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The Future Development of China's Higher Education

Jinming Zhang

School of International Education, North China University of Water, Resources and Electric Power, Zhengzhou 450011, China

*Corresponding author: 978852813@qq.com

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Abstract: In recent years, higher education has played an increasingly important role in China. A large number of students provide talent support for China's technological progress and economic growth. However, due to the increase in the number of educated people and the continuous improvement of the academic requirements of employers, the unemployment rate of Chinese college students has risen. So, will unfair competition in the education industry continue? How will China's higher education develop? Through this article, we will further explore the future development of China's higher education through research on China's education policy.

1. Introduction

In Cambridge Dictionary, higher education is defined as“education at a college or university where subjects are studied at an advanced level” [1]. Through this definition, it is not difficult for us to find several key words, one of which is "in university" and the other is "an advanced level". These two things reflect the same thing, that is, a university is a place that can provide young students with better educational resources. But in fact, there are still many Chinese youth who do not really enjoy the dividends of this educational model.

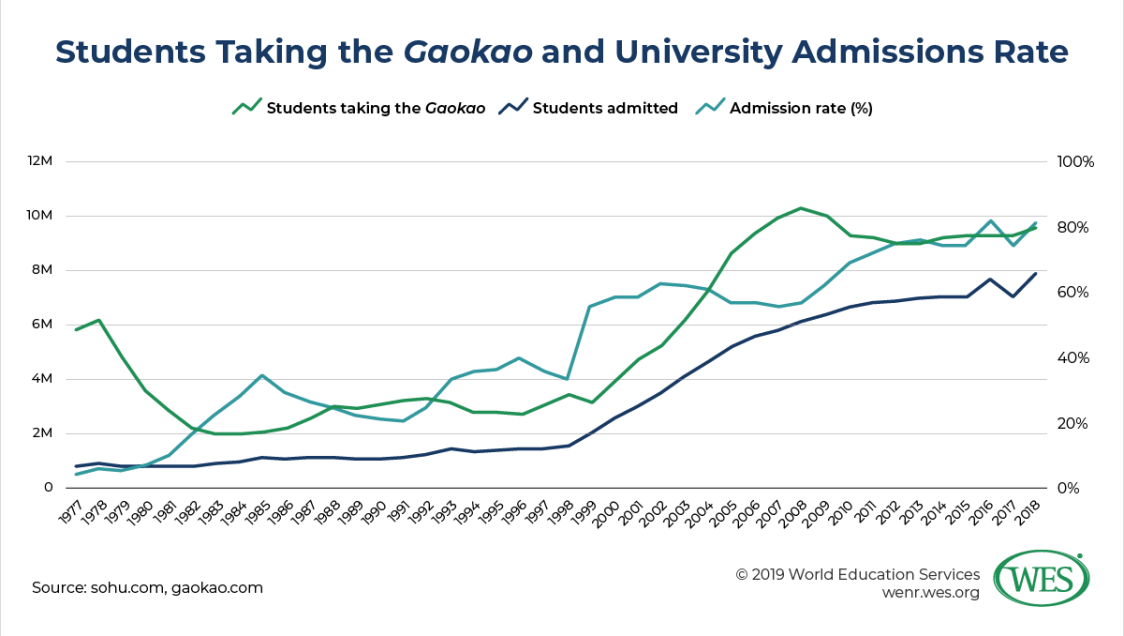

Figure. 1 Students Taking the Gaokao and University Admissions Rate [2]

From this chart, we can see that the rate of Chinese high school students taking the college entrance examination is close to 80%, but the admission rate is only less than 70%. From this perspective, it is equivalent to less than 70% of students have the opportunity to receive university education, and can they really enjoy high-quality educational resources? Obviously not. In China, high-quality educational resources for higher education are often monopolized by universities that have become "985 and 211".

More importantly, the students entering these universities each year account for less than 1% of the total number of university students. The undergraduate rate in China is only 3.8% of the total population. Therefore, from a statistical point of view, there are many serious problems in the fundamentals of Chinese higher education.

However, we need to consider from another angle. Since the above-mentioned problems are objectively existing and difficult to change for a long time, these problems can be used as constants affecting the future development of Chinese education.

2. Materials and methods

2.1 Introduction to the discourse framework

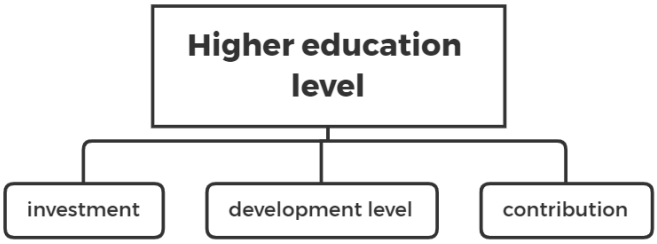

Figure. 2 Three components of higher education level

2.2 Analytic Hierarchy Process

The analytic hierarchy process is a common method of mathematical analysis, and its main method is to make different things have different classifications through stratification.

