end{aligned} \tag{5}$$

In the total model, $(\beta_0 + \beta_1 x_{ij})$ is the fixed part, $(u_{0j} + u_{1j} x_{ij} + e_{ij})$ is random part. β_0 is the average intercept and β_1 is the average slope, $e_{ij} \sim N(0, \sigma_{e_0}^2)$ is the residual term of level 1, $u_{0j} \sim N(0, \sigma_{u_0}^2)$ is intercept term horizontal 2 residual, $u_{1j} \sim N(0, \sigma_{u_1}^2)$ is the slope term horizontal 2 residual, $Cov(u_{0j}, e_{ij}) = 0$.

4. Model Construction and Result Analysis

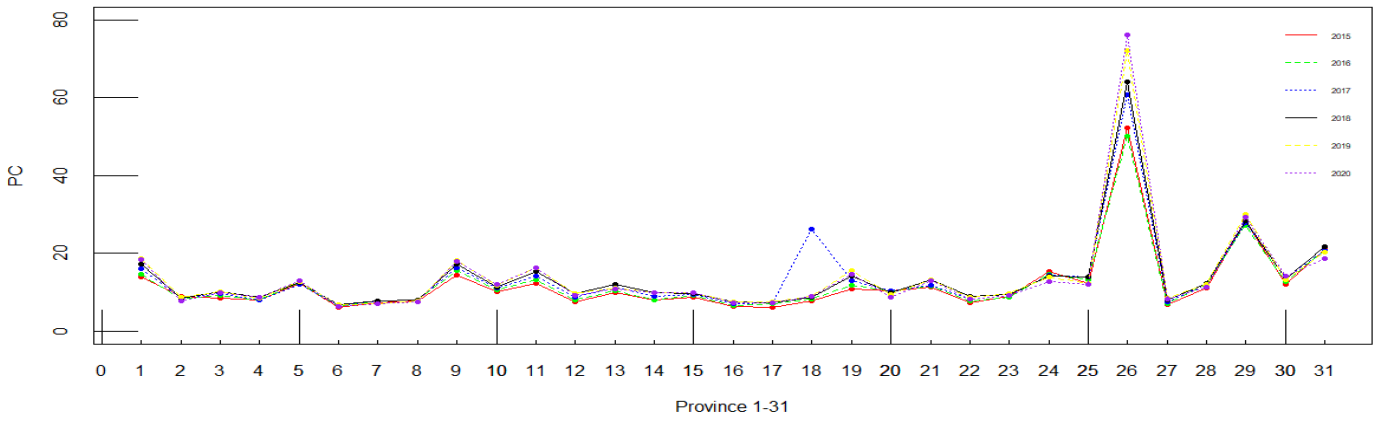

Fig. 1 Comparison of education budget per capita in general public finance of provinces and cities from 2015 to 2020

Provinces 1 to 31 indicate, in order, Beijing municipal, Tianjin municipal, Hebei province, Shanxi province, Inner

Mongolia Autonomous Region, Liaoning province, Jilin province, Shanghai municipal, Jiangsu province, Zhejiang province, Anhui province, Fujian province, Jiangxi province, Shandong province, Henan province, Hubei province, Hunan province, Guangdong province, Guangxi Zhuang Autonomous Region, Hainan province, Chongqing municipal, Sichuan province, Guizhou province, Yunnan province, Tibet Autonomous Region, Shaanxi Province, Gansu Province, Qinghai Province, Ningxia Hui Autonomous Region and Xinjiang Uygur Autonomous Region. On the whole, the 31 provinces had little fluctuation in the PC for education expenditure from 2015 to 2020. Tibet Autonomous Region ranked first in the country in terms of education expenditure per student from the general public budget during the six years, followed by Qinghai Province. Hunan Province saw a big fluctuation in 2017, reaching 262,300 yuan. In the past six years, the education expenditure per student in Henan Province from the general public financial budget was no more than 80,000 yuan, which also reflects that although there is a lot of investment in education. There are a lot of students in Henan Province, but only a few of them are allocated to each college student.

