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# Quantitative Analysis of the Effectiveness of Investment in Education—in the Background of Chinese Provinces and Regions

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**Abstract**

With the rapid development of social productivity and science and technology, the importance of education has become increasingly prominent and the relationship between education and the economy has become increasingly close. This paper uses regression analysis to correlate the level of investment in education with the number of enterprise development projects and the gross domestic product through the R language and a series of quantitative analyses. It is concluded that the level of education shows a positive relationship with the number of enterprise projects and the gross product, and the phenomenon is illustrated by data visualisation with the long-term development of the country as the goal.

**Keywords:** investment in education, statistical modeling, quantitative analysis

## 1. Introduction

Education, as an activity of fostering human beings, consumes a certain quantity of human, financial, and material resources, and the consumption of human and material resources is ultimately demonstrated in the form of financial consumption (Hanushek, 1996). The investment in education is the basis and prerequisite to ensure the normal financial consumption of educational activities, and the investment in education funding will directly affect the development of education and the economy. The socio-economic function of education must be achieved through a certain amount of education expenditure. Financial education funding refers to the government's special public expenditure on education, which, due to its unique policy background and stability of expenditure, makes it the main financial guarantee for the sound development of education (Kruss et al., 2015).

The financial expenditure on education in China should reach at least 4.5% of the GDP by 2020. Yang Dongping, President of the 21st Century China Education Research Institute, synthesizing the findings of several researchers on financial investment in education, believes that the target of 4.5% to 5% of GDP for financial education is in line with China's level of economic and socio-economic development and that this figure is in the ongoing National Education Reform and Development. This figure must be clearly reflected in the Medium- and Long-term Planning Outline (Tang, 2020). And the question of how to invest appropriately in education funding is one that is increasingly being explored. This article considers the contribution to education funding as a starting point and explores whether there is a linear relationship between the contribution to education funding and the number of new product items in industrial enterprises above a specified level.

In this article, the Regression Analysis is conducted on the number of new products and projects of industrial enterprises above a certain size and the domestic gross domestic product as independent variables and education expenses. First of all, the number of new products and projects of industrial enterprises above a certain scale is defined as the number of new products and projects produced by industrial enterprises that have reached a

certain scale as determined by the government, using this indicator can indirectly reflect the academic support provided by students for the development of enterprises each year (Arora et al., 2021). Secondly, GDP refers to the final result of the productive activity of all resident units in a country (or region) over a certain period of time at market prices, so GDP can, to a certain extent, show the dividends that the level of education brings to the development of the local economy.

## 2. Data

In order to investigate whether there is a significant linear relationship between education expenditure and the other two types of indicators and whether a model could be built and regressed, the data was manipulated using R statistical modeling software using the official data provided in the database of the National Statistical Office of China (Durner, 2021).

The data analysis is performed by means of ratios because of the differences in units of measurement between the indicators, by calculating the average value of each indicator based on the data given by the National Bureau of Statistics for 2019 and dividing each value by the corresponding average value to arrive at a ratio indicator with no units of measurement, and then performing a regression analysis of the data. In some surveys, the year 2019 has been chosen as the time unit for cross-sectional comparisons in order to exclude the impact of the new crown epidemic on China. For the data from the National Bureau of Statistics of China, there is no great degree of comparability with other countries.

## 3. Explanation of the Data Terminology

(1) Education funding: Education funding is the amount of money actually spent on education in the budgets of the central and local treasuries.

(2) The number of new products in industrial enterprises above the scale: New products refer to brand new products developed and produced using new technical principles and new design ideas, or products that have significantly improved in one aspect, such as structure, material and technology, over the original products, thus significantly improving their performance or expanding their functions (Miao et al., 2021). New product output value and new product sales revenue include both new products identified by the relevant government departments and within the validity period, as well as new products developed by enterprises on their own without being identified by the relevant government departments and within one year from the date of production.

(3) Gross domestic product: Gross domestic product (GDP) refers to the final results of production activities of all resident units in a country (or region) at market prices over a certain period of time.

## 4. Methods

This essay adopts statistical methods such as descriptive analysis, regression analysis, and R-squared testing. In using regression analysis, the bivariate is tested simultaneously, and finally, the R-squared test is used to check the model against the fit and to judge the merit (Chicco et al., 2021).

For taking data, operations such as data pre-processing are performed, including data cleaning, data differencing, data de-duplication, and other operations.

Finally, data visualisation techniques are used to visually compare and test the regression model results.