It derives from 1970s which was developed by Thomas L. Saaty, a distinguished University Professor at the University of Pittsburgh. This method focus on the complex problems solving and based on the based on mathematics and psychology. [1]

The use of this method can be described as model the problem as a hierarchy, the high level is usually megascopic, because the content of this level needs to embody a variety of objects, in fact, these contents look a bit abstract. The low level is belongs to the high level, it is the concrete objects for people to use and we can generalize them a microscopic things or concrete things.

Of course, this method is always used by many decision situations, so it is suitable for us to analyze the decisions in higher education. More importantly, it is crucial to decompose the higher education system into different sub-problem which is easier for us to comprehend. Hence, we concluded higher education have three different parts to discuss.

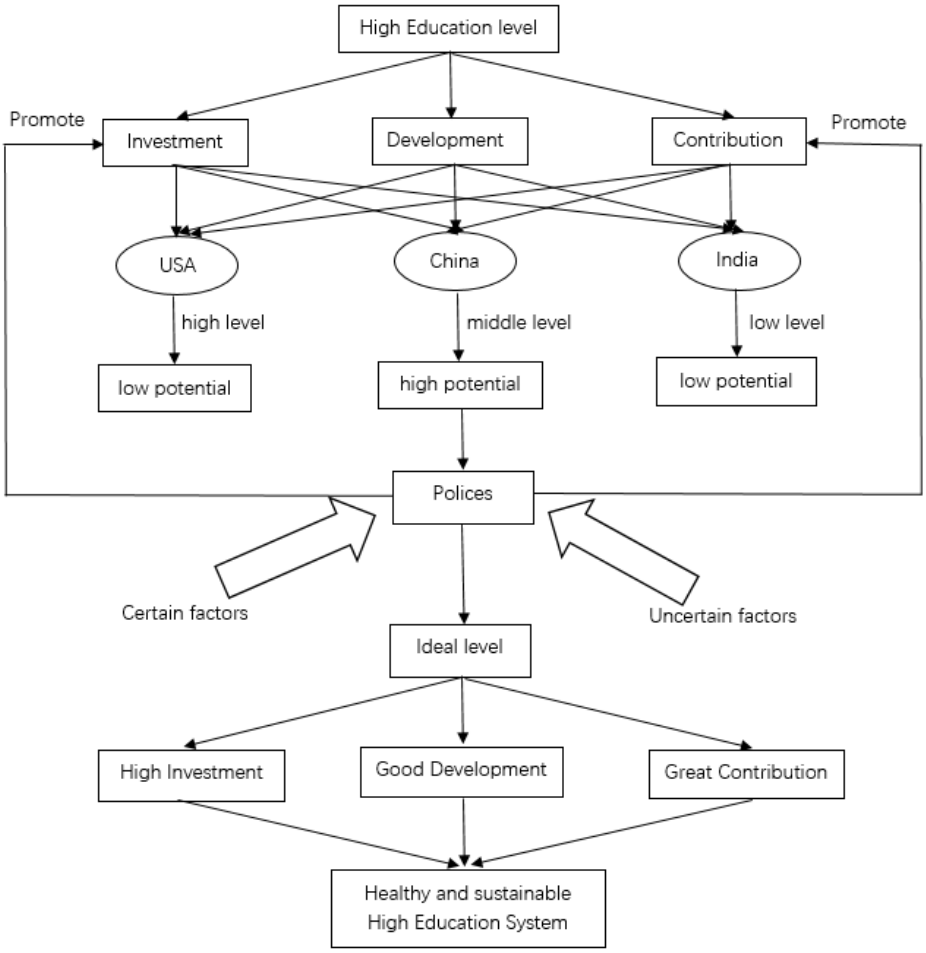

Figure. 3 Modeling Flow Chart

2.3 Basic overview of Higher Education levels around the world

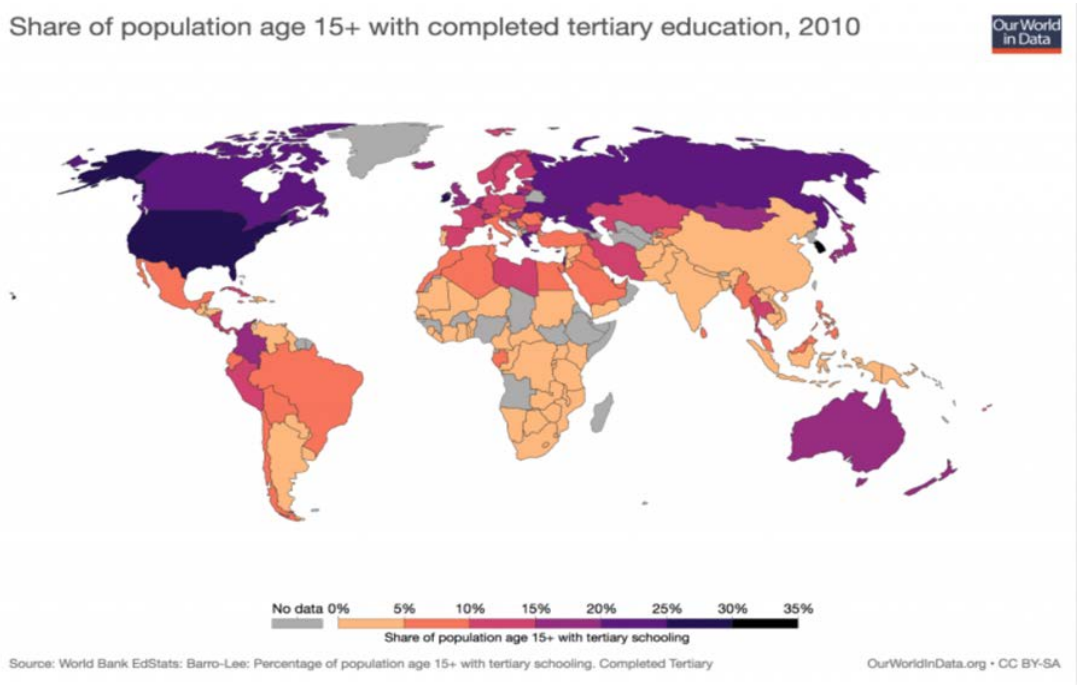

Figure. 4 the share of population older than 14 years that has completed tertiary education. [3]

According to this educational level distribution diagram. It is not difficult to find that the darker the color, the higher the level of education. However, these regions only account for a small part, mainly in North America and Europe. And the degree of higher education in Asia, the most populous Asia, is not very high. In addition, Africa is the largest of the eight continents in the world, and its level of higher education is lower than that of Asia. Therefore, we have to lament that the distribution of higher education in the world is very uneven. China is in the light-colored area in this graph, so there is still a lot of room for growth in the current average distribution of higher education resources in China.

3. Health assessment model: Result and Analysis

3.1 Analysis approach

