Comparative Analysis on the Efficiency of Science and Technology Innovation in Chinese Universities Based on DEA_Malmquist and Regression Analysis

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Abstract. Based on the data compiled from scientific and technological statistics of colleges and universities in 2015-2019, this paper measures the transformation efficiency of the scientific and technological achievements of Double First-Class initiative colleges and universities from the micro and macro perspectives. The micro part uses the panel data fixed effect method to carry on the regression analysis to the input-output data of the science and engineering double first-class university and the ordinary university, determines the regression coefficient. Based on the DEA-Malmquist method, the macro part calculates the efficiency and dynamic changes of scientific and technological achievements between "211 and provincial co-construction colleges and universities "and ordinary colleges and universities in 2015-2019. The results show that double-class universities have obvious advantages over ordinary universities in pure technological innovation. Still, the social benefits of ordinary universities are better than those of double-class universities. Based on the research results, this paper puts forward some policy suggestions to optimize the resource allocation system of higher education and promote the close combination of higher education development with technological innovation and industrial structure transformation.

Keywords-Efficiency of Science; Technology Innovation; DEA_Malmquist; Regression Analysis

1. INTRODUCTION

At present, China is in a critical period of industrial transformation. Whether China can make breakthroughs in core technologies as soon as possible is the key factor to overcome the middle-income trap and achieve higher-quality development. The overall plan for promoting the construction of world-class universities and disciplines issued by the State Council calls for speeding up the construction of world-class universities and disciplines and making them a

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"charge call" for Chinese universities to sprint to the forefront of the world and build into top universities. Industrial transformation and upgrading, as the name imply, is to promote the country's overall economic activities from low-tech level to high-tech level through scientific and technological innovation and progress. Industrial transformation and upgrading play a decisive role in the sustainable development of a country's economy. At present, the main body of China's basic research and scientific and technological innovation is all kinds of higher education institutions, and the scientific and technological innovation achievements of each university are directly related to the level of China's overall scientific and technological strength. Taking this as a starting point, this paper will study the innovation capacity of Chinese universities by studying the relationship between the scientific and technological innovation achievements of target universities and their scientific research input. At the same time, colleges and universities in China at the present stage have relatively obvious stratification. From Tsinghua University, Beijing University represents national first-class top universities to provincial key universities. Ordinary undergraduate universities, colleges, and universities at different levels have obvious differences in teachers' capacity, scientific research equipment, and financial support. Therefore, through the contrast between the double first-class university and ordinary university innovation efficiency and ability, analysis in the same conditions whether the innovation ability of double first-class universities is stronger than the ordinary universities. Based on this, this paper discusses whether the agglomeration effect of Chinese universities is more serious, whether the current educational resource allocation system needs to be adjusted, and whether the current resource allocation can promote the upgrading of China's industrial structure and social and economic development.

2. LITERATURE REVIEW

At present, most of the research literature mainly focuses on the innovative research results of China's double-first colleges and universities. There is relatively little research on ordinary colleges and universities. Li Wenhui of South China Normal University and others found that the number of patent applications in double-class construction colleges and universities increased year by year from 2006 to 2017 as a measure of technical patents. Double first-class colleges and universities have strong scientific and technological innovation abilities. Still, some technologies show an aging trend [1]. Each of the two first-class colleges and universities should grasp the trend and direction of technological development and increase investment in advanced technology with good prospects. Compared with the double first-class colleges and universities, the technological innovation of ordinary colleges and universities is facing a certain degree of difficulty. Xie Hongqiang and others found that non-double first-class colleges and universities face the dilemma of lack of capital investment in the cultivation of innovative talents, inadequate education system, and low transformation of results [2]. Ordinary colleges and universities urgently need more support to solve the major problems that restrict their development. At the same time, the innovation ability of Chinese colleges and universities shows a clear trend of regional differentiation. Based on the results of component analysis, Liu Wei of Tsinghua University and others found that the scientific and technological innovation ability of eastern colleges and universities is better than the universities and colleges in the central region, which is better than the universities and colleges in the western area. However, colleges and universities' scientific and technological innovation performance in some provinces and cities in the central and western regions is very eye-catching [3]. Wang Meixia of the Xi'an University of Technology and others found that there are obvious regional differences in the collaborative innovation ability of Chinese universities. The ability of colleges and universities in the eastern provinces to innovate in collaboration is significantly stronger than that in the central and western regions. It shows that colleges and universities in developed areas in the east have strong innovation ability and reflect the trend of strong and strong combination [4]. At present, the regional imbalance in the development of Chinese colleges and universities is more obvious.

