Is the Optimization of Human Capital Structure Improving the Quality of China's Economic Growth?

Hongxia Zhang, Tianhui Wang*, Yue Wang and Yuge Zhang

Department of Practical Economics, University of Shandong University of Technology, Faculty of Economics, Faculty of Economics of Shandong University of Technology, No.88 Gongqingtuanxi Road, Zhangdian District, Zibo City, Shandong Province, China.

*Corresponding Author’s Email: wth1085189181@126.com

Abstract. Using the 1996-2016 Chinese provincial panel data to measure and analyze the human capital structure and total factor productivity, and empirically examines the impact of human capital structure on high-quality economic growth. The results show that the human capital of higher education promotes the high-quality growth of the economy more significantly, while the human capital of secondary education plays a significant inhibiting role. The heterogeneity study from three regions further shows that the impact of different levels of human capital on the high-quality economic growth of different regions is different. The higher education human capital has a greater role in promoting the high-quality economic growth of the three regions. Basic and secondary education human capital only affects the eastern region.

1. Introduction

As China's economy has entered a normal development, it has become an inevitable choice to switch from high-speed growth to high-quality growth. Among them, improving total factor productivity, including labor productivity, which is the main means to ensure the quality of China's economic growth (Jiguo Yang and Dongbo Zhu, 2018) [1]. In fact, the improvement of labor productivity can be achieved by three approaches, like replacing capital with labor, improving total factor productivity which be considered as labor productivity, and improving the level of human capital. Among them, the improvement of human capital is the foundation and guarantee of the former two. The simultaneous development of the optimization of human capital structure and economic growth is a typical feature of China's economic growth. With the implementation of a policy which is universities start to enroll more students, the proportion of human capital in higher education is rising, it has up to 19.4% from 3.8% during the nineteen years. These changes fully reflect the continuous optimization of China's human capital structure. But the more important thing needs to think about is whether the optimization of human capital structure can promote high-quality economic growth. Researching the issue will help to further understand the role of human capital in the process of improving the quality of economic growth, and provide a useful reference for related policy formulation.

Many scholars have done in-depth research on the relationship between human capital and economic growth. Many scholars show that the improvement of human capital can stimulate the innovation vitality of enterprises, increase the added value of enterprises, promote social employment, and finally promote economic growth, like Barro(1991) [2] and Mingyong, Lai(2005) [3] etc. Other scholars have studied the relationship between human capital and total factor productivity. Benhabib & Spiegèd’s (1994) [4] research thinks that human capital plays direct and significant role in promoting total factor productivity. Jianxin, Wu and Dexue, Liu(2010) [5] studied the impact of human capital
and R & D on China's technological progress, and argued that human capital of higher education can significantly promote technological progress. However, some scholars have inconsistent research conclusions. Vandenbussche et al. (2006) [6] found that the different levels of total factor productivity will impact human capital, and the influence is heterogeneous, then higher-educated human capital has a more significant role in promoting TFP than other human capital. Looking at the related literature, most scholars have done in-depth research from the perspective of the relationship between human capital level, economic growth or total factor productivity. Few scholars have deeply analyzed its relationship with economic growth, especially high-quality growth, from the perspective of human capital structure. Based on this, this article takes the basic education, the secondary education, and the higher education as the measurement indicators of human capital structure, and takes the total factor productivity as the proxy indicator of high-quality economic growth to further test the relationship between the optimization of human capital structure and the quality of economic growth.

2. Variable Selection and Data Description

2.1. Explained Variable
This article uses the total factor productivity (TFP) to represent the quality of economic growth, and uses the Malmquist index based on data envelopment analysis (DEA) to measure the total factor productivity of each province in China.

2.2. Main Explanatory Variable
Based on the method of Guohua, Peng (2007) [7], this paper takes the years of education of workers as the main indicator of human capital structure and divides them into human capital for basic education, human capital for secondary education, and human capital for higher education.