Whether a country's higher education develops healthily is affected by many factors, so we can use the analytic hierarchy process to judge the country's healthy development of higher education. The specific implementation are as below: Take a country's healthy and sustainable higher education system as the target level of the level analysis (A); The factors to be considered for a country's healthy and sustainable higher education system: investment in higher education, the development level of higher education, and the contribution of higher education are used as the criterion layer of the level analysis (B); Due to the large number of indicators at the program level (M), we denote the indicators at the program level (M) with. Then establish the hierarchical structure model I, as shown in Figure 4.

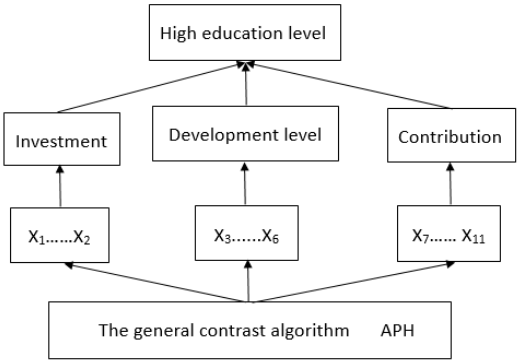

Figure. 5 Thinking flowchart

3.2 Model preparation

Table 1 Variables and their meanings

Number	Sign	Significance
1	x_i	The single index we selected to reflect the corresponding indicators
2	ϖ_i	Eigenvectors in analytic hierarchy process
3	n	The number of indicators in each subsystem
4	F_i	Comprehensive scores for health assessment indicators
5	R_i	Judgment matrix in analytic hierarchy process
6	I_i	The index weight was calculated by analytic hierarchy process

Table 2 Higher Education System

sector	short	indicator	Significance
investment	HEF	x_1	Higher education funding(hundred billion)
	HEC	x_2	Higher education cost(Hundred million)
development	GER	x_3	Gross enrollment rate(%)
	NCS	x_4	Number of college students (Ten million)
	NFS	x_5	Number of foreign students (Ten thousand)
	NOI	x_6	Number of institutions(Ten thousand)
contribution	NPW	x_7	Number of Nobel Prize winners
	NSP	x_8	Number of scientific papers(Ten thousand)
	NOP	x_9	Number of patents(Ten thousand)
	ER	x_{10}	employment rate(%)
	GDP	x_{11}	Gross Domestic Product(%)

In terms of health assessment, the evaluation index system can be divided into three subsystems: investment in higher education, development level of higher education and contribution of higher education. When selecting specific indicators for each indicator, the principles of science, simplicity,

coordination and substitution should be followed. We referenced international articles and establish an optimistic, scientific, predictable and comparable variable set. They are shown in table 1 and 2.

3.3 Model establishing--sustainability evaluation model based on Genetic Algorithm

Step1: construct a judgment matrix

Before constructing the judgment matrix, we need to compare the relative importance of the indicators. Generally, we use the scale method of 1-9 and its reciprocal, and as shown in the table 3.

