

Analysis of Factors Influencing Education Expenditure in Each Region of the Country in 2022

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Abstract

Education is a major plan of the country, and young talents are the main force for the country to maintain its competitiveness and vitality. China has always been a country that attaches great importance to education, and its investment in education has been increasing in recent years. However, due to problems such as unbalanced development between regions, the education expenditure in different regions of China shows obvious differences. Starting from the relevant factors that may affect education expenditure, this paper applies the cross-section data of different regions in 2022, and analyzes the factors affecting China's education expenditure by establishing an econometric model, and puts forward relevant suggestions, so as to contribute to the development of China's education.

Keywords

Education Expenditure; Gross Domestic Product; Compulsory Education.

1. Introductory

During his visit to the south in 1992, Deng Xiaoping emphasized that faster economic development must rely on science, technology and education. Science and technology are the first productive forces, while education is the strategic basis for modernization. Since the Cultural Revolution of the 1960s and 1970s, governments at all levels in China have gradually deepened the importance they attach to education. At the national level, government funding for education has increased year by year, and the 19th National Congress of the Communist Party of China (CPC) has even proposed "prioritizing the development of education". Local governments have responded positively to this call, and the development of education has been deeply rooted in people's hearts. However, the development of education is not balanced, to the eastern coastal areas and western regions, for example, the economic development of the two are not at the same level, the gap between the government's financial revenue is obvious, the funds that can be used for the development of education is naturally not the same; similarly, the two regions of the residents of the family consumer spending on education is also different, the east of the parents of developed cities to give their children a better educational environment, better after-school tutoring, more open-minded. Parents in developed cities in the east give their children a better educational environment, better after-school tutoring, and a broader vision. These can produce higher-end talents. Imbalance exists in all aspects, what we can do is to minimize the gap, from imbalance to reasonable imbalance, to promote the good and rapid development of education in all regions.

2. Modeling

2.1. Analysis of Influencing Factors

2.1.1. General Public Budget Revenues in Different Regions

General public budget revenues include tax revenues, administrative fee revenues, revenues from the use of state-owned resources and transfer revenues. As the economic foundation determines the superstructure, the stronger the financial capital the government possesses, the more part it can give to the educational institutions, and the more it has the courage to develop education. In society, the strength of the capital is a prerequisite for the ability to make some achievements, how many hesitant and ambitious entrepreneurs fell in the first step to raise funds; in education, there is not enough money, the construction can not meet the needs of the infrastructure, to provide students with the necessary learning tools, not to mention those teaching resources, children in poor areas have books to read is already a big step forward, abroad, study abroad, summer camps, research around the world, and so on. Studying abroad, summer camps, and research trips may not exist in their world. This is because the investment in education varies greatly from region to region, and because there is a huge difference in the economic level of each region. It can be seen that the general public budget income of different regions has a significant impact on the education expenditure in different regions, so this paper selects the general public budget income of different regions (X1) as the explanatory variable.

2.1.2. Gross Regional Product

Gross product reflects the level of production capacity and economic construction of the region, and the components of gross product include government expenditure, so even if there is no definite functional relationship between gross product and education expenditure, there must be a correlation, and generally a positive one. When the gross regional product is higher, government expenditure should also be higher from the perspective of constancy. And among the government expenditures, education expenditures must occupy a considerable proportion. Therefore, different regional GDP has a certain influence on education expenditure in different regions, so this paper selects different regional GDP (X2) as the explanatory variable.

2.1.3. Per Capita Expenditure on Education, Culture and Recreation By Region

When the people were struggling to make ends meet, almost all of their income was spent on survival, leaving them with no extra funds for enjoying life, and they did not place education expenditure among the necessary items of expenditure. In today's society, as people's living standards continue to improve, free from the struggle for survival, the pursuit of a high quality of life is becoming more and more obvious, the per capita expenditure on education, culture and recreation is also increasing day by day. Education expenditure can be regarded as the regional supply of education, the supply comes from the people's demand for education, and the per capita expenditure on education, culture and recreation to a certain extent reflects the people's demand for education, and there is a demand for expenditure. Therefore, this paper selects per capita education, culture and entertainment expenditure (X3) as the explanatory variable.

