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Contribution Value of Scientific and Technological Talents in Universities ——Based on Cobb-Douglass Function

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ABSTRACT – This paper aims to determine the contribution value of scientific and technologicaltalents from colleges and universities to national economic development, with data collecting on the correlations between the national education industry and the national economic development from 2005 to 2017, comprising the added value, the capital formation and the total wages and growth rate of the education industry. Through the Cobb-Douglas production function method, the contribution index of university and college educational talents was confirmed. Combining this index with high-tech talents, the contribution value of universityand college science and technology talents was calculated and determined by using big date and informatization method. The results show that in 2005, the contribution value of Chinese university and college S&T talents to GDP was 201,046 yuan per capita, which increased to 863,914 yuan in 2017, the average annual increase was 12.92%.

Keywords— Big data, Contribution value of scientific and technological talents, Cobb-Douglas production function method

1. RESEARCH ON THE PERFORMANCE OF SCIENTIFIC AND TECHNOLOGICAL TALENTS IN COLLEGES AND UNIVERSITIES

On CNKI.cn, the research results on the contribution performance of scientific and technological talents in colleges and universities mainly involves two aspects: research content and research methods.

The first point is to study the contribution performance of talents as well as research results of other scientific research performance. Through studying the level of scientific research, scientific innovation ability and the situation of the combination of production study and research in universities and colleges in Henan Province, Ye Jing (2017) constructed the evaluation system of scientific and technological innovation performance, includingscientific and technological talents, funds for scientific research projects, papers and monographs, cooperation and transformation of production, education and research and intellectual property rights [1]. With the applying of data of 2006-2016 *Compilation of Science and Technology Statistics of Colleges and Universities* and in reference to the 2015 scientific research efficiency level of universities and colleges in 12 Provinces in the west of China, Fang Lijuan et al. (2018) managed to evaluate of the scientific research efficiency level of colleges and universities in Ningxia Province. The measurements include: first, scientific research investment: teaching and research staffs, research and development staffs; second,scientific research achievements: published monographs, published papers and patent of inventions, participation in international academic exchanges [2]. Taking Beijing universities as an example, Yan Jian et al. (2016) designed measurements such as science and technology funds, investment on science and technology manpower, rewards for achievement, science and technology subjects, ownership and authorization of patents, licensing and transferring of patents, etc. The data of input and output of science and technology from 2004 to 2013 in 15 universities in Beijing were analyzed through empirical analysis. The input and output constructure of Beijing has been deemed reasonable.

Scientific and technology achievements is related to yearly total input, scientists in teaching and research staffs and so onin Chinese[3].

The second point is to study the contribution performance of talents through the same evaluation method adopted byother research achievements. In addition to the clustering method adopted by above-mentioned Yan Jian, connecting the S&T innovation during the period of the Twelfth Five-Year, Wang Xiaomeng (2018) finished the research of her own performance (including talent contribution performance) in Chinese [4]. Through data2011-2014 studying and the using of fixed-effect model, Meng Fanrong et al.(2017) compared the performance of scientific and technological innovation among enterprises, universities and scientific research institutions, and it has been confirmed that the quantity of scientific and technological human resources of universities and scientific research institutions had a major significant effect on scientific and technological innovation: the contribution from enterprises is mainly reflected on the competition with each other; The contribution from universities is mainly embodied as the inclusiveness of other research contentsin Chinese[5]. Wu Dandan et al. (2016) conducted empirical analysis on the performance of scientific and technological innovation in colleges and universities by using nonlinear regression analysisbased on the scale independent zone in Chinese . It is believed that the changes of regional GDP, input and output of scientific and technological innovation in colleges and universities have significant non-linear effects on the performance of scientific and technological innovation in colleges and universities in Chinese [6].

In their study, Varrichio et al. (2012) emphasise the role of synergy in future innovation, i.e. that the future trend in innovation management is to promote and improve performance through the coordination of linkages between research institutions, production sectors and government [7]. Sadegh Rast (2013) used a collaborative approach to assess the assignment of perceptual parameters in five types of universities and research institutions in Malaysia to derive a preliminary framework for influencing performance across parameters [8].

Although the above research results are innovative in multiple aspects, there are still three deficiencies: firstly, the research only pays attention to data of researchers involved in this research, or "full-time equivalent" data, but ignores the value attribute of researchers; secondly, it did not integrate foreign research methods on this subject; thirdly, measurements were selected only fromcolleges and universities in a limited number of provincesor regions, did not draw an overall picture. This paper aims to evaluate the contribution value of scientific and technological talents in Chinese colleges and universities by studying all the relevant data of Chinese universities and colleges throughthe "Cobb-Douglas production function method".