Hongjie Zheng et al. summarized the transformation of scientific and technological achievements of universities in Yunnan Province by using the classification DEA model, analysed the transformation of scientific and technological achievements of Kunming University of Science and Technology on this basis, and finally concluded the main reasons affecting the transformation of scientific and technological achievements of universities in Yunnan Province [5]. Hu Chao Meng et al. divided the transformation of scientific research achievements in universities into two stages: research development and value creation. The super-efficiency DEA model was used to measure the efficiency values of universities in the two stages, and the horizontal and vertical comparative studies were conducted to provide suggestions for improving the management level of scientific and technological innovation in universities of traditional Chinese medicine [7]. Kun Chen et al. used the DEA-Malmquist method to compare and measure the efficiency of Chinese and foreign universities in each stage of the technology transfer process and found that the productivity of professional licensing of American universities has been continuously improved. This is mainly due to the increased willingness of the faculty and the increased dependence of the universities on external R&D funding. Moreover, China's total factor productivity ranks at the bottom, reflecting the backward development of China's technology transfer level, which is mainly affected by the decline of pure technological efficiency [6]. Yaohua Rong et al. used the classification DEA model to measure and evaluate the scientific research efficiency of the overall scientific and technological input-output of universities in different regions and put forward improvement measures and political suggestions on the scientific research efficiency [8].

In the study of efficiency evaluation, scholars choose various evaluation methods, including h index, principal component RBF, grey system theory, BP neural network, grey correlation analysis, optimal weight set, etc. Since the index weight of the DEA model is not affected by human subjective factors and is objective and fair, scholars mostly use the DEA model to evaluate the efficiency of multiple inputs and outputs. However, the DEA-Malmquist method is seldom used by scholars to measure the total factor productivity of scientific research innovation in universities and its decomposition. In terms of research objects, scholars mostly classify universities according to regions, types, and other indicators to study the efficiency of scientific research innovation. They seldom compare the value of scientific research innovation efficiency between Double first-class initiative universities and ordinary universities. Therefore, the macroscopic part of this study is objective and fair in terms of research methods and innovative and realistic in terms of topic selection

3. THE MICRO PART

3.1 Evaluation and Design

3.1.1 Research method and research object

In the micro part, the panel data fixed effect method is used to conduct regression analysis on the input-output data of the target universities from 2015 to 2019 to determine their regression coefficients. In terms of selecting target colleges and universities, since the current scientific and technological innovation achievements are mainly concentrated in natural science and technology, this paper selects 5 colleges and universities of science and technology from 137 double first-class universities and other ordinary universities, respectively, as the research objects. At the same time, in consideration of the fairness and objectivity of the comparative study, Tsinghua University, Peking University, University of Science and Technology of China, and other top universities representing extreme values were excluded from the double first-class universities. Some provincial key science and technology universities with high reputations were selected as the research objects from the rest of ordinary universities. Finally, the Dalian University of Technology, Huazhong University of Science and Technology, South China University of Technology, University of Electronic Science and Technology, Tianjin University were selected as the research objects of the double first-class university group. Yanshan University, Nanjing University of Technology, Zhejiang University of Technology, Kunming University of Science and Technology, Changsha University of Science and Technology were selected as the research objects of the ordinary university group.