2.1.4. Number of Applications for Three Types of Domestic Patents and Number of Granted Patents By Region

The three types of patents stipulated in the Patent Law include: invention patents, utility model patents and design patents. The number of patent applications and the number of patents granted are to some extent a test of the level of education, especially higher education. As some regions have formulated relevant policies to give incentives to individuals or units applying for patents, and the incentives are also part of the education expenditure. So the number of patent applications and the number of grants may affect the amount of education expenditure to a

certain extent, so this paper selects the number of three kinds of domestic patent applications and the number of grants (X4) in sub-regions as the explanatory variables.

2.2. Setting of Variables

Through the analysis of the above main influencing factors, the following five main variables are summarized as the variables for constructing the model. See Table 1 for details.

Table 1. Variable Settings

variable representation	variable name
Y	Expenditure on education
X1	General public budget revenues in different regions
X2	Gross domestic product (GDP) of different regions
X3	Per capita expenditure on education, culture and recreation by region
X4	Number of domestic applications and grants of three types of patents by region

2.3. Data Collection

Below is the data on education expenditure and its influencing factors for each region of China in 2022 (this table excludes China's Hong Kong, Macao and Taiwan regions for the time being).

Table 2. 2022 Expenditure on education and its influencing factors in each region of the country

as suffix city name, means prefecture or county (area administered by a prefecture level city or county level city)	Expenditure on education Y/million dollars	General public budget revenue by region X1/billion yuan	Subregional GDP X2/billion dollars	Per capita expenditure on education, culture and recreation per inhabitant by subregion X3/yuan	Number of applications and grants of three types of domestic patents by region X4/piece
Beijing, capital of People's Republic of China	14794779.70	5817.10	35445.10	4310.9	226113
Tianjin	6270838.51	2410.41	14055.50	3584.4	96045
anhui	19921190.61	3738.99	34978.60	1984.1	101274
Shanxi	9857998.65	2347.75	16961.60	2136.2	31705
Inner Mongolia	8105720.26	2059.69	17212.50	2407.7	21069
Liaoning	10593957.40	2652.40	24855.30	2929.3	69732
also Jilin prefecture level city, Jilin province	6777422.37	1116.95	11726.80	2436.6	31052
Heilongjiang river forming the border between northeast China and Russia	8115855.64	1262.76	13544.40	2444.9	37313
Shanghai	14125407.84	7165.10	37987.60	5495.1	173586
Jiangsu	31093312.61	8802.36	98656.80	2946.4	594249
Zhejiang	27343769.88	7048.58	62462.00	3624.0	435883
Anhui	16375812.41	3182.71	36845.50	2132.8	166871
Fujian	13429130.63	3052.93	42326.60	2509.0	153133
Jiangxi	14535470.30	2487.39	24667.30	2094.2	91474
Shandong	29001760.31	6526.71	70540.50	2409.7	263211
He'nan Mengguzu autonomous county in Qinghai	26685217.10	4041.89	53717.80	2016.8	144010
Hubei	16067051.96	3388.57	45429.00	2459.6	141321
Hunan	17753671.59	3007.15	39894.10	3017.4	106113
hillsides	49187550.80	12654.53	107986.90	3244.4	807700
until 1959, Guangxi province	14367736.47	1811.89	21237.10	2007.0	41900
Hainan Island	4243935.31	814.14	5330.80	2413.4	9302
Chongqing	11442967.43	2134.93	23605.80	2312.2	67271
Sichuan	22547120.96	4070.83	46363.80	1813.5	131529
Guizhou	13622935.25	1767.47	16769.30	1865.6	44328
Yunnan	14833632.20	2073.56	23223.80	1950.0	35212
Tibet	2881230.30	221.99	1697.80	690.3	2304
Shaanxi	12490354.69	2287.90	25793.20	2243.4	92087
Gansu	7998740.73	850.49	8718.30	1843.5	27637
Qinghai	2894894.48	282.25	2941.10	1731.8	5017
Ningxia prefecture level city in Zhejiang	2532753.92	423.58	3748.50	2352.4	9275
Xinjiang	10214911.20	1577.63	13597.10	1876.1	14771