## 5. Initial Results

The first step is to draw histograms based on the data provided by the National Bureau of Statistics of China using statistical software in R. The aim is to analyze whether the main distribution tendencies are similar by using visualization techniques. The histogram analysis is shown in Figures 1 to 3.

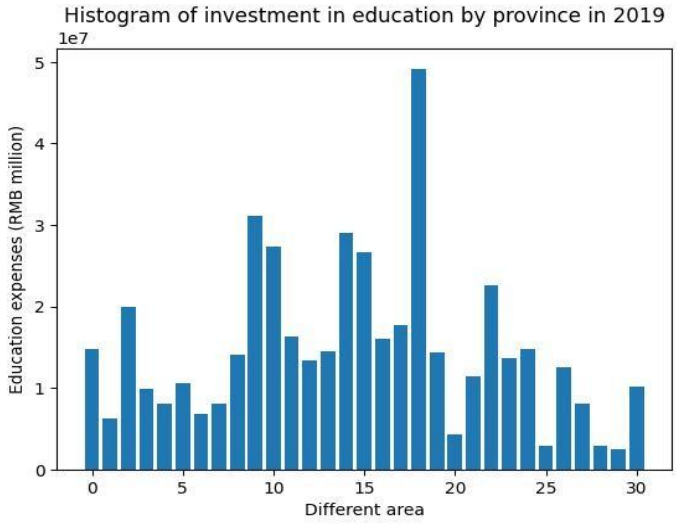



Figure 1. Education Investment Bar Chart

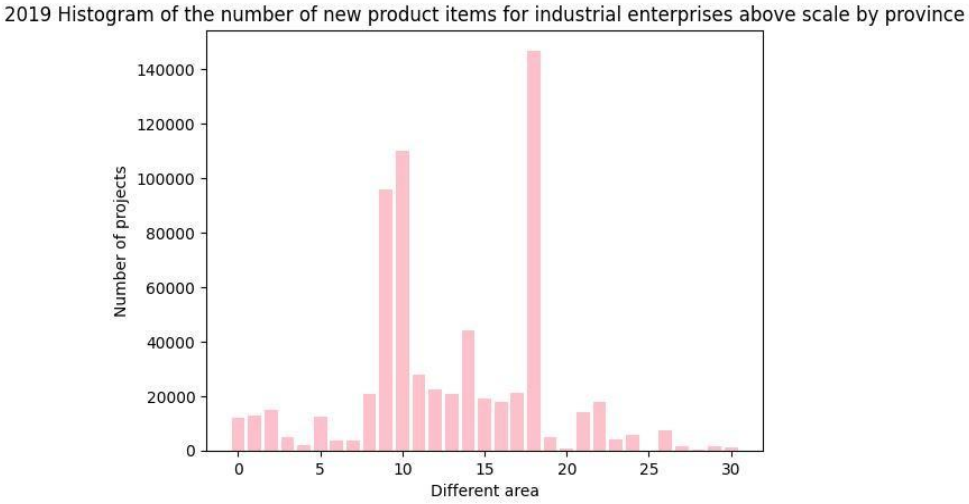



Figure 2. Histogram of number of items

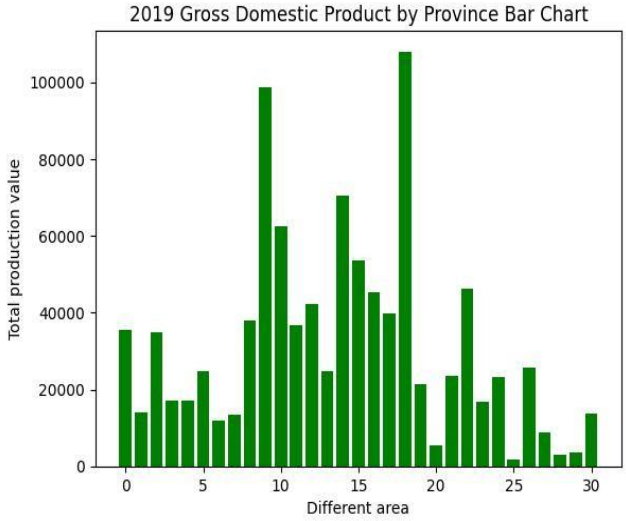