3.1.2 Selection of variables and indicators

In this paper's microscopic partial regression model, the number of patent applications in the year of the target universities is the main explained variable to measure their scientific and technological innovation achievements. The target universities' expenditure in science and technology is selected as the main explanatory variable to measure the research inputs. At the same time, considering that the quality of students has an important impact on the scientific research ability of the university, generally speaking, the higher the quality of students, the stronger the scientific research ability of the university. Therefore, this paper uses the average score of provinces in the national volume (volume 1) of the college entrance examination as the control variable to measure the student quality. It is expected to have a positive effect on the explained variable. In addition, the level of economic development in the location of a university will also have an important impact on the university's research capacity. The more developed the local economy is, the more sufficient the financial support available to the university will be. Meanwhile, the stronger the demand of local enterprises for scientific and technological innovation. Therefore, this paper uses the per capita GDP of the province where each university is located as another control variable to measure economic development. It is expected to have a positive effect on the explained variable. Considering the availability and timeliness of data, data values from 2015 to 2019 are used for all data in this paper.

3.1.3 Results and analysis

In the micro part of this paper, based on the classical multiple regression model, the following two models are constructed to describe the linear regression relationship between scientific research investment and patent output in universities and colleges.

$$pat_{it} = \beta_0 + \theta_0 level + \beta_1 \ln inv_{it} + \beta_2 \ln GDP_{it} + \beta_3 \ln score_{it} + \varepsilon_{it} \quad (1)$$

$$pat_{it} = \beta_0 + \beta_1 \ln inv_{it} + \beta_2 \ln GDP_{it} + \beta_3 \ln score_{it} + \varepsilon_{it} \quad (2)$$

Table 1 is used to describe the situation when considering the combination of double first-rate universities, and ordinary universities pat_{it} represent the number of patent applications of target universities in the year i, $level$ is a dummy variable to distinguish double first-rate universities and ordinary universities. The variable is set as 1 when the target university is double first-rate universities, and 0 otherwise. inv_{it} represents the amount of scientific research funds invested by the target university in year i. GDP_{it} represents the per capital GDP value of the province where the target university is located in year i. Score represents the $score_{it}$ line of college entrance β_{it} examination in year I of the target university and represents the random error item.

Table 2 is used to describe the situation when double first-class colleges and universities are grouped into ordinary colleges and universities. Except that the dummy variable level is not required to be considered, the Settings of other variables are the same as Table 1.

TABLE I. REGRESSION RESULT 1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INVESTMENT	0.363378	0.096604	3.761525	0.0005
GDP	-0.549579	0.206183	-2.665495	0.0106
SCORE	0.707785	2.980324	0.237486	0.8134
LEVEL	0.607724	0.338109	1.79742	0.079
C	0.83321	18.64737	0.044682	0.9646
R-squared	0.473229	Mean dependent var		7.808991
Adjusted R-squared	0.426404	S.D. dependent var		0.761741
S.E. of regression	0.576913	Akaike info criterion		1.832388
Sum squared resid	14.97727	Schwarz criterion		2.02359
Log likelihood	-40.8097	Hannan-Quinn criter.		1.905199
F-statistic	10.10651	Durbin-Watson stat		0.754426
Prob(F-statistic)	0.000006			

TABLE II. REGRESSION RESULT 2

Vari able	Coefficient	Std. Error	t-Statistic	Prob.
INVESTMENT	0.227048	0.112793	2.012964	0.0602
GDP	1.451414	0.275704	5.264395	0.0001
SCORE	-2.682222	1.620505	-1.655177	0.1162
C	20.54939	10.03388	2.048	0.0563
R-squared	0.971381	Mean dependent var		8.204113
Adjusted	0.959596	S.D. dependent var		0.674717
S.E. of	0.135623	Akaike info criterion		-0.90354
Sum squared	0.312691	Schwarz criterion		-0.5135
Log likelihood	19.29425	Hannan-Quinn criter.		-0.795359
F-statistic	82.42897	Durbin-Watson stat		1.690963
Prob(F-statistic)	0.0000			

