Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.8, No.14, 2017

Analysis of Enrollment Scale of Chinese Specialty Education

Jinmei Hao[1] Suke Li[2*]
1.College of Applied Science and Technology, Beijing Union University, South of Shipaifang, District Changping, Beijing, China
2.School of Software and Microelectronics, Peking University Road Jinyuan 24, Daxing District, Beijing 102600, China

Abstract
With the adjustment of industrial structure of China in recent years, the market urgently needs different levels of professionals. Specialty education is an important part of higher education in China, has its unique advantages. Through the analysis of the history data of specialty education in our country, the result shows that the specialty education scale has been increasing steadily. However, there are many variables and parameters influencing the enrollment scale. Based on the econometric method, four linear trend prediction models are given and compared. The results show that the accuracy of the simple linear model with lagged data is higher than that of the normal undergraduate enrollment linear model and the model with GDP variable.
Keywords: specialty education, enrollment scale, linear model

1. Introduction

Recently, China has put forward the strategy of developing higher specialty and vocational education, emphasizing the reform and school-enterprise linkage, which can be seen more and more specialty education and vocational education integration in line with China's economic development needs (Wang Yi & Liu Huizen (2003)). With the adjustment and upgrading of technology of China's industrial structure in recent years, the market urgently need different levels of specialized personnel. Ordinary specialty education is relying on this market demand and access to large-scale development. Specialty education taking into account the industrial subject classification of professional division and adjustment (MOE (2015)) covers all sectors of China's production and life related fields with a wide range of characteristics. This feature also determines that the size of the specialty education is bound to be large and with the industrial policy adjustment and economic transformation of the change. The size of the enrollment is also affected by more other factors.

This paper attempts to analyze the trend of Chinese enrollment and forecast the future enrollment scale of specialty education. This research has already had some relevant research results. In the literature Shi Li & Liu Yuan (2014), the paper analyzes the spatial distribution pattern and influencing factors of the scale of the specialty education in colleges and universities in China. The study shows that the regional distribution of the scale of the college education in China is significant. The scale of the specialty education is affected by the population factor and the people's living standard. This paper also attempts to use GDP data to predict the number of specialty enrollment, the experiment found that GDP data and cannot improve the forecast results. Early studies have also given the development of specialty education and countermeasures, such as the literature (Ni Xiaomin (2004)). In this paper, four kinds of linear prediction models are given, and the predictive accuracy of them is compared. It is found that only the linear prediction model with the first order lag is more accurate.

2. Analysis of Historical Data of Ordinary Specialty Education

The data obtained from the website of the National Bureau of Statistics (http: //www.stats.gov.cn) includes annual data from 2004 to 2014 (Note: annual statistical data for November, 2015, 2016 and 2017, have not been published, although there is a statistical yearbook for 2015, There is not enough detail about specialty education enrollment, so it is not covered by this paper.) (Ni Xiaomin (2004)).