2.4. Modeling

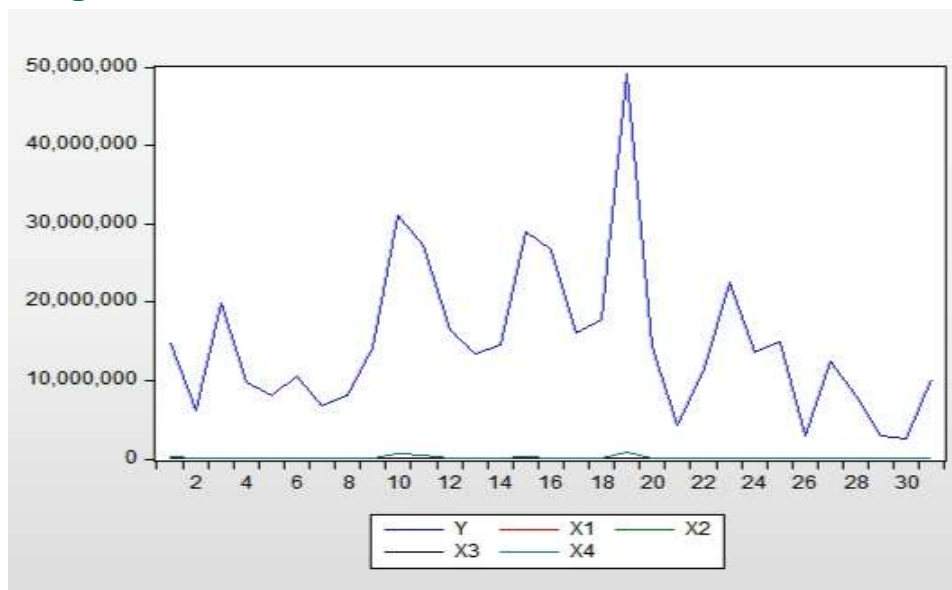


Figure 1. Variable correlation function

From the analysis of the correlation diagram, it can be seen that the explanatory variables general public budget income (X1), different regional gross domestic product (X2) and the number of three kinds of domestic patent applications and authorizations by region (X4) have positive linear correlations with the explanatory variable Y, while per capita expenditure on education, culture and recreation of the residents (X3) and the linear correlation with the explanatory variable Y are weaker.

As can be seen from the figure below, the correlation coefficients between the explanatory variable education expenditure Y and the general public budget revenue (X1), different regional gross domestic product (X2) and the number of three kinds of domestic patent applications and authorizations in sub-regions (X4) are 0.901145, 0.932470 and 0.94285, respectively, with the absolute values of all of them larger than 0.8, which preliminarily indicates that there may be a highly positive correlation between the explanatory variable education expenditure Y and the general public budget income (X1), the gross domestic product of different regions (X2) and the number of three kinds of domestic patent applications and authorizations by region (X4). The correlation coefficient between the explanatory variable Education Expenditure Y and per capita education, culture and recreation expenditure (X3) is 0.253410, with an absolute value lower than 0.3, which initially indicates that there may be a positive and weak correlation between the explanatory variable Education Expenditure Y and per capita education, culture and recreation expenditure (X3).