2.2.1. Human capital stock. The human capital stock from 1996 to 2016 was measured through the method of per capita education years, higher human capital stock means more years of per capita education, and the calculation formula is as follows:

\[ \text{Human capital stock (Hc)} = \text{Proportion of never going to primary school} \times 0 + \text{Proportion of primary school population} \times 6 + \text{Population proportion in junior high school} \times 9 + \text{Proportion of high school population} \times 12 + \text{Proportion of population above university (College + Bachelor + Graduate)} \times 16. \]

2.2.2. Human capital structure. Because different levels of human capital have different effects on the quality of economic growth, this article divides human capital into three level to reflect human capital structures: basic education human capital (R), secondary education human capital (S), and higher education human capital (H). Scholars generally believe that the education level of the labor force includes three categories: primary school, secondary school (including junior high school and high school), and university (junior college and above). Years. And set the years of education as 6 years, 6 years (3 years in junior high school, 3 years in high school), 3.5 years. However, considering that the number of years of education at the university and above is more than 3.5 years, this article sets the education period of colleges, undergraduates and graduates to 3 years, 4 years and 3 years, and the next is to measure the human capital of higher education. The specific measurement formula is as follows:

- Human capital in basic education (R) = Proportion of primary school population \times 6
- Human Capital in Secondary Education (S) = Population proportion in junior high school \times 3 + Proportion of high school population \times 3
- Human capital in higher Education (H) = Proportion of University college population \times 3 + Proportion of Undergraduate population \times 4 + Proportion of Graduate population \times 3

2.3. Control Variable
Gov (Government size): This article uses the ratio of government fiscal expenditure of every province to every province’s GDP to indicate the size of the government. Infra (Infrastructure level): This article refers to the method of Shujie, Yao (2006) [8] and others, and expresses the level of infrastructure by the ratio of highway mileage of the whole country and every province to the geographical area of the
The level of imports and exports: This article expresses the level of imports and exports by the ratio of total imports and exports to GDP of the whole country and every province. The above-mentioned data are mainly obtained through the official website of the National Bureau of Statistics of China, the official websites of the provincial bureaus of statistics, and the China Labor Statistics Yearbook.

3. Inspection and Result Analysis

3.1. Model Settings
In order to test the impact of human capital structure on total factor productivity, the econometric model is constructed in this paper as follows:

\[
\ln TFP_{i,t} = \alpha_0 + \alpha_1 \ln R_{i,t} + \alpha_2 \ln S_{i,t} + \alpha_3 \ln H_{i,t} + \alpha_4 \ln Hc_{i,t} + \alpha_5 \ln X_{i,t} + \mu_i + \epsilon_{i,t} \tag{1}
\]

Among them, \(i\) is the province, \(t\) is the year, \(TFP\) is the total factor productivity, \(R\) is the human capital of primary education, \(S\) is the human capital of secondary education, \(H\) is the human capital of higher education, \(Hc\) is the human capital stock, \(X\) is the control variable, and it is impossible to observe province fixed effects represent random error terms, \(\mu_i\) is the fixed effects of every province which can’t be unobservable and \(\epsilon_{i,t}\) is the random error terms. In order to avoid the problem of pseudo-regression, four methods are used to perform unit root tests on the related variables. The test results show that the variables involved or the first-order variables pass the unit root test. To ensure the validity of the test results, this paper further uses three methods to test the cointegration relationship between variables, including Kao, Pedroni & Westerlund. And the results show that there is a long-term equilibrium relationship between total factor productivity and explanatory and control variables.