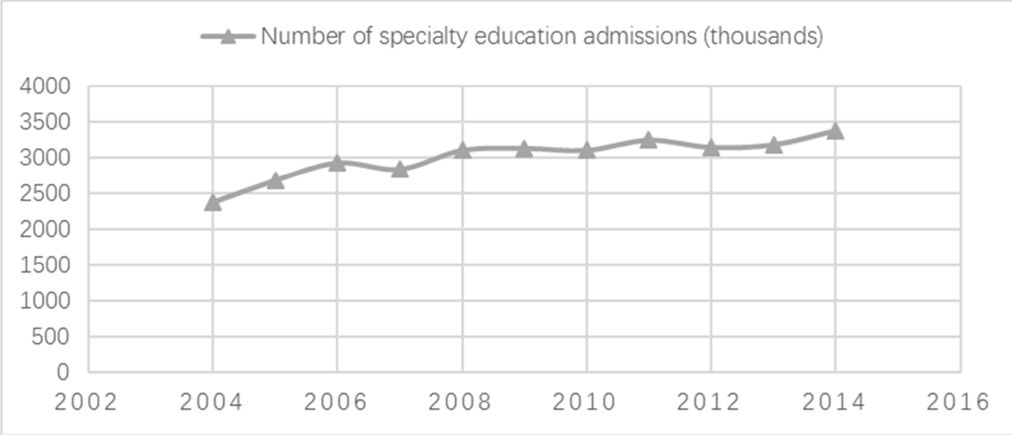

Figure 1. The Trend of Enrollment Scale in China's Specialty Education

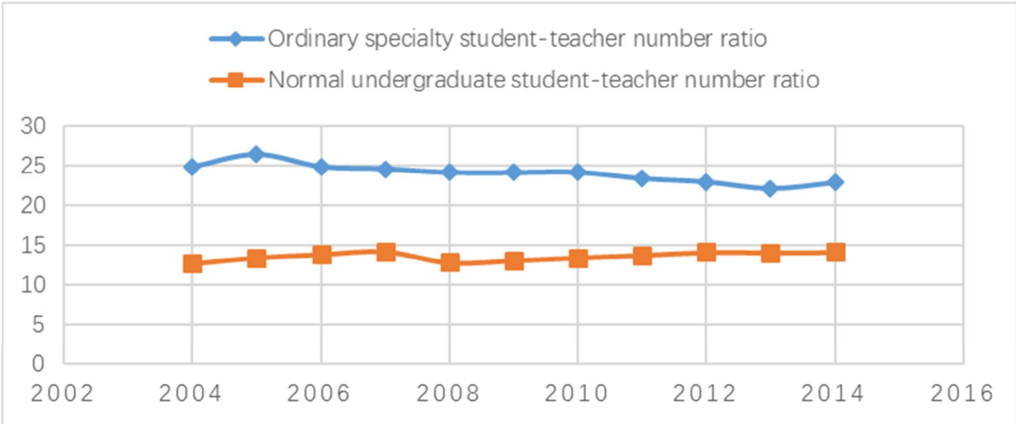

Figure 2. Specialty Education and Normal Undergraduate Student-teacher Number Ratio in China

These data include the number of faculty and staff in Chinese colleges, the number of ordinary specialty education teachers, the number of ordinary specialty college students, China's gross domestic product (GDP) data, and the number of specialty education schools. From the data point of view, the number of full-time teachers in China and the number of ordinary specialty college enrollment has increased significantly over time. Figure 1 shows in 2004 the number of ordinary specialty college enrollment was 2.374 million, by 2014, the size of ordinary specialty college enrollment reached 3.399 million. The absolute size of the enrollment scale of ordinary specialty education development is very rapid. In 2004 the specialty education of full-time teachers only 24 million people, to 2014 reached 44 million people. In addition, the ratio of full-time teachers and specialty faculty remained stable for a long time. The full-time teacher is basically synchronized with the size of the enrollment, and the Pearson correlation coefficient for the two sets of data is 0.953. Therefore, the number of full-time teachers can be considered to be positively correlated with the enrollment scale. From 2004 to 2014, the number of ordinary specialty college enrollment trend is shown in Figure 1. China's general college entrance examination in 2004 to 2006 the development of very rapid and steady rise in enrollment. However, in Figure 2 we can see the ordinary specialty education student-teacher ratios have been lower than the normal undergraduate student-teacher ratios for many years in China. We think it is a big problem for the long-term development of China's specialty education.

3. Forecast Models of the Enrollment Scale of Ordinary College Education

Although the scale of specialty education enrollment has been steadily increasing over the years, it is not clear whether the scale of specialty college enrollment has autocorrelation. It is not sufficient to use the historical data of enrollment scale to predict the future enrollment scale. Figure 3 shows the number of normal undergraduate students in the number of growth rate in 2008 even is negative. After the rapid recovery in 2009, the growth rate of specialty student number surpasses the growth rate of the normal undergraduate enrollment rate. Therefore, in order to make the model more fully and accurately we need use the history of enrollment scale and the associated variables in the construction of the forecast model. Through the early literature research can be seen, the size of specialty enrollment, GDP, and undergraduate enrollment scale have a certain relationship.