Table 3. Variable correlations

	Y	X1	X2	X3	X4
Y	1.0000	0.9011	0.9533	0.2534	0.8860
X1	0.9011	1.0000	0.9324	0.5795	0.9428
X2	0.9533	0.9324	1.0000	0.3588	0.9278
X3	0.2534	0.5796	0.3588	1.0000	0.4259
X4	0.8860	0.9429	0.9278	0.4257	1.0000

On the basis of the above analysis and economic theory, a preliminary multivariate linear regression model of the factors influencing education expenditure in each region was developed.

$$Y=C+C1*X1+C2*X2+C3*X3+C4*X4+ \epsilon$$

2.5. Estimation of the Model

According to the relevant data in Table 2, multiple linear regression analysis was performed by the least squares method, and the following results were obtained:

$$y=9232102.99267+2861.27985923*x1+205.043136856*x2-3401.71745588*x3-12.9017056565*x4$$

$$R^2=0.944921 \bar{R}^2 = 0.936448 DW=2.203357 F=111.5130 \hat{\sigma} =2499673$$

3. Testing and Adjustment of the Model

3.1. Statistical Inference Tests for the Original Model

Goodness-of-fit test: $r^2 = 0.944921$ is close to 1, indicating that the model fits the sample data well.

F-test: the Prob(F) value of 0.000000 is also significantly smaller than, indicating that the linear relationship of the model is significant, or that the explanatory variables general public budget revenue (X1), different regional gross domestic product (X2), per capita education, culture and recreation expenditures of the residents (X3), and the number of three types of domestic patents applied and granted by subregion (X4) have a significant effect on the explained variable of education expenditures, Y, in conjunction with each other.

T-test: the t-value of general public budget income (X1), different regional GDPs (X2), and per capita education, culture and recreation expenditures of residents (X3) are all greater than 2, indicating that these parameters have a significant impact on education expenditure Y. The absolute value of the t-value of the number of three types of domestic patents applied for and granted in subregions (X4) is less than 2, indicating that it has no significant impact on education expenditure Y.

Finally, the regression model is built according to the principle of stepwise regression, and the results are shown below:

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	3253779	873648.8	3.724356	0.0008
X2	365.7055	21.50310	17.00711	0.0000
R-squared	0.908874	Mean dependent var		14842166
Adjusted R-squared	0.905732	S.D. dependent var		9915565.
S.E. of regression	3044385.	Akaike info criterion		32.75784
Sum squared resid	2.69E+14	Schwarz criterion		32.85035
Log likelihood	-505.7465	Hannan-Quinn criter.		32.78799
F-statistic	289.2417	Durbin-Watson stat		1.804715
Prob(F-statistic)	0.000000			

Figure 2. Functional regression model

The model is reported in the form of $Y = 3253779.22158 + 365.705465417*X2$
 (873648.8) (21.50310)

$t=(3.724356)(17.00711)$

$R^2=0.908874 \bar{R}^2 = 0.905732DW=1.804715F=289.2417 \hat{\sigma} =3044385$

3.2. Statistical Inference Tests for Adjustment Models

Goodness-of-fit test: $R^2 = 0.908874$ is close to 1, indicating that the model fits the sample data well.

F-test: $F = 289.2417 > F_{\alpha}(k - 1, n - k) = 4.20$ and Prob(F) value of 0.000000 is also less than $\alpha = 0.05$, indicating that the overall linear relationship of the model is significant or the explanatory variable Gross Regional Product of Different Regions (X2) has a significant effect on the explanatory variable Educational Expenditure of Different Regions Y.

T-test: the absolute value of T-test value of Gross Regional Product (X2) of different regions is greater than 2 and Prob(F) value 0.000000 is also less than $\alpha = 0.05$. It shows that there is a significant effect of different regional GDP (X2) on education expenditure Y in different regions.

