

An Empirical Analysis of the Effect of the Quality of Higher Vocational Education on Economic Growth in Hubei Province

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Abstract: *After more than 40 years of development, higher vocational education in Hubei Province has become an important type of education system. However, many higher vocational colleges in Hubei province pay too much attention to scale expansion, the overall quality of higher vocational education is not high, at the same time, the funding of higher vocational education in Hubei Province is less, and the teachers in higher vocational colleges are in short supply. This paper establishes an economic growth model including the variables of higher vocational education quality and makes an empirical analysis using the data of Hubei province. The results show that the higher vocational education funds, human capital, population, labor productivity and industrial structure promote economic growth in Hubei province, while the ratio of students to teachers in higher vocational education and the income gap between urban and rural areas restrain economic growth. Hubei should increase the investment in higher vocational education to improve the overall benefit of higher vocational education to economic growth; Optimize the structure of teachers in higher vocational colleges and improve the training quality of technical talents; We will accelerate innovation in higher vocational education and promote the construction of high-quality higher vocational colleges with new characteristics.*

Keywords: *Quality of higher vocational education; Economic growth; Empirical analysis*

1. Introduction

After more than 40 years of development, higher vocational education in Hubei Province has become an indispensable type of education system in Hubei Province. The continuous development of higher vocational education in Hubei has met the demand for skilled talents in the economic and social development of Hubei, and the role of higher vocational education in promoting the high-quality development of Hubei has become more prominent. With the deepening of Hubei's economic development, the economic and social transformation and development of Hubei has an increasingly urgent demand for high-quality technical and technical talents, and higher vocational education also needs to shift from scale development to quality improvement. How to study the relationship between the quality of higher vocational education and economic growth in Hubei is of great practical significance for promoting the high-quality development of higher vocational education in Hubei, promoting the connotation development and transformation development of higher vocational colleges in Hubei, strengthening the training of high-quality technical and technical talents in Hubei, and accelerating the construction of modern vocational education system to promote the high-quality economic development in Hubei.

2. Literature review

As for the relationship between higher vocational education and economic growth, scholars at home and abroad have made in-depth studies from the following two aspects. First of all, most scholars have analyzed the relationship between the scale of higher vocational education and economic growth. Liu Xiaoming and Wang Jinming (2011) used Cobb-Douglas production function to calculate the contribution rate of higher vocational education to economic growth in Zhejiang Province^[1]. Wang Lei (2011) put forward a theoretical model of the impact of vocational education on economic growth, and found through empirical test that the development of vocational education can promote economic growth^[2]. Qu Xiaochu and Zhu Xiaoyan (2014) used Denison coefficient method to estimate the contribution rate of vocational education to regional economy in Guangdong and Hunan provinces. Through empirical analysis^[3]. Tang Wenzhong (2015) found that the development of higher vocational

education promoted economic development, but its marginal rate of return was low^[4]. Yang Yong, Ning Rui and Qi Xugao (2016) analyzed the relationship between the scale of higher vocational education and economic growth in China, and the results showed that the scale of higher vocational education is the Granger reason for economic growth^[5]. Zhou Youwen and Zhu Dequan (2017) analyzed the relationship between the scale of higher vocational education and the level of economic development in Chongqing and found that the scale of higher vocational education development in Chongqing is the Granger reason^[6] for the change of the level of economic development in Chongqing. Todosiichuk (2017) found that Russia improved the value output of the working-age labor force by increasing the proportion of higher vocational education in the labor force^[7]. Marks et al. (2017) took the youth labor market in Australia as an object of study and pointed out that the impact of vocational education on the youth labor market output was not as significant as that of undergraduate education^[8]. Yang Ziyang (2020) calculated the contribution rate of vocational education to economic growth based on the Cobb-Douglas production function. Secondly, a few scholars have studied the relationship between the quality of vocational education and economic growth^[9]. Wang Wei (2017) analyzed the impact of vocational education quality on economic growth, and the results showed that external education quality and internal education quality had positive promoting and inhibiting effects on economic output respectively^[10]. Shi Guangjun (2018) analyzed the impact of higher vocational education on economic output and found that high-quality higher vocational education is more valued in the eastern and northeastern regions of China, high-quality and large-scale higher vocational education is more valued in the western region of China, but not in the central region of China^[11]. Based on the research of the above scholars, this paper will establish a model of the effect of higher vocational education quality on economic growth to analyze the impact of higher vocational education quality on economic growth in Hubei province.