Table 3 Comparison of quantitative values between indicators is specified

Factor i and. factor j	Quantizer
Equally important	1
Weakly important	3
Stronger important	5
Strongly important	7
Extremely important	9
The middle value of two adjacent judgments	2, 4, 6, 8
reciprocal	$a_{ij}=1/a_{ij}$

Filled by experts, we construct a judgment matrix between the target layer A and the evaluation criterion layer B:

Table 4 The tabular form of the judgment matrix

A	Investment(B_1)	Development (B_2)	Contribution(B_3)
Investment(B_1)	1	1/5	1/6
Development (B_2)	5	1	1/2
Contribution(B_3)	6	2	1

In order to facilitate mathematical processing, we usually write the above results in the following matrix form, called the pairwise comparison matrix.

$$R_1 = \begin{Bmatrix} 1 & 1/5 & 1/6 \\ 5 & 1 & 1/2 \\ 6 & 2 & 1 \end{Bmatrix} \tag{1}$$

According to the principle of column normalization, a new matrix R_2 is obtained and it is shown as below

$$R_2 = \begin{Bmatrix} 0.0833 & 0.0625 & 0.1000 \\ 0.4167 & 0.3125 & 0.3000 \\ 0.5000 & 0.6250 & 0.6000 \end{Bmatrix} \tag{2}$$

Step2: Use the following mathematical formula in matrix R_2

$$\varpi_i = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} B_{ij}}{n} \tag{3}$$

The eigenvector corresponding to the maximum eigenvalue of the matrix is calculated as ϖ = [0.0819, 0.3431, 0.5750].

Step3: The maximum eigenvalue corresponding to the matrix R_1 can be obtained by the formula $R_1\varpi = \lambda_{\max}\varpi$:

$$\lambda_{\max} = \sum_{i=1}^{n} \frac{[R_1\varpi_i]}{n\varpi_i} \tag{4}$$

Substitute the data to calculate the maximum eigenvalue $\lambda_{\max}$ = 3.0292. To perform the consistency test of the level single sort, the consistency index $CI = {(\lambda_{\max} - n)}/{(n-1)}$ needs to be calculated, and the consistency index CI =0.0146 is obtained by calculation.

Step4: Average random consistency index RI value, the details are shown in the table 5 below:

Table 5 RI form

Order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0	0	0.52	0.89	1.12	1.26	1.36	1.41	1.46	0.49	0.52	1.54	1.56	1.58	1.59

Since the matrix R_1 is a third-order matrix, RI = 0.52, according to the random consistency ratio formula:

$$CR = {CI}/{RI} \tag{5}$$

Obtained CR =0.03<0.1, it is considered that the results of single-level sorting have satisfactory consistency.

3.4 Model application

By collecting data, we have obtained data related to higher education in the United States, China, and India, The specific content is shown in the following table:

Table 6 Quantitative indicators for three countries

sector	indicator	USA		China		India	
		2010	2019	2010	2019	2010	2019
Investment	HEF	4.039	8.680	1.483	2.081	0.063	0.136
	HEC	5.530	7.652	1.223	1.624	0.042	0.072
development	GER	89	92.3	37.3	51.6	19	30
	NCS	1.670	1.790	2.550	4.002	2.850	3.010
	NFS	24.73	32.78	9.851	66.2	10.32	48.82
	NOI	0.461	0.472	0.236	0.269	4.691	4.782
contribution	NPW	3	5	0	0	0	0
	NSP	8.9060	9.4029	3.4089	5.2739	1.2736	2.3736
	NOP	4.486	5.784	1.234	5.899	0.127	0.347
	ER	40	68.9	86.6	91.5	39.7	46.8
	GDP	23.4	30.4	12.3	18.4	9.3	15.3

Note: The above values have units, please refer to Table 2 for details.

① Establish mathematical formula for index evaluation:

$$F = \sum_{i=1}^{n} y_i I_i \tag{6}$$

Among them, F represents the total score of higher education, y_i represents the value of each indicator in Table 6, and I_i represents the weight of each sector, multiply each y_i with I_i , and then sum.

② According to the above formula, we can get the total scores of the three countries in 2010 and 2019, the specific content is shown in the table 7 below.

Table 7 Index scores of three countries

Subsystem	USA		China		India	
	2010	2019	2010	2019	2010	2019
Investment	0.7837	1.3302	0.2216	0.3034	0.0086	0.017
development	39.75	43.69	17.13	41.48	12.65	29.71
contribution	45.88	68.70	59.54	69.62	28.98	37.27
F	86.41	113.72	76.89	111.4	41.64	66.99

According to Table 7, it can be concluded that the higher education of the three countries has increased in different degrees during the 10 years from 2010 to 2019, which can be reflected in Table 8 below:

Table 8 Range of score changes in the three countries

Ranks	USA	China	India
Score Range	(86.41, 113.72]	(76.89, 111.4]	(41.64, 66.99]

3.5 Model application

From the results in Table 7 and Table 8, it can be seen that although China's higher education has achieved great improvement in the past 10 years, it has far exceeded the development of the Indian higher education industry, but it is still insufficient compared to the United States and other western countries. For example, in terms of capital investment in higher education, there are huge differences between the two countries, and the United States has a huge investment in education. In addition, in terms of the contribution of higher education, China and the United States also have differences, mainly showing that the United States is strong and China is weak.