3.3. Econometric Tests of Adjustment Models

3.3.1. Heteroscedasticity Test

(1) Residual plot analysis

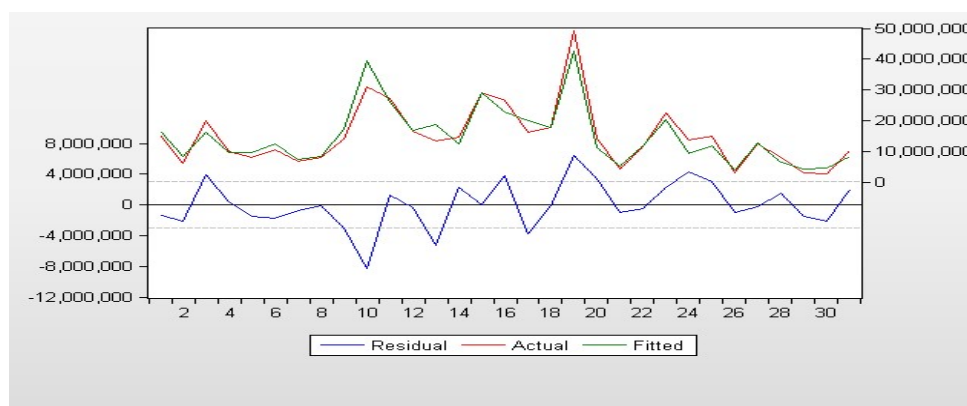


Figure 3. Residual plot

The residual plots show a clear tendency for the distribution of the residuals of the regression equation to widen, i.e., they indicate the presence of heteroskedasticity in the model

(2) White's test

F-statistic	21.52022	Prob. F(2, 28)	0.0000
Obs*R-squared	18.78161	Prob. Chi-Square(2)	0.0001
Scaled explained SS	21.85803	Prob. Chi-Square(2)	0.0000

Test Equation:
 Dependent Variable: RESID^2
 Method: Least Squares
 Date: 06/30/23 Time: 20:09
 Sample: 1 31
 Included observations: 31

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.88E+12	3.94E+12	1.237476	0.2262
X2^2	5725.622	1951.611	2.933792	0.0066
X2	-1.79E+08	2.04E+08	-0.876064	0.3884

R-squared	0.605858	Mean dependent var	8.67E+12
Adjusted R-squared	0.577705	S.D. dependent var	1.44E+13
S.E. of regression	9.34E+12	Akaike info criterion	62.66046
Sum squared resid	2.44E+27	Schwarz criterion	62.79923
Log likelihood	-968.2371	Hannan-Quinn criter.	62.70569
F-statistic	21.52022	Durbin-Watson stat	2.317217
Prob(F-statistic)	0.000002		

Figure 4. White's test

Taking the significance level $\alpha = 0.05$, since $nR^2 = 18.78161 > 5.99$, the practical application can be directly observed that its concomitant probability $\text{prob}(nR^2)$ is 0.000002, which is also smaller than the given significance level $\alpha = 0.05$, so the original hypothesis is rejected, and it is considered that the regression model has heteroskedasticity.

(3) Park's test

F-statistic	5.461953	Prob. F(1,29)	0.0265
Obs*R-squared	4.913260	Prob. Chi-Square(1)	0.0267
Scaled explained SS	4.763505	Prob. Chi-Square(1)	0.0291

Test Equation:
 Dependent Variable: LRESID2
 Method: Least Squares
 Date: 06/30/23 Time: 20:34
 Sample: 1 31
 Included observations: 31

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.557939	3.879576	-2.205895	0.0355
LN2	0.902917	0.386344	2.337082	0.0265

R-squared	0.158492	Mean dependent var	0.467036
Adjusted R-squared	0.129475	S.D. dependent var	2.223482
S.E. of regression	2.074551	Akaike info criterion	4.359708
Sum squared resid	124.8091	Schwarz criterion	4.452223
Log likelihood	-65.57547	Hannan-Quinn criter.	4.389866
F-statistic	5.461953	Durbin-Watson stat	1.825752
Prob(F-statistic)	0.026548		

Figure 5. Park test

From the regression results, it can be seen that the coefficient estimate of Lnx2 is significantly non-zero and the F-test passes, indicating that the variance of the attendant error term is strongly correlated with the explanatory variables and the model is considered to be heteroskedastic.