4. THE MACRO PART

4.1 Evaluation and Design

4.1.1 Research method and research object

In the macro part of this paper, the output-oriented DEA-Malmquist method constructed by Far et al [9] is mainly used to compare the output efficiency of scientific and technological achievements of Universities of 211 Project (The 211 Project is a strategic cross-century project formulated by the Chinese government for the implementation of the strategy of invigorating the country through science, technology and education, provincial-level co-built universities and ordinary universities). The DEA-Malmquist method can process multiple input and output panel data well. It can be used to analyze the efficiency changes of the decision-making unit (DMU) in different periods. The geometric mean of the DEA-Malmquist index in two periods is used to calculate the DEA-Malmquist index. That is the DEA-Malmquist index from t to t+1. The DEA-Malmquist index can be decomposed into effch (Efficiency Change Index) and Techch (Technology Change Index), i.e., tfpch= effch * techch. It can be expressed as:

$$m_0(x_{t+1}, y_{t+1}, x_t, y_t) = [\frac{d_0^t(x_{t+1}, y_{t+1})}{d_0^t(x_t, y_t)} \times \frac{d_0^{t+1}(x_{t+1}, y_{t+1})}{d_0^{t+1}(x_t, y_t)}]^{1/2} \quad (3)$$

Where x_t, y_t respectively represent the input and output in the period of t; x_{t+1}, y_{t+1} respectively represent the input and output in the period of t+1.Effch and techch are the two proportions on the right side of the equation, respectively, representing the degree to which the DMU catches up with the production front in the period from t to t+1. Effch and techch < 1, =1, > 1 respectively represent the decline, constant and improved technical efficiency and technological regression, constant and progress. Furthermore, effch can be decomposed into pech (pure technical efficiency change) and sech (scale efficiency change), that is, effch=pech*sech.It can be expressed as:

$$m_0(x_{t+1},y_{t+1},x_t,y_t)=\frac{d_1^{t+1}(x_{t+1},y_{t+1})}{d_1^t(x_t,y_t)}\times[\frac{\frac{d_1^t(x_t,y_t)}{d_0^t(x_t,y_t)}}{\frac{d_1^{t+1}(x_{t+1},y_{t+1})}{d_0^{t+1}(x_{t+1},y_{t+1})}}] \quad (4)$$

$$\times[\frac{d_0^t(x_{t+1},y_{t+1})}{d_0^t(x_{t+1},y_{t+1})}/\frac{d_0^t(x_t,y_t)}{d_0^{t+1}(x_t,y_t)}]^{1/2}$$

This equation changes the assumption that the returns to scale is constant. The footnotes 0 and 1 of d (distance function) are the cases where the returns to scale is constant and the returns to scale changes respectively.

In this paper, a year at the university of science and technology input and output as a DMU, make sure two classes are at the best production frontier every year. Then each year of the university of production frontier, compared with the optimal frontier of two classes at the university of science and technology innovation efficiency, was determined. It is concluded that two kinds of university based on output indicators DEA-Malmquist index.

4.1.2 Selection of variables and indicators

Based on the DEA-Malmquist method, the macro part calculates the scientific and technological achievement output efficiency and its dynamic change of Universities of 211 Project and ordinary universities from 2015 to 2019. It compares the research innovation efficiency of Universities of 211 Project, provincial-level co-construction universities, and ordinary universities respectively horizontally and vertically. To explore the factors that affect the efficiency of scientific and technological innovation in various universities. Based on the availability of data and according to the "Compiler of Statistics on Science and Technology of Colleges and Universities" published by the Ministry of Education every year, the target subjects are mainly Universities of 211 Project, co-built by the province and the ministry and ordinary universities. The universities selected in the macro part are not completely consistent with the micro part. However, selecting the research objects in the macro part is also scientific and reasonable considering that the Double first-class initiative universities in China are all included in the Universities of 211 Project, provincial-level co-construction universities.