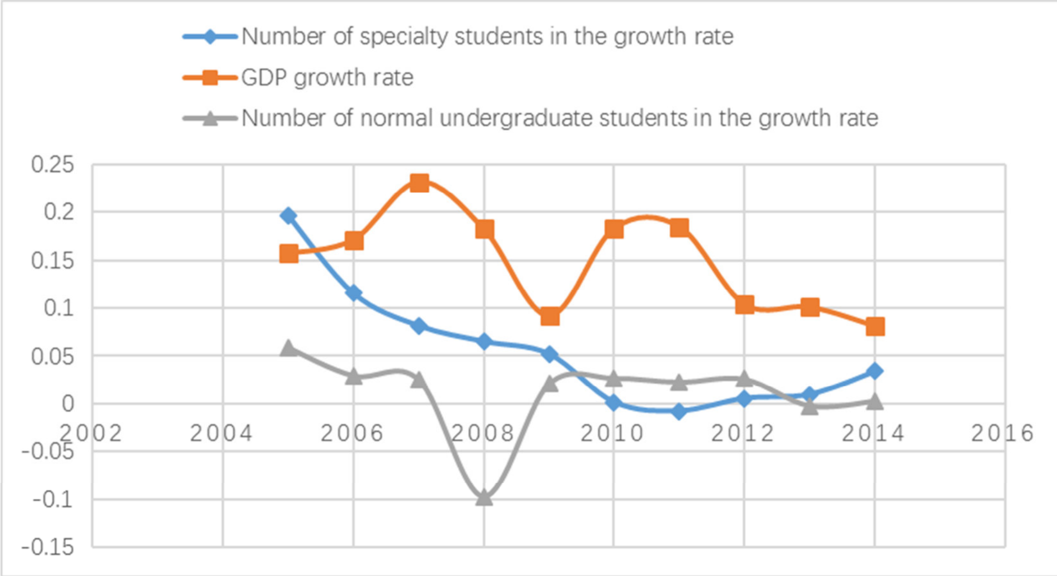

Figure 3. Specialty Education Enrollment, Normal Undergraduate Enrollment and GDP Growth Rate in China

Shi Li & Liu Yuan (2014) demonstrated that the scale of Chinese specialty education and people's living standards are significantly related, so this article also try to use GDP data to predict the size of ordinary college enrollment. From 2010 to 2014, the growth rate of normal undergraduate students in the school has stabilized, while GDP growth rate has steadily declined since 2011. China's higher education expansion has played an important role in the development of the national economy. The effects of education for economy will show its role in the years after the national economic development. Intuitive point of view, GDP and the number of ordinary institutions of higher learning enrollment has an approximate trend. By comparison, GDP data can be used as an independent variable to predict. After calculation, the Chinese GDP data and specialty college enrollment scale data of Pearson correlation reached 0.851. The Pearson correlation coefficient of the random variables X and Y can be calculated using the formula (1), where cov (X, Y) represents the covariance of X and Y, σ_X is the standard deviation of X and σ_Y is the standard deviation of Y.

$$\rho_{X,Y} = corr(X, Y) = \frac{\operatorname{cov}(X, Y)}{\sigma_X \sigma_Y} \tag{1}$$

According to the Pearson correlation coefficient, the correlation between the number of students enrolled in specialty education and the enrollment of normal undergraduate students reaches to 0.909. The correlation between annual enrollment and national GDP is 0.851. So there is reason to think that if we want to predict the size of the number of years of enrollment in specialty, the specialty enrollment number of historical data, the number of ordinary undergraduate enrollment scale and GDP data can be used. Therefore, we construct four linear models and we also compare the accuracy of the predictive model. We only have 11 years of annual data, so we only consider the independent variable which is one-year lag after the impact of future enrollment. If the amount of data is more, we can consider to use data of more than one year lags and more other factors. The training data of this paper are the annual data from 2004 to 2011, and the data from 2012 to 2014 are validated as test data. After fitting the model parameters, we retain the decimal point after the three. The absolute value of GDP data is larger, so the coefficient to retain more decimal places.

Model-1. model equation: $w_t = a \cdot w_{t-1} + d$, where w_t is the dependent variable, representing the number of specialty college students to be expected; w_{t-1} is the number of specialty college enrollment with one year lag; *a* is coefficients *and d* is intercept. The independent variable of Model-1 is the number of annual enrollment in the previous year. The model equation obtained on the training data is:

$$w_t = 0.592 \cdot w_{t-1} + 130.061.$$

The parameters of Model -1 were significant at the 5% significance level.

Model-2. The model equation is: $w_t = a \cdot x_{t-1} + d$, where w_t is the dependent variable, representing the number of specialty education enrolled students to be predicted; *d* is the intercept. The independent variable x_{t-1} of Model-2 is the number of normal undergraduate students enrolled in the year. The model equation obtained on the training data is:

$$w_t = 0.365 \cdot x_{t-1} + 198.645.$$

The coefficient of Model-2 is significant at the significant level of 5%.