3. The empirical test of the effect of higher vocational education quality on economic growth in Hubei Province

Based on the research of the aforementioned scholars, this paper establishes an economic growth model including variables of the quality of higher vocational education to measure the impact of the quality of higher vocational education on economic growth, as shown in formula (1).

$$\ln Y_t = \beta_1 \ln JYJF_t + \beta_2 \ln SSB_t + \beta_3 \ln HC_t + \beta_4 \ln RK_t + \beta_5 \ln WMYCD_t + \beta_6 \ln LDSCL_t + \beta_7 \ln CYJG_t + \beta_8 \ln CXSRCJ_t + C + \varepsilon_t \quad (1)$$

All variables in the model are based on the data of Hubei Province. t in the model represents the year t , $JYJF$ represents the funding variable of higher vocational education in Hubei Province, SSB represents the student-teacher ratio variable of higher vocational education in Hubei Province, HC represents the human capital variable of Hubei Province, RK represents the population variable of Hubei Province, and $WMYCD$ represents the foreign trade dependence variable of Hubei Province. $LDSCL$ represents the variable of labor productivity in Hubei Province, $CYJG$ represents the variable of industrial structure in Hubei Province, $CXSRCJ$ represents the variable of urban-rural income gap in Hubei Province, C represents the constant term and the residual term of the model. ε_t All the variables are based on data from 2005 to 2020.

3.1 Explained variables

In this paper, economic development level is used as the explained variable of the model. Compared with gross domestic product (GDP), per capita GDP can better reflect the macroeconomic growth of a country or region. In this paper, per capita GDP of Hubei Province is used to measure the economic growth level of Hubei Province. The per capita GDP data of Hubei Province is derived from Hubei Statistical Yearbook for 2021.

3.2 Explanatory variables

The quality of higher vocational education reflects the overall level of education presented by higher vocational colleges so that higher vocational education can be accepted and recognized by the public. The measurement methods of higher vocational education quality include the scale of teachers in higher vocational colleges, the ratio of students to teachers and the input in higher vocational education. In this paper, two variables of higher vocational education input and student-to-teacher ratio are introduced into the economic growth model to measure the quality of higher vocational education.

3.2.1 Investment in higher vocational education

The investment in higher vocational education reflects the government's support to higher vocational colleges. In this paper, the educational expenditure of higher vocational colleges in Hubei Province is used to measure the investment in higher vocational education in Hubei Province. The greater the government's investment in higher vocational colleges, the more attention the government attaches to higher vocational education. So as to train talents in all walks of life for regional and national economic development, and then promote regional economic growth. The education expenditure data of vocational colleges in Hubei Province comes from the Statistical Yearbook of China Education Expenditure from 2005 to 2020.

3.2.2 Ratio of students to teachers in higher vocational education

The student-teacher ratio is the ratio between the number of students and the number of full-time teachers in a school, which is the core index of the basic running conditions of higher vocational colleges, and an important index to measure the utilization efficiency of human resources in higher vocational colleges, the allocation of teacher resources and the quality of higher vocational education. The data of the student-teacher ratio in higher vocational colleges in Hubei Province comes from the website of the Ministry of Education.

3.3 Control variables

3.3.1 Human capital

Human capital is the sum of quality factors such as knowledge, skills and physical strength (health status) that have economic value and exist in the human body. Enterprises bring about the spillover effect of human capital by investing in human capital. The external effect of human capital will be transmitted between people and products to improve the productivity of production factors, thus promoting the increase of production returns. The data of human capital stock in Hubei province used in this paper comes from China Human Capital and Labor Economy Research Center of Central University of Finance and Economics.

3.3.2 Population

Population reflects the overall population size of a country or region, and provides a certain number of potential students for higher vocational education. China's population has long been the largest in the world. A large population base is a basic feature of China, and also an important dividend for China's economic construction. A large population base creates a huge consumer group and market size in China, which brings strong consumption power of a country or region, and promotes the sustainable economic development and income level of a country or region. The population data of Hubei Province is derived from Hubei Statistical Yearbook for 2021.

3.3.3 Foreign trade dependence

The degree of foreign trade dependence reflects the degree of dependence of a country or region on international trade, and is used to measure the level of opening-up and external market space of a country or region. In this paper, the ratio of the sum of Hubei's annual imports and exports to GDP is used to measure Hubei's foreign trade dependence. The import and export volume and GDP data of Hubei Province are derived from Hubei Statistical Yearbook for 2021.