4. Policies that contribute to the development of education : Solution

4.1 Analysis approach

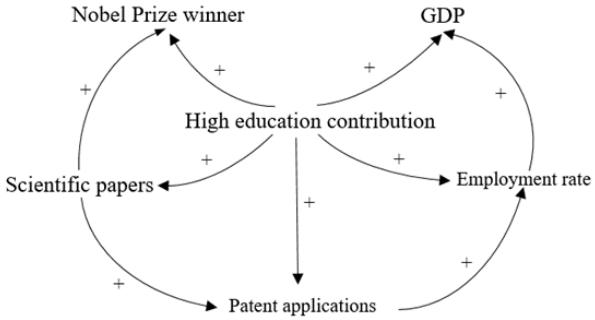

Figure. 6 Causal Loop Diagram

In order to come up with a scientific and reasonable plan, we should consider the internal relationships of each subsystem and combine China's overall situation. In addition, China is an agricultural country with a relatively weak industrial base. Taking into account the complexity of the indicator system, we analyze the effects of these strategies by selecting financial indicators for higher education investment, gross enrollment rate indicators for higher education development and college graduate employment rate indicators for higher education contributions.

Taking the contribution of higher education and the employment rate of college students as an example, first determine the contribution of higher education, and then analyze the relationship between the contribution of higher education and the employment rate of college students, and finally establish a model of the contribution of higher education and the employment rate of college students. Which is shown in Figure 7.

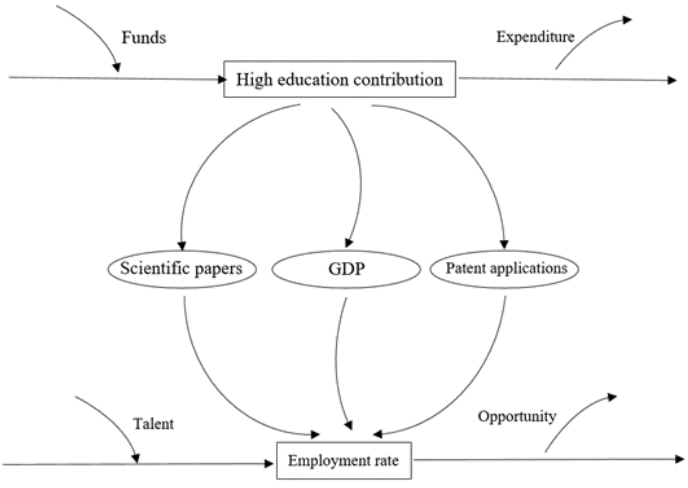

Figure. 7 System diagram

By inputting the employment rate data of college students in the past 10 years, we can see from Figure 8 that as the contribution of higher education is positively correlated with the employment rate of college students, as the contribution of higher education further increases, the proportion of employed college students has steadily increased.

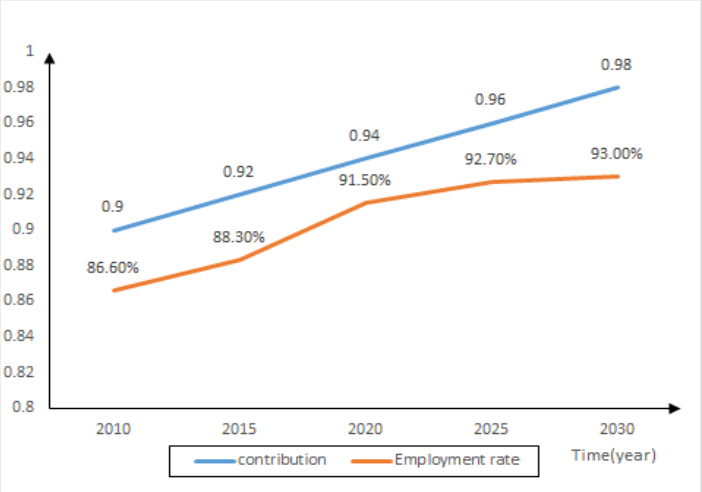

Figure. 8 Relation chart

Through the analysis of Figure 8, it can be seen that as the contribution of higher education continues to increase, the employment rate of college students will not increase indefinitely, but tends to a certain level and no longer increases. After reaching this specific level, the state at this time is called the saturation value.

These subsystems are interconnected and affect each other. Similarly, higher education investment and funding, higher education development and gross enrollment rate are similar. We use the same method to analyze the relationship between the various subsystems. Based on the above analysis, combined with the actual situation, we propose countermeasures from four aspects:

- **Economic strategy**

For China, only through Conducting the Special Campaign to Accelerate Innovation and through the implementation of this policy can industries with innovative capabilities to develop and promote national economic growth through these innovative industries. At the same time, the growth of the country's economic growth will help enhance the country's overall strength. Only by implementing such a specific strategy can the country have sufficient funds to provide higher education and strengthen investment in this field.