Model 3. The model equation is: $w_t = a \cdot w_{t-1} + b \cdot x_{t-1} + d$, where w_t is the dependent variable, on behalf of the number of specialty students to be expected to enroll. The independent variable x_{t-1} that the number of normal undergraduate enrollment with one year lag, and d is the intercept. Model-3 has two independent variables. The model equation obtained on the training data is:

$$w_t = 0.046 \cdot w_{t-1} + 0.342 \cdot x_{t-1} + 191.724.$$

In the model-3 equation, only the intercept is significant at a significant level of 5%.

Model-4. The model equation is: $w_t = a \cdot w_{t-1} + b \cdot x_{t-1} + c \cdot gdp_{t-1} + d$. Model-4 has only a year-on-year GDP variable more than Model-3. The model equation obtained on the training data is:

$$w_t = 0.027 \cdot w_{t-1} + 0.483 \cdot x_{t-1} + 0.0000725 \cdot gdp_{t-1} + 0.018.$$

The coefficients of Model-4 are not significant at the significant level of 5%.

Table 1. The Predication Results on the Test Data

Year	Ordinary specialty enrollment (thousand)	Model-1 (Predicted Value)	Model-2 (Predicted Value)	Model-3 (Predicted Value)	Model-4 (Predicted Value)
2012	3147.762	**3223.782**	3288.190	3286.388	3288.190
2013	3183.999	**3164.087**	3351.760	3341.313	3351.760
2014	3379.835	**3185.539**	3378.681	3368.205	3378.681

The test data includes annual data for 2012 to 2014, and the results of the three models for the three years are shown in Table 1. The average absolute error can be calculated using equation (2). In the formula, *n* represents the number of test data, *r* is the predicted value, and *p* indicates the actual value.

$$e = \frac{\sum_{i=1}^{n} | p_i - r_i |}{n} \tag{2}$$

Table 2. Average Errors of the Four Prediction Models

Models	Mean Average Error
Model-1	**0.0293**
Model -2	0.0325
Model -3	0.0323
Model -4	0.5412

In Table 1, the results show the error of Model-1 is the lowest, and the error of Model-4 is the highest. The lower the error, the more accurate the forecast. Model-4 introduces the GDP variable, and the GDP variable is not very helpful to the forecast of the number of ordinary specialty college admissions, but reduces the forecast accuracy. From 2012 to 2014 the number of ordinary specialty college enrollment of 3147.762 thousand, 3183.999 thousand and 3379.835 thousand, while the predicted results are: 3223.782 thousand, 3164.087 thousand and 3185.539 thousand respectively. From the experimental results of this paper, based on the limited data on the scale of China's enrollment in the four linear prediction models, we conclude GDP and the normal undergraduate enrollment number are not significant variables for prediction.

4. Conclusion

This paper discusses the trend of the enrollment scale of specialty education in China according to the data of the National Bureau of Statistics. At present, under the current level of economic development, the scale of specialty education still shows a good growth trend, the number of enrollment and the number of students in school have increased significantly. Four linear models are designed on the basis of studying the relevant variables and parameters. By comparing the forecasting models of the specialty enrollment scale, we found that Model-1 with the one-year lag data as independent variable is more effective for prediction. GDP data and normal undergraduate enrollment data do not allow the linear prediction models to predict more accurately. The results of this paper can provide a reference and forecast for the educational institutions to provide more budget and decision-making in the field of specialty education. However, due to the limited amount of data, the interpretability of the model is limited.

References

MOE (Ministry of Education Higher Vocational Education) (2015). *Higher Specialty Education (specialty)*

professional directory, http: //www.moe.edu.cn/.
Ni Xiaomin (2004). Review of China's Specialty Education Development and Countermeasures (Chinese). *Zhejiang Social Sciences.*
Shi Li & Liu Yuan (2014). Spatial Distribution Pattern and Influencing Factors of Specialized Education Scale in Ordinary Colleges and Universities in China (Chinese). *Education & Economy.*
Wang Yi & Liu Huizen (2003). The Development Trend of Higher Education and the Integration of Higher Specialty and Technical Education (Chinese). *Journal of Beijing Institute of Technology (Social Science Edition)*.