In the macro part of this paper, based on the reference of domestic and foreign researches and combining with the actual situation of Chinese colleges and universities, the evaluation index system of university scientific research for 2015-2019 is constructed to measure the scientific and technological innovation ability of universities and colleges. In Table 3, Among them, "investment index" includes "human resources", "investment of funds", "scientific research projects", "scientific research institutions" four level 2 indexes and "full-time research and development personnel", "scientific research expenditure", "project number", "Institution number" level 3 indexes." Output index" includes level 2 indexes: "economic benefit" and "social benefit". Among them, "economic benefit" includes "actual income from technology transfer" and "social benefit" includes "published monographs", "number of patent applications", "academic papers published in foreign and national journals" and "awards for scientific and technological achievements".

TABLE III. FONT STYLES FOR A REFERENCE TO A JOURNAL ARTICLE.

Level 1 index	level 2 index	level 3 index
Input	human resources	Full-time research and development personnel
	investment of funds(thousand yuan)	Scientific research expenditure
	Scientific research project	Project number
	Scientific research institutions	Institution number
Output	Economic benefits (thousand yuan)	published monographs
	Social benefits	Number of patent applications
		Published academic papers in foreign and national journals

4.1.3 Results and analysis

Analysis of total factor productivity(tfpch) (shown in Figure 1): the total average value of total factor productivity of Universities of 211 Project, provincial-level co-construction universities, and ordinary universities maintained positive growth in five years, and the average level reached moreover than1, which was effective in DEA. However, the growth rate of total factor productivity of Universities of 211 Project fluctuated during the five years, and the growth rate continued to decline during 2015-2018 and generated negative growth during 2016-2018. Except for the negative growth in 2015-2016, the total factor productivity of colleges and universities keeps positive growth in other years, and the growth rate keeps rising. The total average total factor productivity of general universities was significantly higher than that of Universities of 211 Project.

The decomposition of total factor productivity: factors that affect the total factor productivity are the comprehensive technical efficiency index (effch)and technical progress index (techch). It can be concluded from the table 4-6 that the main factor affecting the decrease of total factor productivity of Universities of 211 Projects the decrease of technical efficiency index. In contrast, the main factor affecting the positive growth of total factor productivity of ordinary universities is the increase of technical progress index.

From the perspective of pure technical efficiency level(pech), the pure technical efficiency level of technological innovation of the two types of colleges and universities is basically good on the whole, with an average of 1, indicating that the two types of colleges and universities adapt to the existing technology and management level.

From the perspective of scale efficiency(sech), the scale efficiency of ordinary universities is on the rise while that of Universities of 211 Project is slightly down. This indicates that the overall input-output structure, resource allocation and overall market size of 211 universities need to be optimized.

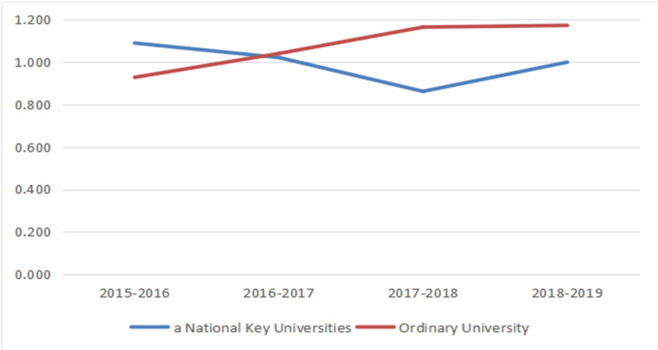

Figure 1. The Changing Trend of tfpch.