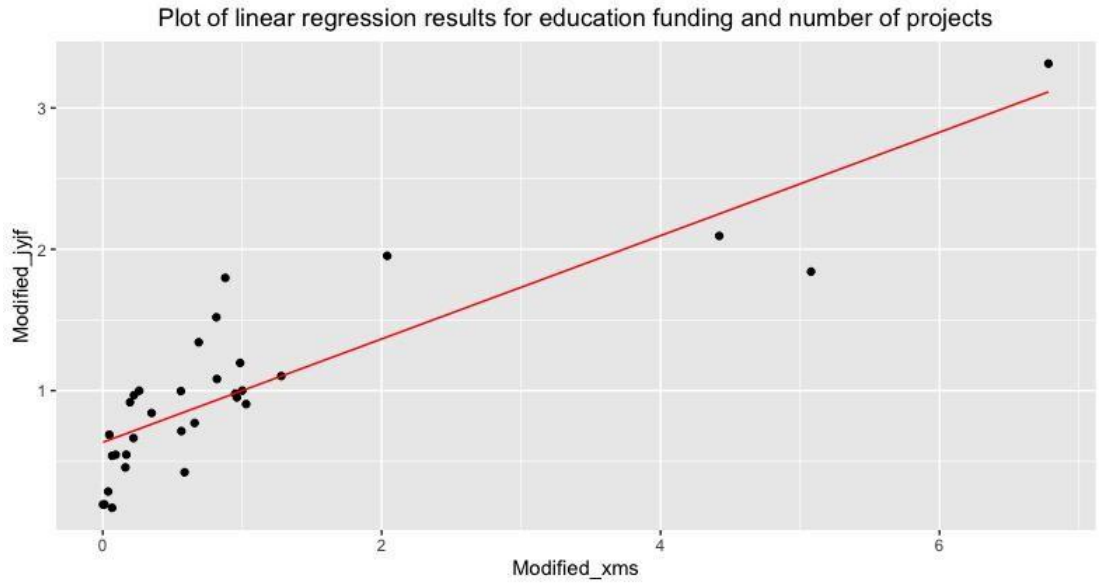

Figure 3. Gross domestic product bar chart

Through preliminary analysis, it was determined that the trends were approximately the same, and regression analysis was then carried out by using the software.

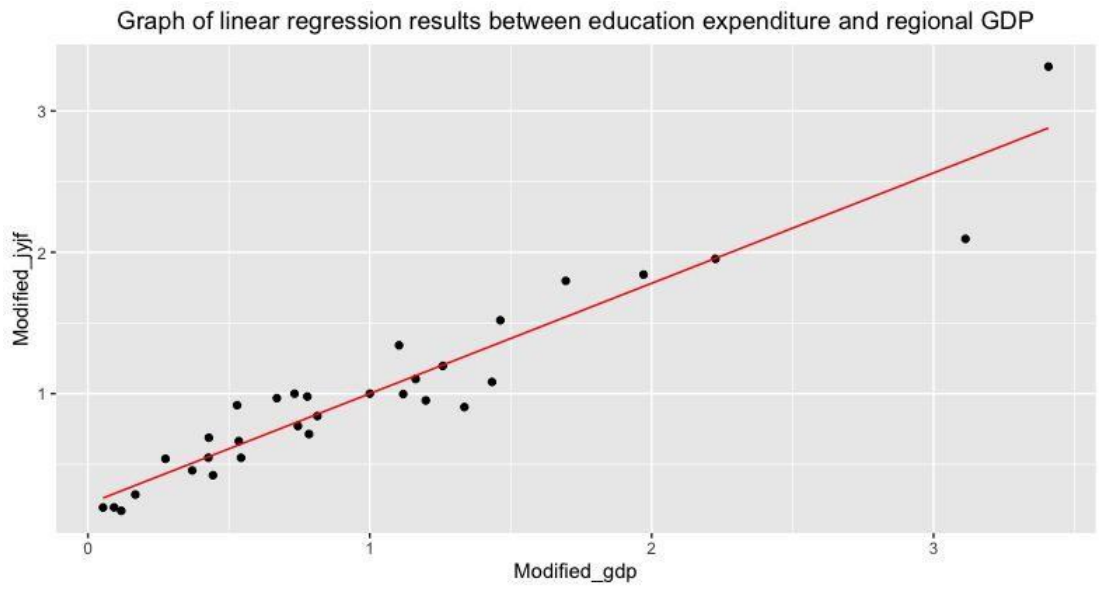
**6. Regression Analysis Results**

Allowing education expenditure to be regressed against the other two variables, a final binary regression analysis model has been constructed, along with an R-squared test. Models 1, 2, and 3 are derived and the tables are plotted below.