(4) Heteroscedasticity correction

According to Park's test, we get: $LRESID2 = 25.31610 + 0.284243 * LN(X2)$, taking the weight variable $W1 = 1/x2^{0.284243}$.

According to the Gleises test, the most statistically significant (i.e., R^2 is the largest) test is the:

$$|e_i| = 1475203 + 0.000457 * X2^2, \text{ so the choice of the weight variable is:}$$

$$W2 = 1/X2^2$$

In addition, the general form was chosen as the weight variable:

$$W3 = 1/resid^{0.5}$$

$$W4 = 1/abs(resid)$$

Weighted least squares estimation model with weights $W1 = 1/x2^{0.284243}$.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2767579.	599801.9	4.614154	0.0001
X2	378.4575	21.06053	17.96998	0.0000
Weighted Statistics				
R-squared	0.917595	Mean dependent var	12579742	
Adjusted R-squared	0.914753	S.D. dependent var	5477584.	
S.E. of regression	2493991.	Akaike info criterion	32.35901	
Sum squared resid	1.80E+14	Schwarz criterion	32.45152	
Log likelihood	-499.5646	Hannan-Quinn criter.	32.38917	
F-statistic	322.9204	Durbin-Watson stat	1.816989	
Prob(F-statistic)	0.000000	Weighted mean dep.	10319710	
Unweighted Statistics				
R-squared	0.907698	Mean dependent var	14842166	
Adjusted R-squared	0.904516	S.D. dependent var	9915565.	
S.E. of regression	3063966.	Sum squared resid	2.72E+14	
Durbin-Watson stat	1.784802			

Figure 6. Weighted least squares estimation model with weights W1

Weighted least squares estimation model with weights $W2=1/X2^2$.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2370319.	119110.3	19.90020	0.0000
X2	270.0220	56.11859	4.811632	0.0000
Weighted Statistics				
R-squared	0.443931	Mean dependent var	3661475.	
Adjusted R-squared	0.424756	S.D. dependent var	9043990.	
S.E. of regression	864304.4	Akaike info criterion	30.23958	
Sum squared resid	2.17E+13	Schwarz criterion	30.33209	
Log likelihood	-466.7135	Hannan-Quinn criter.	30.26974	
F-statistic	23.15180	Durbin-Watson stat	1.799314	
Prob(F-statistic)	0.000043	Weighted mean dep.	2896804.	
Unweighted Statistics				
R-squared	0.685529	Mean dependent var	14842166	
Adjusted R-squared	0.674685	S.D. dependent var	9915565.	
S.E. of regression	5655479.	Sum squared resid	9.28E+14	
Durbin-Watson stat	0.809005			

Figure 7. Weighted least squares estimation model with weights W2

Weighted least squares estimation model with weights $W3=1/resid^{0.5}$.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4136742.	665574.5	6.215294	0.0001
X2	396.5124	18.95594	20.91758	0.0000
Weighted Statistics				
R-squared	0.977656	Mean dependent var	17334067	
Adjusted R-squared	0.975421	S.D. dependent var	8193567.	
S.E. of regression	1491995.	Akaike info criterion	31.42014	
Sum squared resid	2.23E+13	Schwarz criterion	31.50096	
Log likelihood	-186.5208	Hannan-Quinn criter.	31.39022	
F-statistic	437.5451	Durbin-Watson stat	1.948444	
Prob(F-statistic)	0.000000	Weighted mean dep.	15335346	
Unweighted Statistics				
R-squared	0.980161	Mean dependent var	19259690	
Adjusted R-squared	0.978177	S.D. dependent var	11369951	
S.E. of regression	1679635.	Sum squared resid	2.82E+13	
Durbin-Watson stat	1.566787			