- **Talent strategy**

A healthy and sustainable higher education is inseparable from the cultivation of talents by the country. Therefore, China should prioritize Human Resource Development: on the basis of nine-year compulsory education, begin to popularize high schools and even universities. By doing so, the gross enrollment rate of higher education in China will be effectively and significantly increased.

- **Political strategy:**

For the country, we must first understand the status of higher education in the entire education. In order to consolidate the position of higher education in the entire education industry, it is necessary not only to increase the investment in higher education funds, but also to further regulate and manage the development of higher education. And through financial support, China's higher education industry can operate with sufficient funds, and use additional funds to promote its exploration of some emerging areas, such as curriculum reform and replacement of more advanced teaching hardware equipment, so that students can really enjoy the policy dividend and increase their interest in learning and desire for knowledge. Through the above-mentioned series of measures, China's higher education system will maintain a healthy level and continue to maintain sustainable development with certain policy support.

- **Social strategy**

Since China is a multi-ethnic and multi-cultural country and the whole society is a big family, we must actively promote the importance of higher education in the society and gradually form people's thinking and concepts. People can treat the development of higher education with a more positive attitude only after they have established correct ideological concepts. Therefore, contemporary people will encourage their children to embrace higher education through the establishment of correct values, so that the higher education system will continue to develop further while having a healthy situation and achieve sustainable development.

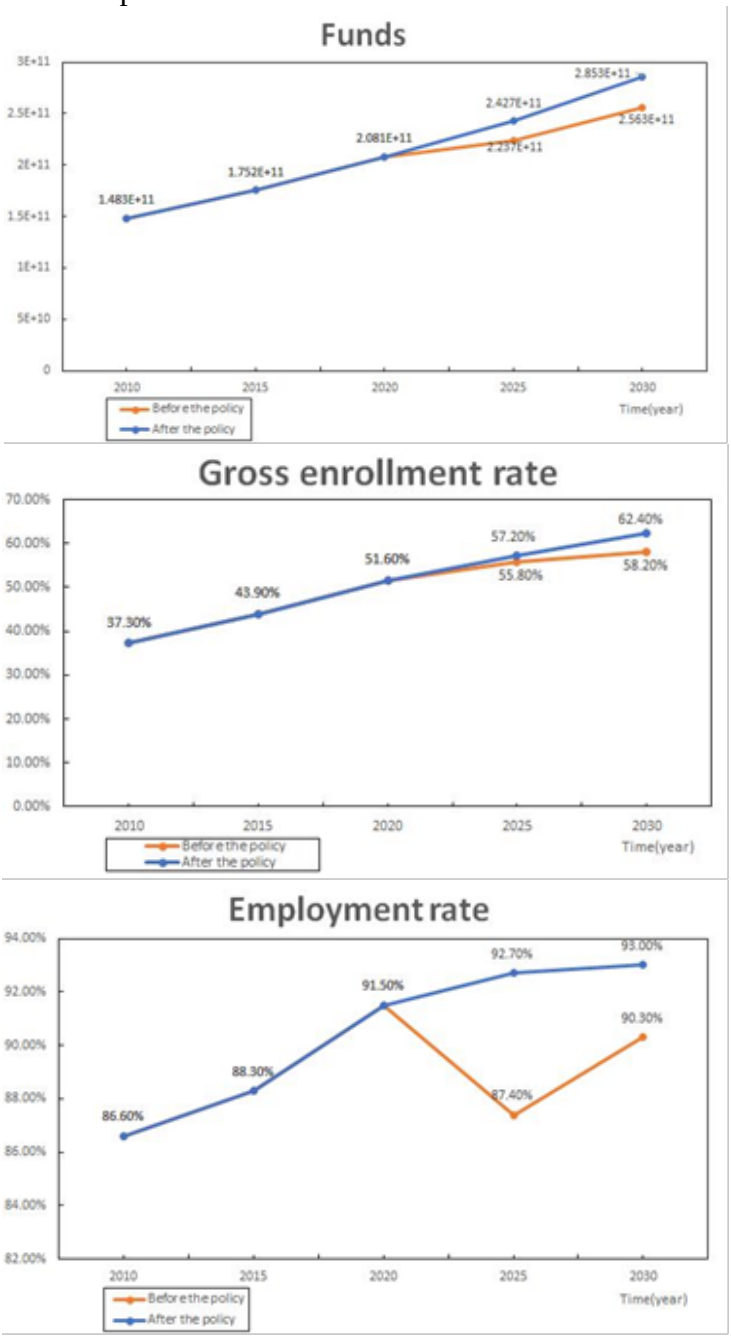

Figure. 9 The changes of Indicator before & after

4.2 Result analysis

The simulation cycle of the entire model is 2010-2030. The comparison with historical data from 2010 to 2020 is a correction of the model. After 2020, we use the model's scenario simulation to analyze the impact of different strategic choices on the future.