4.1. Build an Empty Model

This paper studies the financial input of 31 provinces in higher education from 2015 to 2020. The sample data of each province is the first level, and different years in each province are the second level [25]. An empty model is established to test whether there are differences in the financial input of higher education in 31 provinces in the study year. The model is as follows:

$$\text{Level 1: } PC_{ij} = \beta_{0j} + e_{ij}$$
$$\text{Level 2: } \beta_{0j} = \beta_0 + u_{0j}$$
$$\text{General model: } PC_{ij} = \beta_0 + u_{0j} + e_{ij} \quad (6)$$

Among them, $i = 1,2,\ldots,31$, express in turn Beijing municipal, Tianjin municipal, Hebei province, Shanxi province, Inner Mongolia Autonomous Region, Liaoning province, Jilin province, Shanghai municipal, Jiangsu province, Zhejiang province, Anhui province, Fujian province, Jiangxi province, Shandong province, Henan province, Hubei province, Hunan province, Guangdong province, Guangxi Zhuang Autonomous Region, Hainan province, Chongqing municipal, Sichuan province, Guizhou province, Yunnan province, Tibet Autonomous Region, Shaanxi Province, Gansu Province, Qinghai Province, Ningxia Hui Autonomous Region and Xinjiang Uygur Autonomous Region. $j = 1,2,\ldots,6$, express in turn 2015, 2016, 2017, 2018, 2019 and 2020. β_0 is the total intercept, which is the fixed effect of the model; $(u_{0j} + e_{ij})$ is the random effect of the model; $\sigma^2_{u_0}$ is the inter-provincial variance; $\sigma^2_{e_0}$ is the intra-provincial variance or the individual level variance.

Using R software to run the empty model, the results are as follows:

Table 2. Random effect result

Random effect		variance	Standard deviation
Inter-provincial variance	$\sigma^2_{u_0}$	103.663	10.18
intra-provincial variance	$\sigma^2_{e_0}$	5.903	2.43

Table 3. Fixed effect result

Fixed effect		Estimated value	Standard error	t- the statistic	df	P-value
PC total mean	β_0	13.193	1.837	7.181	30	5.45e-08 ***

*Note: Here *** represents P<0.001.*

In the test result of the empty model, the estimated value of the unique intercept term a is 13.193. That is, the estimated value of PC between provinces is 13.193. It passed the significance test of the parameters and was significant at the significance level of 1%.

By calculating the correlation coefficient within the group, it can be obtained

$$ICC = \frac{\sigma^2_{u_0}}{\sigma^2_{u_0} + \sigma^2_{e_0}} = \frac{103.663}{103.663 + 5.903} = 0.9461.$$

That is, 94.61% of the total variation was caused by inter-provincial differences, indicating significant inter-provincial PC differences. In addition, there was significant intra-object variation, which was statistically significant. Therefore, it is

reasonable to adopt a multi-level model.

4.2. Construct a Random Intercept Model

Next, explanatory variables at level 1 are introduced, the random intercept model is constructed as follows:

Level 1:

$$PC_{ij} = \beta_{0j} + \beta_1 GDP_{ij} + \beta_2 College_{ij} + \beta_3 Student_{ij} + \beta_4 DGE_{ij} + \beta_5 FES_{ij} + \beta_6 UL_{ij} + e_{ij}$$

Level 2:

$$\beta_{0j} = \beta_0 + u_{0j}$$

General model:

$$PC_{ij} = \beta_0 + \beta_1 GDP_{ij} + \beta_2 College_{ij} + \beta_3 Student_{ij} + \beta_4 DGE_{ij} + \beta_5 FES_{ij} + \beta_6 UL_{ij} + u_{0j} + e_{ij} \quad (7)$$

After running the model, the results are as follows:

Table 4. Random effects and fixed effects results of random intercept models

Random effect		**variance**	**Standard deviation**			
Inter-provincial variance	$\sigma_{u_0}^2$	93.795	9.685			
intra-provincial variance	$\sigma_{e_0}^2$	3.924	1.981			
Fixed effect		**Estimated value**	**Standard error**	**t- the statistic**	**df**	**Pr(>|t|)**
Intercept term	β_0	13.1935	1.7427	7.559	23.0281	1.11e-07 ***
GDP	β_1	4.8238	1.0505	4.592	166.0009	8.63e-06 ***
College	β_2	-5.2965	2.1027	-2.519	98.4032	0.0134 *
Student	β_3	-3.2586	1.5930	-2.046	178.7871	0.0423 *
DGE	β_4	1.2706	0.1722	7.380	144.3047	1.15e-11 ***
FES	β_5	0.8878	0.5556	1.598	161.3454	0.1120
UL	β_6	2.2462	0.8909	2.521	162.0961	0.0127 *

*Note: Here *** means P<0.001, ** means P<0.01, * means P<0.05.*

It can be seen from the table 4 that GDP, College, Student, DGE and UL have a significant impact on the per capita general public financial budget for education. Among them, GDP, DGE and UL have a positive impact on the per capita general public financial budget for education, and GDP has the largest impact. When other conditions remain unchanged, the per capita general public property education budget will increase by 48,238 yuan per unit of GDP. College and Student have a negative impact on the per capita general public finance budget education budget. The effect of FES on the per capita education budget of general public finance is not significant.

4.3. Construct a Random Slope Model

The random intercept model only interprets changes between provinces and years as changes in intercepts. In order to further understand the change of slope, it is necessary to fit the stochastic slope model and consider the impact of different slopes on per student public property education budget. The following model is constructed:

Level 1:

$$PC_{ij} = \beta_{0j} + \beta_{1j} GDP_{ij} + \beta_{2j} College_{ij} + \beta_{3j} Student_{ij} + \beta_{4j} DGE_{ij} + \beta_{5j} FES_{ij} + \beta_{6j} UL_{ij} + e_{ij}$$

Level 2:

$$\beta_{0j} = \beta_0 + u_{0j}, \beta_{1j} = \beta_1 + u_{1j}, \beta_{2j} = \beta_2 + u_{2j}$$
$$\beta_{3j} = \beta_3 + u_{3j}, \beta_{4j} = \beta_4 + u_{4j}, \beta_{5j} = \beta_5 + u_{5j}$$

$$\beta_{6i} = \beta_6 + u_{6i}$$

General model:

$$PC_{ij} = \beta_0 + \beta_1 GDP_{ij} + \beta_2 College_{ij} + \beta_3 Student_{ij} + \beta_4 DGE_{ij} + \beta_5 FES_{ij} + \beta_6 UL_{ij} + u_{0i} + u_{1i} GDP_{ij} + u_{2i} College_{ij} + u_{3i} Student_{ij} + u_{4i} DGE_{ij} + u_{5i} FES_{ij} + u_{6i} UL_{ij} + e_{ij} \quad (8)$$

Among them, $u_{1i} \sim N(0, \sigma_{u_1}^2)$, $u_{2i} \sim N(0, \sigma_{u_2}^2)$, $u_{3i} \sim N(0, \sigma_{u_3}^2)$, $u_{4i} \sim N(0, \sigma_{u_4}^2)$, $u_{5i} \sim N(0, \sigma_{u_5}^2)$, $u_{6i} \sim N(0, \sigma_{u_6}^2)$ is the horizontal residual of slope term 2.

Running this model, it can be seen that in the part of random effects after enough iterations. The random effects of FES and UL are not significant, while the random effects of GDP, College, Student and DGE are significant. Therefore, the random effects of FES and UL are not considered for regression again [26]. That is, the model is:

Level 1:

$$PC_{ij} = \beta_{0i} + \beta_{1i} GDP_{ij} + \beta_{2i} College_{ij} + \beta_{3i} Student_{ij} + \beta_{4i} DGE_{ij} + \beta_{5i} FES_{ij} + \beta_{6i} UL_{ij} + e_{ij}$$

Level 2:

$$\beta_{0i} = \beta_0 + u_{0i}, \beta_{1i} = \beta_1 + u_{1i}, \beta_{2i} = \beta_2 + u_{2i}$$
$$\beta_{3i} = \beta_3 + u_{3i}, \beta_{4i} = \beta_4 + u_{4i}, \beta_{5i} = \beta_5$$
$$\beta_{6i} = \beta_6$$