2. CONFIRMATION OF EDUCATIONAL TALENT CONTRIBUTION AND SCIENTIFIC RESEARCH CONTRIBUTION VALUE

2.1. The Determination of Contribution Rate of Educational Talents

The scientific research talents in universities are the talents in higher education industry. The contribution rate of educational talents is contribution from the human resource in education industry, and normally adopt the Douglas production function method.

The calculation formula is as follows:

$$GDP = A(t) L^{\alpha} K^{\beta} \mu$$

In the formula, *GDP* is the added value of education industry; *A(t)* is the comprehensive technical level, and *L* originally meant the number of labors invested (the unit is ten thousand person or person), which is often reflected with the total wages by later generations, but this paper uses the total wages in the education industry to reflect; *K* is the invested capital, including fixed capital and working capital, which is reflected with the "gross capital formation" in GDP calculated by expenditure method; α is the elasticity coefficient of labor output, β is the elasticity coefficient of capital output, and μ represents the influence of random interference. When $\mu = 1$, β is the complement of α.

When the above formula is applied, take the logarithm on both sides, and get:

$$LnGDP=LnA(t)+\alpha LnK+\beta LnL$$

See Table 1 for the application of "Cobb-Douglas Production Function Method" in China's education industry from 2004 to 2017:

Table 1 Application of "Cobb-Douglas Production Function Method" in China's Education Industry from 2004 to 2017

year	Added value of education industry (100 million yuan)	Growth rate of added value of education industry	Capital formation rate in GDP under national expenditure method	Capital formation amount calculated by education industry (100 million yuan)	Total wages of education industry (100 million yuan)	Growth rate of total wages in education industry	Output elasticity of educational talents	Contribute index of educational talents
	1	2	3	4=2×3	5	6	7	8=7×6÷1
2004	4892.6		42.70%		2346.2			
2005	5656.3	15.61%	41.00%	2319.1	2690.8	14.69%	0.5521	0.5195
2006	6179.0	9.24%	40.60%	2508.7	3127.8	16.24%	0.5521	0.9703
2007	7286.3	17.92%	41.20%	3002.0	3917.2	25.24%	0.5521	0.7776
2008	8887.5	21.98%	43.20%	3839.4	4556.1	16.31%	0.5521	0.4098
2009	10481.8	17.94%	46.30%	4853.1	5338.6	17.17%	0.5521	0.5286
2010	12042.1	14.89%	47.90%	5768.2	6136.5	14.95%	0.5521	0.5543
2011	14429.4	19.82%	48.00%	6926.1	6938.8	13.07%	0.5521	0.3641
2012	16282.7	12.84%	47.20%	7685.4	7851	13.15%	0.5521	0.5651
2013	18951.4	16.39%	47.30%	8964.0	8721.1	11.08%	0.5521	0.3733
2014	21159.9	11.65%	46.80%	9902.8	9722.5	11.48%	0.5521	0.5440
2015	24253.1	14.62%	44.70%	10841.1	11492.1	18.20%	0.5521	0.6874
2016	26770.4	10.38%	44.10%	11805.7	12787.1	11.27%	0.5521	0.5994
2017	**28329.4▲**	7.02%	44.40%	12720.7	14324.4	12.02%	0.5521	0.9452

Data source: *China Statistical Yearbook* from 2005 to 2018; ▲ Because the *China Statistical Yearbook-2018* did not announce the added value of the education industry.

Using the data in Table 1 to output Douglas production function by using EVIEWS least square method, see the results in Table 2:

Table 2 Output Douglas production function results table by using EVIEWS least square method

Variable	Coefficient	Std. Error	t-Statistic
LnA(t)	0.8172	0.1952	4.1871***
LnK：	0.4405	0.1252	3.5194***
LnL：	0.5521	0.1392	3.9670***
R-squared	0.9973		
Adjusted R-squared	0.9968		
F-statistic	1889.7989		

Note: *, * *, * * * mean significant correlation at the levels of 10%, 5% and 1& respectively (significance coefficients are 0.0019, 0.0055 and 0.0027)

The regression equation obtained from Table 2 is: $LnGDP = 0.8172+0.4405LnK+0.5521LnL$.