3.3.4 Labor productivity

Labor productivity is an important indicator and fundamental measure to measure the level of economic development and productivity development of a country or region. This paper uses the ratio of the output value of the tertiary industry in Hubei province to the number of employees in the tertiary industry to measure the labor productivity of the whole province. The output value of the tertiary industry in Hubei Province and the number of employees in the tertiary industry are derived from Hubei Statistical Yearbook in 2021.

3.3.5 Industrial structure

The industrial structure reflects the production links and proportional relations between the production departments of a country or region's economy. China divides the national economy into primary industry agriculture, secondary industry industry and tertiary industry service industry. In this paper, the ratio of the sum of the output value of the second and third industries of Hubei Province to its GDP is chosen to represent the industrial structure of Hubei Province. The output value and GDP

data of the secondary and tertiary industries of Hubei Province are derived from Hubei Statistical Yearbook in 2021.

3.3.6 Urban-rural income gap

The urban-rural income gap reflects the fairness of national income distribution and has a great impact on regional economic structure, welfare policies and family education decisions. This paper uses the index of relative income gap to measure the urban-rural income gap. Relative income gap refers to the ratio of per capita income of urban residents to that of rural residents. The greater the ratio, the worse the fairness of income distribution and the greater the urban-rural income gap. The per capita income of urban residents and per capita income of rural residents in Hubei Province are measured by disposable income of urban residents and disposable income of rural residents, respectively. The data of disposable income of urban residents and disposable income of rural residents in Hubei Province are derived from Hubei Statistical Yearbook from 2006 to 2021.

3.4 Regression results

In this paper, Eviews 11.0 software is used to estimate the model shown in formula (1) by ordinary least square method to analyze the effect of the quality of higher vocational education on economic growth in Hubei province. Meanwhile, the multicollinearity problem among the independent variables of the model is tested by variance expansion coefficient method. The results are shown in Table 1. The regression results of the higher vocational education funds and labor productivity in Hubei province are significant, while the regression results of the independent variables such as the ratio of students to teachers in higher vocational education in Hubei Province, human capital, population, foreign trade dependence, industrial structure and urban-rural income gap are not significant. At the same time, the VIF value of all the independent variables is greater than 10, which indicates that there is a serious polycollinearity problem among these independent variables.

Table 1: Results of least square method estimation

	Model 1		
	Regression Coefficient	t statistic	VIF
lnjyif	0.110**	2.470	63.457
lnssb	0.099	0.533	14.313
lnhc	0.037	0.255	434.822
lnrk	2.861	1.079	50.812
wmycd	0.003	0.359	10.616
lnldscl	0.868***	4.926	1053.631
cyjg	0.012	0.977	75.480
cxsrej	0.071	1.173	21.389
Constant term	52.579	1.049	
R ²	1		
F statistic	4371.830		
DW Statistics	2.156		

Note: *, ** and *** indicate passing the significance test at the significance level of 10%, 5% and 1% respectively.

If there is a multicollinearity problem with the model, the estimates derived from the ordinary least square method are no longer applicable. In this paper, Ridge regression estimation method is used to overcome the multicollinearity problem among independent variables. Before the ridge regression analysis, the ridge trace map should be combined to confirm the values, as shown in Figure 1. Let k be set from 0 to 1, and the step size is 0.01. In this paper, kSPSS 19.0 software is used to make the model ridge trace map including the standardized regression coefficients corresponding to different values. When $k=0.01$, the regression coefficients of independent variables such as higher vocational education funding, higher vocational education student-teacher ratio, human capital, population, foreign trade dependence, labor productivity, industrial structure and urban-rural income gap tend to be stable, so $k=0.01$. Then, when $k=0.01$, this paper uses SPSS 19.0 software to perform ridge regression estimation on the model shown in formula (1), and the results are shown in Table 2. Table 2 provides the non-standardized coefficient, standardized coefficient, standard deviation and t statistic value of all independent variables. The regression coefficients of 6 independent variables in the model are not significant. In the results of Ridge regression estimation, in addition to the regression coefficients of

foreign trade dependence, the regression coefficients of higher vocational education funds, the ratio of students to teachers in higher vocational education, human capital, population, labor productivity, industrial structure and urban-rural income gap are relatively significant, indicating that the estimation results of the Ridge regression model are effective.