General model:

$$PC_{ij} = \beta_0 + \beta_1 GDP_{ij} + \beta_2 College_{ij} + \beta_3 Student_{ij} + \beta_4 DGE_{ij} + \beta_5 FES_{ij} + \beta_6 UL_{ij} + u_{0i} + u_{1i} GDP_{ij} + u_{2i} College_{ij} + u_{3i} Student_{ij} + u_{4i} DGE_{ij} + e_{ij} \quad (9)$$

The results are as follows:

Table 5. Random effects and fixed effects results of a random slope model

Random effect		**variance**	**Standard deviation**			
Inter-provincial variance	$\sigma_{u_0}^2$	25.559	5.056			
GDP	$\sigma_{u_1}^2$	148.253	12.176			
College	$\sigma_{u_2}^2$	2.087	1.445			
Student	$\sigma_{u_3}^2$	131.512	11.468			
DGE	$\sigma_{u_4}^2$	16.644	4.080			
intra-provincial variance	$\sigma_{e_0}^2$	2.839	1.685			
Fixed effect		**Estimated value**	**Standard error**	**t- the statistic**	**df**	**Pr(>|t|)**
Intercept term	β_0	11.5147	0.9560	12.045	9.5862	4.19e-07 ***
GDP	β_1	6.9423	2.3775	2.920	6.2996	0.02518 *
College	β_2	-2.3632	0.7854	-3.009	33.1180	0.00498 **
Student	β_3	-5.2442	2.3202	-2.260	5.8465	0.06568 .
DGE	β_4	-1.3929	0.8954	-1.556	10.4522	0.14953
FES	β_5	0.7975	0.3196	2.495	12.6669	0.02726 *
UL	β_6	0.2556	0.4367	0.585	48.4449	0.56113

*Note: Here *** represents P<0.001, ** represents P<0.01, * represents P<0.05, . represents P<0.1.*

It can be seen from the table 5 that the influences of various factors on response variables in different provinces and different years are taken into account. It can be concluded that GDP, College, Student and FES have significant effects on the per capita general public finance budget of education. However, DGE and UL have no significant impact on the per capita general public finance budget of education. Among them, GDP has the greatest impact on the response variable. The second is FES, and the influence is positive. That is, the per capita education budget of general public finance will increase with the increase of GDP and FES. However, College, Student and DGE have negative effects on response variables. In other words, the PC decreases as the number of students and DGE increases.

It can be seen from the table 6 that there is almost no difference between the intercept item of the empty model and that of the random intercept model. That is, in the case of no explanatory variables, the total average of the education funds of the general public financial budget per student per capita is 131,930,000 yuan. However, the average value changes, decreasing from 131,930,000 yuan to 115,147 yuan in the random slope model.

Table 6. Comparison of results of empty model, random intercept model and random slope model

		empty model	random intercept models	random slope model
Random effect				
Inter-provincial variance	$\sigma_{u_0}^2$	103.663	93.795	25.559
GDP	$\sigma_{u_1}^2$			148.253
College	$\sigma_{u_2}^2$			2.087
Student	$\sigma_{u_3}^2$			131.512
DGE	$\sigma_{u_4}^2$			16.644
intra-provincial variance	$\sigma_{e_0}^2$	5.903	3.924	2.839
Fixed effect				
Intercept term	β_0	13.193 ***	13.1935 ***	11.5147 ***
GDP	β_1		4.8238 ***	6.9423 *
College	β_2		-5.2965 *	-2.3632 **
Student	β_3		-3.2586 *	-5.2442 .
DGE	β_4		1.2706 ***	-1.3929
FES	β_5		0.8878	0.7975 *
UL	β_6		2.2462 *	0.2556

*Note: Here *** represents P<0.001, ** represents P<0.01, * represents P<0.05, . represents P<0.1.*