3.2. Empirical Results and Analysis

3.2.1. Benchmark regression test. First, the impact of human capital structure on total factor productivity is judged from the overall level. Because the fixed effect estimation method requires the explanatory variables to be exogenous, in order to avoid the problems of endogenous and weak instrumental variables, this paper uses the GMM method to regress. GMM is divided into differential GMM and system GMM. Differential GMM only estimates differential equations, only estimate variables that change with time, and it is easily to be affected by weak instrumental variables and small sample errors. However, the system GMM can estimate horizontal equations and difference equations at the same time. It can not only estimate variables which don’t change with time, but also solve endogenous problems better. To improve the reliability of the regression results, this paper mainly uses the estimation method of system GMM (SYS-GMM) to finish estimation test. And the specific results are shown in Table 1. The second-order sequence-related AR (2) p value of the system GMM test is between 0.69-0.88, and the Sargan test p value is 1, both greater than 0.05. The autocorrelation test and Sargan test results support the assumption that the error term of the estimation equation does not have a second-order sequence correlation and the selection of instrumental variables is reasonable and effective, indicating that the model setting is reasonable.
In order to avoid multiple collinearity among multiple variables, the method of adding control variables one by one is used to test the model, as shown in Table 1. The regression coefficients of total factor productivity (L.\lnTFP) which is the lagging period are all significantly positive at the level of 1%. After adding the control variable, the total factor productivity in the previous period increased by 0.63%, which indicates that the total factor productivity of the previous period has a significant promotion effect on the current total factor productivity. Before introducing the control variables, the impact of higher education human capital (\lnH) on total factor productivity was not significant. Moreover, for every 1% increase in human capital in higher-education, total factor productivity will increase by 0.78%, which shows that after controlling other variables, human capital in higher-education can significantly promote the improvement of total factor productivity and the growth of high-quality economic. The possible reason is that China is not yet a technologically advanced country, and technological progress is mainly achieved by learning and imitating the world's advanced technologies. For the human capital of higher-education, it has got professional education and training in a formal system, and it has a stronger understanding and application ability of new technologies. So, it is the main group to receive advanced technology and finish Dry School, and it is also the main group for scientific and technological innovation activities. In a word, it promotes the effective improvement of the enterprise's total factor productivity and increases the efficiency of the enterprise, and promotes high-quality economic growth (Guohua, Peng 2007) [7]. The regression coefficients of basic education human capital (\lnR) are significant positive at the level of 1%. For
every 1% increase in basic education human capital, total factor productivity increases by 1.38%, which shows that the improvement of human capital in basic education has a significant driving effect on TFP. Human capital stock shows a significant positive impact on total factor productivity. For every 1% increase in human capital stock, total factor productivity increases by 3.50%, which indicates that the human capital stock can effectively promote the improvement of total factor productivity. The human capital of secondary education (lnS) has a negative correlation with total factor productivity. For every 1% increase in human capital in secondary education, total factor productivity decreases by 1.34%.

3.2.2. Regional heterogeneity test. Further, to examine whether the impact of human capital on total factor productivity is heterogeneous in the three regions of east, central, and west, the system GMM method is used to test. The results are shown in Table 2.

| Variables | Eastern region | Middle region | Western region |
|-----------|----------------|---------------|---------------|
| L.lnTFP   | 0.4426***      | 0.6185***     | 0.7236***     |
|           | (3.90)         | (7.60)        | (16.08)       |
| lnR       | 0.0106***      | 0.0078        | -0.0023       |
|           | (4.33)         | (0.47)        | (-0.11)       |
| lnS       | -0.0091***     | 0.0208        | -0.0110       |
|           | (-5.64)        | (0.50)        | (-0.23)       |
| lnH       | 0.0113***      | 0.0424**      | 0.0215***     |
|           | (9.37)         | (2.28)        | (2.05)        |
| lnHc      | 0.0247         | -0.1936       | -0.0528       |
|           | (0.68)         | (-1.58)       | (-0.67)       |
| lngov     | -0.0293**      | -0.0402**     | -0.0167***    |
|           | (-2.22)        | (-2.36)       | (-2.16)       |
| lninfra   | 0.0095*        | 0.0081***     | 0.0053***     |
|           | (1.77)         | (3.19)        | (2.57)        |
| lnie      | 0.0079         | 0.0014        | 0.0017        |
|           | (1.56)         | (0.87)        | (0.94)        |
| Constant  | -0.2709        | 0.9458        | 0.3266        |
|           | (-1.00)        | (1.31)        | (1.19)        |
| Observations | 220            | 160           | 220           |
| Prob >chi2 | 0.0000         | 0.0000        | 0.0000        |
| AR (1) p   | 0.0148         | 0.0220        | 0.0039        |
| AR (2) p   | 0.3062         | 0.5185        | 0.4961        |
| Sargan test p | 1.0000       | 0.0872        | 1.0000        |

Note: The test results are given by stata15.1, *, **, and *** indicate significant levels at 10%, 5%, and 1%, respectively, and the values in parentheses are z values.