① Funding: According to the content of the relevant documents of the 2020 government work report, the state will further increase its investment in higher funds after 2020.

② Gross enrollment rate: According to relevant documents issued by the Ministry of Education, the gross enrollment rate of upstream higher education has exceeded 50%; after the implementation of the policy, the gross enrollment rate will exceed 62%.

③ Employment rate of college students: According to a statement issued by the Human Resources and Social Security Bureau, the employment competition for college students will further intensify after 2020; and the implementation of policies can stabilize the employment rate of college students. tons of oil equivalent).

5. Future

Someone might say that COVID-19 has been effectively controlled in China, and Chinese college students no longer need to take online courses like foreign students. However, I think this is a very wrong view. Although the inability of foreign governments to deal with COVID-19 has caused the epidemic to spread more widely around the world, the widespread spread of the epidemic around the world has prompted some Chinese students working and studying abroad to return to their countries. In terms of employment, this has also exacerbated the transformation of some potential international student groups into groups participating in domestic graduate students. These groups will become the main force in China's job market in the next 3-5 years.

For current Chinese university undergraduates, there are two common methods for further study. One is to participate in the postgraduate examinations organized by the state, the examination subjects are English, politics and professional courses; therefore, it only depends on the examination ability of college students like the college entrance examination. The second is for graduate students applying for foreign universities. To apply for a foreign graduate student, you need to submit application materials, which can only be passed after approval by the admissions staff of the applicant institution; and the application materials usually need to submit the applicant's GPA and IELTS scores, plus your own project experience. In summary, the common point of these two methods is that they require higher English proficiency. Therefore, if some people who work abroad and those who plan to study abroad and then study in China have a great advantage in English proficiency, and because of their strong comprehensive strength, then this group of people usually ranks high in the country. Go to a university. Therefore, when they are hired, they can get a better job due to better English and comprehensive skills. As a result, due to lack of competitiveness, some students who could have been admitted to relevant positions were screened out, and they had to find lower-level jobs. Those students who could have accepted relatively lower-level jobs must find lower-level jobs. Therefore, this epidemic is actually a vicious circle of China's higher education talent export.

Figure. 10 "Statistics" of the rich: a map of the rich in China (with photos) [4]

At the same time, because these groups of students who were originally going to go abroad have relatively rich family conditions, their families not only have more wealth, but also have more social resources. And these social resources will allow them to have better educational resources, such as participating in more paid activities during high school or university, such as participating in the online scientific research of 30,000 yuan provided by CIS(Cathaypath Institute of Science), then students participating in the project will pass this This kind of high-cost activity obtains recommendation letters from professors from world-renowned universities and their own academic achievements.

From another point of view, because many college students favor investment banking and securities company jobs, but because some of the parents in this group of students are investment bank executives or people who know those executives. Therefore, these students do not need to spend a lot of energy to intern or even work in top financial institutions, while other students are not only because of their insufficient academic qualifications, but also because of their own social resources and the resources provided by their families.

Therefore, through the above analysis, I think the future of China’s higher education industry is bright.

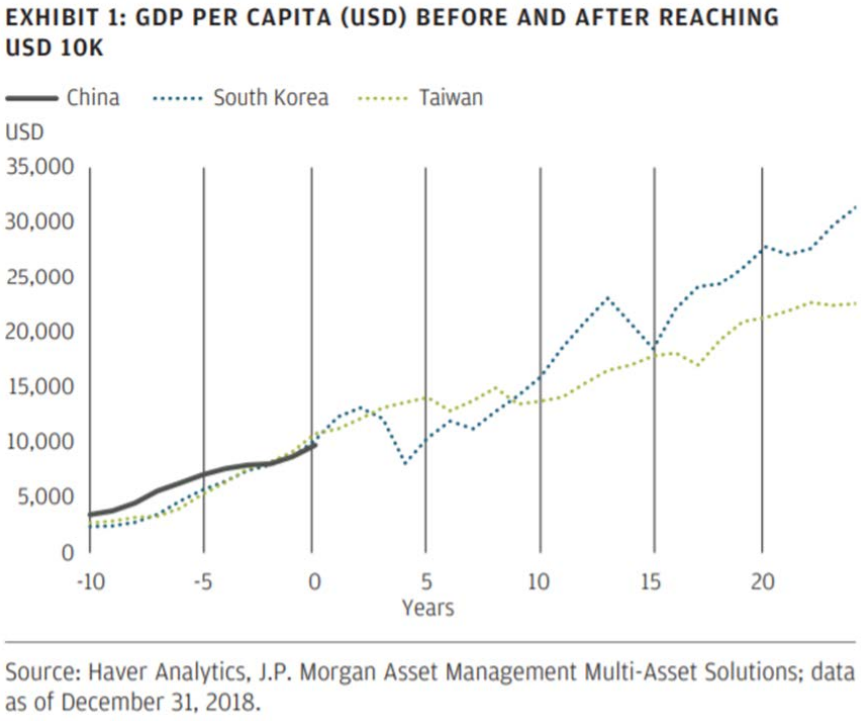

Figure. 11 JP Morgan Asset Management Research Report [5]

From the report of JP Morgan Chase's asset management department, we can see that due to China's economic growth, per capita GDP has gained more room for growth. Although this report is not the latest, it is due to China's fight against COVID-19 in 2020. With all these efforts, China's economy has maintained positive growth while the global economy has been declining collectively. This will also provide financial support for the development of China's higher education. At the same time, due to the growth of per capita GDP, the shrinking of low-income groups will help increase China's undergraduate rate and will also alleviate the uneven distribution of social resources to a certain extent.