TABLE IV. THE MEAN VALUE OF MALMQUIST INDEX OF TECHNOLOGY TRANSFER EFFICIENCY OF TWO TYPES OF UNIVERSITIES FROM 2015 TO 2019

Universities	Pech	Techch	Pech	Sech	Tfpch
Ordinary universities	1.016	1.096	1.000	1.016	1.113
Universities of Project 211	0.998	1.054	1.000	0.998	1.051

TABLE V. THE MALMQUIST INDEX OF TECHNOLOGY TRANSFER EFFICIENCY OF UNIVERSITIES OF PROJECT 211 FROM 2015 TO 2019

	2015-2016	2016-2017	2017-2018	2018-2019
effch	1.012	1.003	0.867	0.985
techch	1.075	1.016	0.993	1.013
pech	1.000	1.000	1.000	1.000
sech	1.012	1.003	0.867	0.985
tfpch	1.088	1.020	0.861	0.998

TABLE VI. THE MALMQUIST INDEX OF TECHNOLOGY TRANSFER EFFICIENCY OF ORDINARY UNIVERSITIES FROM 2015 TO 2019

	2015-2016	2016-2017	2017-2018	2018-2019
effch	0.931	1.026	1.043	1.016
techch	0.996	1.013	1.115	1.153
pech	1.000	1.000	1.000	1.000
sech	0.931	1.026	1.043	1.016
tfpch	0.927	1.039	1.163	1.171

5. DISCUSSION

From the regression results in this paper, the micro part, the innovation ability of double-first universities is stronger than the ordinary colleges and universities to some extent. At the same time, whether the target university is double-first or not will generate significant positive effect to the innovation ability. Besides, the local economic development level also has an obvious positive effect on the innovation ability. The regression results were basically in accord with the existing research results, double first-class construction of colleges and universities in the top of the institutions of higher learning in China and enjoy priority in the allocation of resources, faculty, research facilities, and scientific research projects. They are the main force of innovation at present. Under the Chinese current university classification system, the development of a university largely depends on its position in the current system. Suppose a university can enter the Chinese double first-class construction list. In that case, this university will take on the fast track of development. All kinds of resources allocation tilt will make double first-class universities faster to improve their hardware facilities. At the same time, the first-class title itself will foster the reputation of the school significantly, higher reputation means that the universities can attract more excellent students and outstanding subject leaders represented by the Yangtze river scholar members. Talent is the core factor of scientific and technological innovation. More excellent talents strength of double-first universities has a significant role in promoting the innovation ability. In addition to the differences in the level of material resources and the quality of talents, double first-class universities also have significant advantages in the internal control construction compared with ordinary universities. According to the data released by the Ministry of Education, by 2020, all 42 building world-class university universities set up an audit committee. It is responsible for all the fiscal spending auditing to ensure the appropriate use of scientific research funds. The audit results will be released to the outside world through the school website to accept society's supervision. Besides, Tsinghua University, Beijing University, Fudan University, Harbin Institute of Technology further established special audit teams for each research project group to strengthen the supervision over the use of research funds. A relatively perfect system of internal control regulation gives the double top universities better service efficiency of funds. The use of scientific research funds is more open and transparent, embezzlement, misuse, theft. Other issues relative to the ordinary colleges and universities are relatively rare. At the same time double first-class universities often undertake national major scientific and technological research work which need to accept the national scientific research project acceptance inspection, the evaluation standard is very difficult, so the research teams of double first-class universities are encouraged to use the research funds more carefully to achieve the best effect.