The coefficient of *LnL* in the regression equation 0.5521 is "the output elasticity of educational talents", that is, the elasticity coefficient of educational talents (the value reflected by the total wages)

to the GDP of education industry is 0.5521, which is greater than the elasticity coefficient of capital to education industry, which is 0.4405. Fill 0.5521 in the rows of "output elasticity of educational talents" column in Table 1; the formula [9] for calculating the "contribution rate of educational talents" (accurately defined as the "contribution index of educational talents") according to the relevant data in Table 1 and Table 2 is as follows (fill the calculation results in Table 1):

Contribution Index of Educational Talents = Output Elasticity of Educational Talents × Growth Rate of Total Wages in Education Industry ÷ Growth Rate of Added Value in Education Industry

2.2. Determination of the Value of Contribution of Scientific Researchers in Universities

The original meaning of the production function model based on Cobb Douglas is that: the left side of the equation is the output, and the right side of the equation is the amount of capital and labor input (the amount of labor force [10]). The author extends the application of this formula by reducing the amount of labor force and believes that the meaning of the Education Talent Contribution Index is (take the actual data in 2016 as an example): the GDP of the education industry increases by 1%, and the contribution value of education talents increases by 0.5994%. By applying this contribution index to the educational industry scientific researchers (the number of scientific research workforce), he is able to calculate the value of contribution of scientific researchers in educational industry. The formula is as follows:

Value of contribution of scientific researchers in universities = Education Talent Contribution Index x University Researchers

Calculate value of contribution of scientific researchers in universities and fill in Table 3.

Table 3 Measurement of value of contribution of universities researchers in China's education industry 2004-2017.

year	Education Talent Contribution Index	Researchers in higher education (thousands)	Value of contribution of scientific researchers in universities (thousands/person)
	1	2	3=1×2
2005	0.5195	38.7	20.1046
2006	0.9703	42.1	40.8488
2007	0.7776	44.8	34.8343
2008	0.4098	47.8	19.5868
2009	0.5286	50.9	26.9052
2010	0.5543	59.4	32.9271
2011	0.3641	63.2	23.0116
2012	0.5651	67.8	38.3138
2013	0.3733	71.5	26.6928
2014	0.5440	76.3	41.5071
2015	0.6874	83.9	57.6743
2016	0.5994	85.2	51.0693
2017	0.9452	91.4	86.3914

From 2005 to 2017, the contribution value of scientific researchers in Chinese universities has been increasing with the changes of the contribution index of scientific researchers and educational talents, from 201,046 RMB per person in 2005 to 863,914 RMB per person in 2017, with an average annual increase of 12.92%.

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REFERENCES

1. Ye Jing.Research on the construction of science and technology innovation capability and performance evaluation system of talents in higher education institutions--a case study in Henan Province[J]. Science and Technology Information,2017, (20), pp.197-198.
2. Fang LJ, Geng SQ. Evaluation of scientific and technological innovation performance of Ningxia University[J]. Value Engineering,2018, (19), pp.207-209.
3. Yan Jian,ZhangLi,Wang Zhanwu. An empirical study on science and technology performance of universities in the context of innovation drive--a case study of local universities in Beijing[J].China University Science and Technology,2016,(12), pp.38-41.
4. Wang Xiaomeng."Assessment and comparison of science and technology innovation performance of southwest universities during the 12th Five-Year Plan[J]. Science Management Research,2018, (5), pp.66-69.
5. Meng Fanrong,WangHuan,ChenZitao. The impact of science and technology human resources on science and technology innovation performance:a comparison based on firms and university institutions[J]. Science and Technology Management,2017, (9), pp.173-180.
6. Wu Dandan,WangZichen,ZhengShengming.Research on the scientific and technological innovation performance of regional universities based on scale-independence[J].Management Modernization,2016,(4), pp.60-63.
7. Varrichio P., et al. Collaborative Networks and sustainable business: a case study in the Brazilian System of Innovation[J]. Procedia - Social and Behavioral Sciences,2012,52, pp.90-99.
8. SadeghRast, NavidKhabiri, Aslan Amat.Senin.Evaluation Framework for Assessing University-Industry Collaborative Research and Technological Initiative[J]. Procedia - Social and Behavioral Sciences,2012,40, pp.410-416.
9. Dong Jing,ZhuXueyi. Study on the economic pull effect of education factor elasticity[J]. Research on Higher Financial Education,2012, (3), pp.1-4.
10. Hu Xining. Introduction to Contemporary Western Economics (2nd ed.) [M]. Beijing: Party School of the Central Committee of C.P.C, 1998-10:53.