At the same time, combined with the report of Deloitte, the world's largest accounting firm, we know that China's effectiveness in epidemic prevention and control is inseparable from the strong execution of the government.

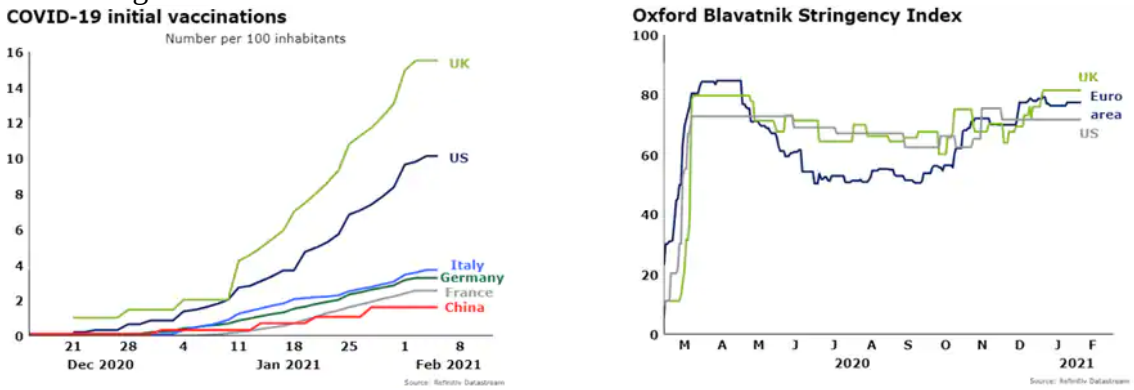

Figure. 12 Deloitte COVID-19 Economics Monitor [6]

And this strong execution is beneficial to the implementation of innovative education policies, so if the Chinese government is willing to invest capital to alleviate the problem of uneven educational resources, I think this problem will have an inflection point. Of course, some inherent social issues require the government to lower its status to consider. For example, for example, Henan Province, which has the largest population in the country, does not have a key university. More than a decade ago, the government did propose that some universities in Beijing would the branch school is located in Henan Province. But in the end it was not implemented. Therefore, I think that the investment of funds is not enough, and some leaders of the relevant departments need to lower their status to effectively consider the interests and practical ideas of ordinary people. I think that enlightened leaders will lead China's higher education industry to maturity and prosperity.

6. Conclusions and Discussion

Although the problem is serious, I think there is still a solution to solve this problem:

Initially, I think the most direct thing to change this problem is the students themselves. Because this is a typical unfair situation in education, it is useless to complain. Although it is difficult for most students to work in this direction to achieve better results, I think students should choose a career from a different angle instead of staring at some traditional high-paying careers. And the change of thinking helps to promote the diversification of the job market, I think this is a very important solution

In addition, Schools also need to reflect on their own problems, rather than blindly instill in students some knowledge for examination. Because the biggest problem of exam-oriented education is "utilitarian." And once the students continue their future lives only for utilitarianism, then the school should assume the corresponding responsibilities. Therefore, Chinese institutions of higher learning should make some changes, such as adopting curriculum reform plans to solve the current employment problem. For example, Peking University continues to open the second bachelor's degree in the School of Software and Microelectronics, and this position for enrollment from the whole society is very attractive, because its major is for software and engineering, and some undergraduates have not learned themselves Students who have ideal majors but do not want to enter postgraduate studies can choose this path.

Furthermore, government departments need to think about this issue seriously. Because the intensification of inherent educational inequity will cause the division of social classes, and this will cause social instability due to social tearing. Although this sounds exaggerated, as far as the United States is concerned, the crime rate is higher for people with lower education levels. Therefore, I think government departments must pay attention to this issue and give some reform measures. The first is to encourage college students to diversify their careers, not just focus on popular majors such as CS and Finance. The second is to encourage the establishment of some non-profit charity organizations, so that more young people can participate. For some students who are not short of money, joining such organizations can help them to help those who are in urgent need of high-paying positions but do not have better Ordinary students with social resources vacate their positions; for most students, public welfare organizations can improve their sense of social responsibility and drive their utilitarianism from another angle. Finally, I think that government departments should allocate funds for education in some underdeveloped areas, such as Henan Province; at the same time, they should introduce prestigious schools to areas with more important geographical locations but lack of educational resources to alleviate the problems of students studying and choosing jobs.

Acknowledgements

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