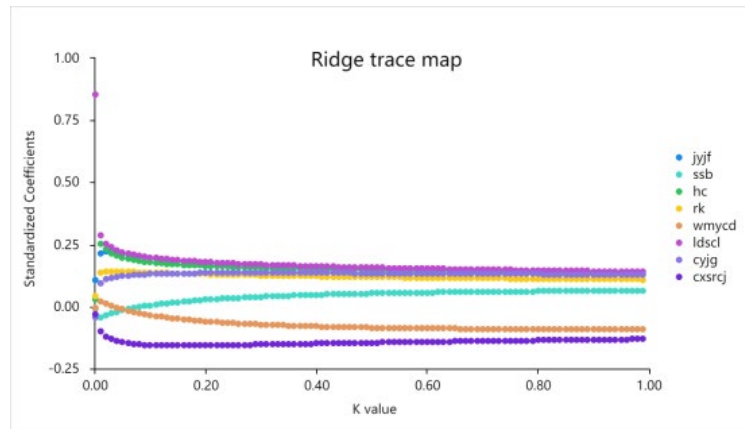


Figure 1: Ling-trace map

Table 2: Results of Ling regression estimation

	Model 1			
	Non-normalized Coefficient	Standard deviation	Coefficient of standardization	t statistic
lnyjyf	0.225***	0.040	0.216	5.565
lnssb	0.419	0.156	0.045	2.691
lnhc	0.332***	0.048	0.253	6.866
lnrk	9.499***	1.444	0.137	6.579
wmycd	0.008	0.008	0.020	0.986
lnldscl	0.293***	0.026	0.289	11.120
cyjg	0.024*	0.010	0.093	2.318
cxsrcj	0.240	0.077	0.099	3.140
Constant term	178.470	25.284	0	7.059
R ²	0.999			
F statistic	1286.201			

Note: *, ** and *** indicate passing the significance test at the significance level of 10%, 5% and 1% respectively.

According to the Ridge regression estimation results of Model 1 shown in Table 2, independent variables such as higher vocational education funding, human capital, population, labor productivity and industrial structure are positively correlated with the explained variables, while independent variables such as higher vocational education student-teacher ratio and urban-rural income gap are negatively correlated with the explained variables. According to the regression results of explanatory variables, when other independent variables remain unchanged, the per capita GDP of Hubei Province will increase by 0.225% when the higher vocational education funding increases by 1%, which also indicates that increasing the investment in higher vocational education has a significant promoting effect on the economic growth of Hubei Province. Increasing the investment in higher vocational education funds is helpful for higher vocational colleges to increase the hardware facilities such as theoretical and practical teaching equipment, improve the working environment of teachers and students in higher vocational colleges, constantly improve the course teaching content and teaching methods, improve teachers' classroom teaching efficiency, enhance labor production efficiency, and promote the economic growth of Hubei province; On the other hand, increasing the investment in higher vocational education funds is helpful for higher vocational colleges to attract and train high-quality teachers and build excellent teaching teams. Increasing the investment in higher vocational education funds is also conducive to increasing the distribution of student subsidies and the coverage of scholarships, and improving the enthusiasm of students in higher vocational colleges. At the same time, when other independent variables remain unchanged and the ratio of students to teachers in higher vocational education in Hubei Province decreases by 1%, the per capita GDP will increase by 0.419%. The ratio of students to teachers in higher vocational education is the main factor affecting the level of

economic development in Hubei Province. Reducing the ratio of students to teachers in higher vocational colleges, strengthening the teaching staff of higher vocational colleges and expanding the teaching staff of higher vocational colleges are conducive to creating an education and teaching environment conducive to the interaction between teachers and students in higher vocational colleges. The quality of higher vocational education directly reflects the technical level of talent training in higher vocational colleges. Increasing the investment in higher vocational education and reducing the ratio of students to teachers in higher vocational colleges can improve the quality of higher vocational education, which is conducive to improving the overall quality of human capital in Hubei province, and then improving the production efficiency of laborers, promoting the optimization, transformation and upgrading of industrial structure in Hubei Province, and promoting the economic growth of Hubei Province.

4. Policy suggestions

Since increasing the investment in higher vocational education and reducing the student-teacher ratio of higher vocational colleges can improve the quality of higher vocational education and then promote the economic development of Hubei province, based on the analysis of this paper, the author believes that to further promote the economic growth of Hubei Province, we should start from the following aspects.

4.1 Increase the investment in higher vocational education and improve the overall benefit of higher vocational education to economic growth

Hubei should continue to increase the funding of higher vocational education, and give play to the promoting role of higher vocational education funding on economic growth. Hubei should increase the proportion of higher vocational education funds in GDP and the proportion of higher vocational education funds in education funds, so as to enhance the overall benefit of higher vocational education to the economic development of Hubei. Hubei should explore the way of issuing special bonds for financing of higher vocational education projects to strengthen the infrastructure construction of higher vocational colleges, and support the projects of talent introduction and practical training platform construction of higher vocational colleges through provincial special funds, and guide the industry enterprises to participate in the education of higher vocational colleges through the integration of industry and education, so as to improve the financing ability of higher vocational colleges.