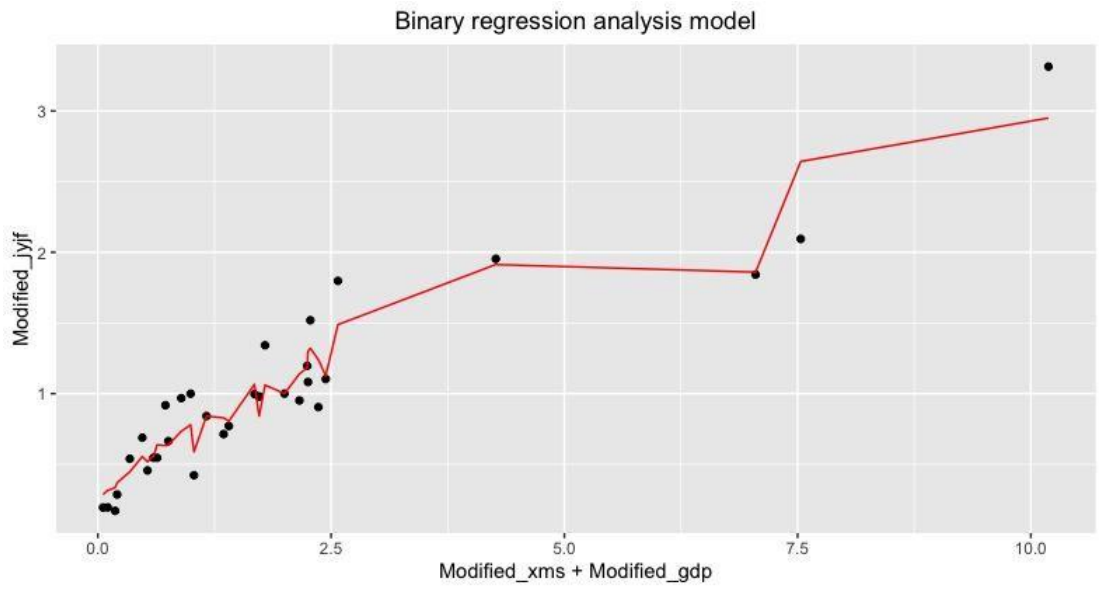
| Model 1 | |
|---|---|
| Dependent variable | Education investment ratio |
| Independent variable | The number of new products in industrial enterprises above the scale |
| Formula | Y = 0.3657 X + 0.6343 |
| R-squared test | 0.7426 |
| Regression analysis results graph | |




| Model 2 | |
|---|---|
| Dependent variable | Education investment ratio |
| Independent variable | Gross domestic product |
| Formula | Y = 0.7808 X + 0.2192 |
| R-squared test | 0.9089 |
| Regression analysis results graph | |




| Model 3 | |
|---|---|
| Dependent variable | Education investment ratio |
| Independent variable | The number of new products in industrial enterprises above the scale + Gross domestic product |
| Formula | Y = 0.04181 X1 + 0.70971X2 + 0.24849 |
| R-squared test | 0.9111 |
| Regression analysis results graph | |




## 7. Results

For the regression analysis results between the three, the strength of investment in education is strongly positively correlated with the other two indicators. The results of the model visualization show that the increasing investment in education will lead to an increase in the number of new product items and the regional GDP of industrial enterprises above the scale to varying degrees. To determine whether the fit of the model is getting better, the R-squared test is performed, and the value of the R-squared test is found to be getting closer to 1, which indicates that the fit of the model is getting better and the model is getting optimized.

## 8. Conclusions and Suggestions

Education has a pioneering and fundamental overall position in economic and social development and national revitalization. With China's long-term development concept, education in science and technology is the basis for science and technology, and science and technology are the first productive force (Zhou et al., 2021). Education has a pioneering and fundamental overall position in economic and social development and national revitalization. With China's long-term development concept, education in science and technology is the basis for science and technology, and science and technology are the first productive factor.

According to the results of this article, it can be clearly indicated that when investment in education increases, it can bring novel products to enterprises while making the local gross domestic product rising, which also shows that the economic level and investment in education show a positive relationship.

This final model cannot be used to predict other countries or at other times due to the limitations of the data sources. In reality, there are a number of factors that contribute to the development and improvement of the economy, and the level of education is only one of them and is a controllable factor. Therefore, it is the optimal choice for a region or country to increase investment in education and therefore influence the development of the economy.

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