It can be seen from Table 2 that the impact of human capital structure on total factor productivity has obvious regional heterogeneity. The regression coefficients of higher-education human capital (LnH) in the eastern, central and western region are all significant positive at the level of 5%. It shows that with the continuous optimization of the human capital structure, higher-education human capital (LnH) in the eastern region, central region and western region have contributed to the improvement of total factor productivity. Among them, it has the greatest promotion effect on the eastern region, followed by the central region, and the smallest in the western region. The possible reason is that the eastern region is an area for the accumulation of human capital in higher-education. Therefore it has a strong ability to absorb and imitate new technologies, while the human capital in higher-education in the central and western regions is relatively scarce. The regression coefficients of human capital for basic education (LnR) and human capital for secondary education (LnS) in the eastern region were
significant positive and negative at the level of 1%, respectively, but had no significant effect on the total factor productivity in the central and western regions. The possible reason is that since the reform and opening up, many preferential policies have been implemented in the eastern region, which is conducive to the formation of industrial clusters in high-tech enterprises. This has not only attracted more human capital of higher-education, but also created employment opportunities which is sample work for human capital who have received basic education. Therefore, human capital of basic education can effectively promote the increase of total factor productivity in the eastern region. In the eastern region, human capital of secondary education has not yet reached the "threshold level" for technological progress, and the promotion of total factor productivity in the eastern region has not yet appeared. Compared with the eastern region, the economic development in the central and western regions is relatively backward, and human capital in basic and secondary education does not play a significant role in driving TFP. So it is more obvious that the effect of higher-education human capital on total factor productivity through technical imitation and technical progress.

The impact of human capital stock (LnHc) on total factor productivity in the eastern, central, and western region are not significant.

4. Conclusions and Policy Recommendations
The test results show that the optimization of human capital structure has improved the quality of China's economic growth, speaking specifically:

- Different levels of human capital have different effects on total factor productivity. The positive driving role of human capital in higher-education is more significant, and human capital in secondary education has a significant inhibitory effect on total factor productivity.
- From the results of the full sample analysis, the government size has a significant inhibitory effect on the improvement of total factor productivity. However, the level of infrastructure, and import and export play a promotional role, which indicates that excessive government intervention hinders the growth of high-quality economic.
- Heterogeneity tests by region shows that the impact of human capital structure on total factor productivity are different in different regions. Human capital of higher-education has significantly promoted the total factor productivity in the eastern, central and western region. The human capital of basic education only has a significant role in promoting the improvement of total factor productivity in the eastern region. Human capital in secondary education only has a significant inhibitory effect on the increase of total factor productivity in the eastern region. And the impact on total factor productivity in the central and western region are not significant.
- China has an imbalance in regional human capital structure, and the human capital stock has not significantly affected the total factor productivity in the eastern, central, and western region.

Based on this, this article makes the following suggestions:

- The key to achieving the growth of high-quality in China's economy is to improve the "quality" rather than "quantity" of human capital which be as a high-level factor of production.
- Reducing the government intervention, exerting fully the regulation function of market, stimulating the vitality of various market players, and improving the efficiency of resource allocation. At the same time, dredging the channels of human capital structure optimization to improve the quality of economic growth, and reducing the inefficient human capital investment caused by resource mismatch.
- Reasonably coordinating the development of education in different regions, especially secondary education, and implementing different junior high school education initiatives according to different situations in various regions. Based on this, consolidating the foundation of quality education, and promote the scientific development of the coordination of regional human capital structure and economic growth.
5. References

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