After adding explanatory variables to explain the factors affecting the PC, we can see that in the random intercept model, the effects of GDP, College, Student, DGE and UL are all significant. Under the premise of other conditions being constant, every unit of GDP, DGE, UL, UL, etc. The PC will increase by 48,238 yuan, 12,706 yuan and 22,462 yuan respectively; For each additional unit of College and Student, the PC will decrease by 52,965 yuan and 32,586 yuan respectively. And the inter-provincial and intra-provincial variances also decrease from 103.663 and 5.903 to 93.795 and 3.924. Compared with the random intercept model, the results of the random slope model show that only GDP, College, Student and FES have a significant impact on the PC, while DGE and UL are no longer significant. On the premise that other conditions remain unchanged, for every unit of increase in GDP, FES and per Student, the PC will increase by 69,423 yuan and 79,775 yuan respectively. For every unit increase in College and Student, The PC will decrease by 23,632 yuan and 52,442 yuan respectively. The intra-provincial and inter-provincial variances were 25.559 and 2.839, respectively, which decreased somewhat.

The random intercept model and the random slope model are compared by variance analysis, and the results are as follows:

Table 7. Variance analysis

	npar	AIC	BIC	logLik	deviance	Chisq	df	Pr(>Chisq)
random intercept models	9	947.11	976.15	-464.56	929.11			
random slope model	23	891.66	965.85	-422.83	845.66	83.453	14	6.444e-12 ***

*Note: Here *** represents P<0.001.*

It can be seen that the random slope model considering the slope term is better and has a significant difference.

5. Conclusion

Based on the relevant education data of 31 provinces in China from 2015 to 2020, this paper selected Per capita general public budget for education as the response variable, economic development level, scale of higher education, local government effort, financial expenditure structure and urbanization level as the explanatory variables, and studied the influencing factors of financial input in higher education.

The local economic level has a significant positive influence on the financial input of higher education. The higher the local GDP level, the more developed the economy, the higher the financial investment in higher education. The more backward the local economy, the lower the development level, the lower the investment in education. However, this does not mean that the regions with better economy must have a better level of education investment. Beijing with better development in 2015 had an average of 140,406,700 yuan of general public financial budget for education per student, while Xinjiang with a relatively poor economy had an average of 210,554,81 yuan of general public financial budget for education. It can be seen that," Adapt to local conditions", "tailored medicine" is very important. The direction and degree of regional economic development have different degrees of influence on the funds invested in various fields. Education is only a part of regional development, so the local government needs to vigorously develop the local economy to promote the development of local education, pay enough attention to the adequacy and reasonable allocation of educational resources, and design a reasonable allocation scheme [27].

The scale of higher education has a significant negative impact on the financial input of higher education. The scale of higher education includes the number of colleges and universities and the number of students. With the increase of the number of colleges and universities, the number of students is also on the rise every year, resulting in an upward trend of the number of students. With the increase of the number of students, the education funds per student in the general public financial budget are decreasing. The government should proceed from the reality, not only to develop education, but also to control the speed, avoid "empty shell" phenomenon, quality is far more important than quantity, to ensure that every student can get enough educational resources.

The degree of effort of local government in higher education investment is the subjective reason that leads to the gap between provinces in higher education financial investment. The coefficient of effort degree of local government input to higher education is negative, indicating that increasing the proportion of higher education fiscal expenditure in the total educational expenditure is conducive to narrowing the gap between the budget expenditure per student of each province. The more local governments pay attention to the level of education in the region, the more resources they will invest in education, thus promoting the development of higher education. The government should make clear the importance of education and avoid sacrificing education funds for the sake of other development.

The structure of fiscal expenditure has a significant positive influence on the financial input of higher education. Due to the different geographical environment and educational ideas received by different provinces, they also have different understandings of the development of education. The proportion of educational fiscal expenditure in the total expenditure of different provinces is also different, which leads to the difference in the financial input of higher education. The government should optimize the structure of financial expenditure and increase support for financial education [28].

Although the influence of urbanization level on the financial input of higher education is not significant. It can also reflect the economic development level of the region to a certain extent.

It should be noted that the comprehensiveness of the conclusions may be affected by the fact that only six years of data are selected. It may be one-sided to make recommendations based on conclusions drawn from six years' data. In order to make the recommendations more feasible, we should select as many years' data as possible, which needs to be explored in future studies.

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