In the macro part, this paper uses the DEA-Malmquist index to measure the scientific and technological innovation efficiency of Universities of 211 Project, provincial-level co-construction universities, and ordinary universities in China. Overall, ordinary universities' scientific and technological innovation efficiency index is higher than Universities of 211 Project, provincial-level co-construction universities. The measurement indicators used in the macro part are more comprehensive than those used in the micro part, and the output indicators include social benefits and economic benefits. Therefore, it can be preliminarily concluded that the comprehensive benefits of scientific and technological innovation of ordinary universities are stronger than those of Universities of 211 Project, provincial-level co-construction universities." Double first-class initiative universities represent the highest level of domestic universities. However, their comprehensive benefits of scientific and technological innovation are still not as good as those of ordinary universities. This shows that although the reform and development of innovation and entrepreneurship education in China's double first-class initiative universities have achieved certain results, there are still some problems. The scale economy of the double first-class initiative universities has declined slightly, which indicates that the overall input-output structure, resource allocation, and the overall market size need to be optimized. Patent technology innovation in colleges and universities has the problem of unequal quantity and quality, scale, and benefit, which is mainly manifested in the high quantity of patent application and authorization during the low application and transformation rate. The concrete manifestation is: First, the consciousness and ability to integrate resources is not strong, and the education subject is single. At present, colleges and universities generally lack high-quality research and teaching carriers of multiple integrations. College education lacks opportunities for innovation and practice and is easily divorced from market demand and industrial development. Secondly, it is difficult to perceive and grasp the market demand for innovation evaluation indicators. The pure quantity and scale indexes cannot objectively reflect the real performance and ability of patent technology innovation in colleges and universities in all aspects, and the quality and market-oriented innovation evaluation indexes of colleges and universities are lacking [10]. Thirdly, It is difficult to integrate practical training with theoretical education. At present, colleges and universities pay more attention to theoretical knowledge and general education, so it is difficult to implement the process of transformation from theory to practice, and college students lack resources for scientific research and practice.

6. CONCLUSION

In general, the more resources to support, more excellent talent team and perfect internal control system under the joint action of the double top universities in technology innovation of pure had obvious advantages compared with ordinary colleges and universities, is the main force of technological innovation at the present stage in China, but on the other hand, China's construction of colleges and universities to some extent the "Matthew effect", Top colleges and universities to absorb the most high-quality talents and resources, high-quality talents and resources to promote the development of first-class universities and bring more achievements and reputation, for the more achievements and reputation, in turn, lead to the high quality resources and talents gathered more to top colleges, but for the ordinary colleges and universities, to remove a few colleges located in the eastern developed areas, Most of them are in the marginal areas of university construction, and have been subject to problems such as lack of funds, brain drain and aging equipment for a long time, which lead to slow development. As a result, the stronger, the stronger, the weaker, the weaker, and aggravate the imbalance of regional education. In addition, from the macroscopic DEA model, this paper analyses the results. After introducing more extensive measures, the social effects of the ordinary colleges and universities present are better than the double trends of first-class universities. It accounts for the vast majority of Chinese universities is also has its irreplaceable role in common colleges and universities, according to figures released by the Ministry of Education, by 2020, There are 3,005 institutions of higher learning in mainland China, among which 137 are double first-class institutions (42 are with first-class university construction and 95 are with first-class discipline construction). Double first-class institutions of higher learning account for only 4.5% of the total number of colleges and universities in China. The vast number of ordinary colleges and universities distributed in various provinces and autonomous regions are the main body of Chinese colleges and universities, absorbing most high school graduates. It is the main force of cultivating a high-quality labour force. Ordinary colleges and universities often do not enjoy a national reputation, but they are an important driving force for developing the local economy.

The majority of ordinary colleges and universities have close contact with local enterprises. They solve various production processes by combining production, education, and research with local enterprises. With the increasing demand for upgrading and transformation of industrial structure, higher education needs to be transformed into the cultivation of high-level scientific research talents. The level of technological innovation and the development of higher education play a positive role in promoting the upgrading and transformation of industrial structure. Therefore, ordinary colleges and universities should promote the upgrading of local industries by strengthening the training of talents in broadening fields. Double first-class initiative universities should also constantly optimize their overall input-output structure, resource allocation and overall market scale, make full use of resource advantages, establish a research mechanism for the correlation between universities and industries, and take technological innovation as a powerful driving force for industrial transformation and upgrading.

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