Figure 8. Weighted least squares estimation model with weights W3

④ Weighted least squares estimation model with weights W4 = 1/abs(resid)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3103993.	87646.88	35.41476	0.0000
X2	367.1341	1.535643	239.0752	0.0000
Weighted Statistics				
R-squared	0.999493	Mean dependent var	17484903	
Adjusted R-squared	0.999475	S.D. dependent var	50401001	
S.E. of regression	436852.2	Akaike info criterion	28.87492	
Sum squared resid	5.53E+12	Schwarz criterion	28.96743	
Log likelihood	-445.5612	Hannan-Quinn criter.	28.90508	
F-statistic	57156.94	Durbin-Watson stat	2.016224	
Prob(F-statistic)	0.000000	Weighted mean dep.	22256436	
Unweighted Statistics				
R-squared	0.908746	Mean dependent var	14842166	
Adjusted R-squared	0.905599	S.D. dependent var	9915565.	
S.E. of regression	3046534.	Sum squared resid	2.69E+14	
Durbin-Watson stat	1.800945			

Figure 9. Weighted least squares estimation model with weights W4

The above four regression models estimated by weighted least squares, except for models W2 and W4, the rest of the models W1 and W3, the concomitant probability of its nR^2 statistic, i.e. $\text{prob}(nR^2)$ are all greater than the given level of significance $\alpha = 0.05$, accepting the original hypothesis that none of the adjusted W1 and W3 regression models have heteroskedasticity, and because the goodness-of-fit of the W3 model is the highest among the four models. Its $R^2 = 0.977656$, so finally selected model W3 as the ideal model, namely:

$$y = 4136741.60298 + 396.51242388 \cdot x_2 \cdot w_3 = 1/\text{resid}^{0.5}$$

$$(665574.5) (18.95594)$$

$$t = (6.215294)(20.91758)$$

$$R^2 = 0.977656, F = 437.5451$$

This shows that when different Gross Regional Product (X2) increases by \$100 million, education spending increases by \$396.51242388.

4. Conclusions and Recommendations

4.1. Conclusion

From the above analysis, we can see that the Gross Domestic Product (X2) of different regions is a very important factor affecting the education expenditure of different regions in China, which has a bearing on whether China's education expenditure can continue to grow steadily and whether such growth is in the direction of a more balanced development. However, the GDP is only an important aspect that affects the education expenditure, and it is not possible to generalize the whole picture. From the analysis of the model, we can see that it is the economic factors that play a decisive role in education expenditure, so in order to achieve a good and fast growth in education expenditure, it is crucial to grasp the economic development.

4.2. Policy Recommendations

Make good use of the policy of rural revitalization strategy, increase investment and enhance budget management at the same time, and improve the management level of financial investment in compulsory education in the western region. Utilizing the policy to increase investment in human, material and financial resources for compulsory education while enhancing budgetary management, rationally planning educational resources, and keeping the financial investment in compulsory education at an optimal scale, thus promoting the improvement of the efficiency of financial expenditure on compulsory education in the western region.

From the perspective of local governments, since the central government attaches great importance to education, local governments at all levels are beyond reproach in their attitude towards education. The point is that some places are relatively backward in terms of economic development or are geographically remote, and even if national policies provide special care, local finances may not be able to afford the high costs. For these places, the central government should give more care and increase the proportion of transfer payments invested in these areas; local governments should actively develop their economies, and industrially backward areas can develop tertiary industries such as specialty tourism based on local strengths, and the improvement of economic strength is the cornerstone of the development of education.

From the perspective of schools, teaching and educating people is the primary task and duty of schools, and they have to develop education well, regardless of whether the Government has given them sufficient funding. With a certain degree of financial support, it is all the more necessary to actively arrange extra-curricular activities to enhance students' abilities in all aspects, including ethics, intellect, physique, social skills and aesthetics.

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