While increasing the investment in higher vocational education, Hubei Province should also encourage higher vocational colleges to raise funds in a diversified way and increase the funds for running schools to improve the quality of running schools. Hubei should set up a cooperation platform for the government, higher vocational colleges, enterprises and social organizations, improve the diversified financing mechanism, increase the investment in higher vocational education in Hubei, explore the shareholding system and mixed ownership mode to make up for the lack of government financial investment, and broaden the sources of funding for higher vocational education in Hubei. Hubei should continue to improve the conditions of higher vocational education, optimize the structure of the teaching staff, improve the quality of talent training, quality of higher vocational education and efficiency of running the school, train talents suitable for the needs of economic and social development of Hubei, promote regional economic development, so as to promote the coupling of higher vocational education and economic development in Hubei.

4.2 Optimize the structure of teachers in higher vocational colleges and improve the training quality of technical skills talents

Hubei higher vocational colleges should constantly strengthen the connotation construction, adjust and optimize the professional structure, and promote the construction of a high-quality modern higher vocational education system in Hubei. On the premise of ensuring the number of students, Hubei higher vocational colleges should introduce high-quality teacher resources and pay attention to the continuous training of teachers, so as to increase the number of full-time teachers and reduce the student-teacher ratio to meet the needs of students. Hubei higher vocational colleges should encourage higher vocational colleges to promote school-enterprise cooperation and promote the construction of "double-qualified" teachers. Higher vocational colleges can introduce high-level skilled talents from enterprises by introducing experts in engineering, management or skills as full-time or part-time teachers. Schools should also send teachers to participate in the production and research and

development practice of enterprises and guide students to complete the internship in enterprises. In order to make the professional offering and course content of higher vocational colleges meet the needs of enterprises; Vocational colleges in Hubei should establish a full-time teacher skill training system to enhance the comprehensive quality of teachers and improve the quality of vocational education in Hubei.

Hubei higher vocational colleges should focus on students' professional quality, focus on the theme of constantly improving the quality of training technical and skilled talents, closely combine production practice with classroom teaching, promote school-enterprise cooperation to achieve deep and boundary-free integration, and rely on information technology to promote the conformal development of higher vocational education, so that students can develop in an all-round way. Hubei higher vocational colleges should adjust the personnel training mode and professional setting in time according to the changes of market economy, revise the quality standards of students' personnel training according to the development trend of market technology, and adjust the professional setting of higher vocational colleges in time according to the changes of market industrial structure, so as to integrate higher vocational colleges with market economy and better realize the promoting role of higher vocational education on economic growth.

4.3 Accelerate the innovation of higher vocational education and promote the construction of high quality and new characteristics higher vocational colleges

Hubei higher vocational education should highlight the types and characteristics of higher vocational education, make overall plans and integrate resources, optimize the structure and layout, constantly bring forth new ideas in personnel training mode, school-running philosophy and methods, management mechanism and security system, effectively enhance the adaptability of higher vocational education, and train more high-quality and skilled talents needed by Hubei's economic development. To provide powerful talents and skills support for Hubei to speed up the construction of a new development pattern of the pilot zone and fulcrum, walk in the forefront, and compose a new chapter.

The higher vocational colleges in Hubei should deepen the reform, pay attention to the high-quality development of higher vocational education, adjust and rationalize the management system of higher vocational colleges, actively integrate the resources of higher vocational education, and promote the construction of the spatial layout of higher vocational education that is compatible with the regional development layout of "one main lead, two wings driven and the whole area coordinated" in Hubei. Hubei should give priority to building a group of high-level higher vocational colleges with distinctive characteristics, vigorously implement the plan for the construction of high-level higher vocational colleges and majors, build technical talent training highlands and innovation and entrepreneurship service platforms, constantly improve the quality of talent training in higher vocational colleges, and focus on cultivating high-quality and skilled talents to serve Hubei's economic and social development. And focus on serving the technology research and development and product upgrading of small, medium and micro enterprises in Hubei. Hubei should promote the construction of national demonstration higher vocational colleges, constantly innovate the mode of running higher vocational education, explore group running, cooperative running and joint-stock running, strengthen the cooperation between higher vocational colleges and enterprises, between higher vocational colleges and higher vocational colleges, and between higher vocational colleges and scientific research institutions, achieve complementarity in professional personnel training, and promote the continuous improvement of the quality of higher vocational education in Hubei.

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