Hindawi
Advances in Multimedia
Volume 2022, Article ID 6554127, 9 pages
https://doi.org/10.1155/2022/6554127

Research Article

The Relationship between Human Capital and Economic Growth beyond Logarithmic Production Function

Hongmei Geng

Yangzhou Polytechnic Institute, Yangzhou 225127, Jiangsu, China

Correspondence should be addressed to Hongmei Geng; genghm@ypi.edu.cn

Received 13 May 2022; Revised 22 June 2022; Accepted 4 July 2022; Published 8 August 2022

Academic Editor: Qiangyi Li

Copyright © 2022 Hongmei Geng. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

The problem that the relationship between human capital and industrial development goes beyond the logarithmic production function is solved, the needs of human capital's understanding of the economic development process and the lack of understanding of the relationship between human capital and development are met, and the understanding of the relationship between human investment and business development is improved. Based on the new characteristics of industry development and population emergence, this paper adopts a functional model with no further elasticity of logarithmic production, resulting in an empirical analysis of national development observations based on Chinese statistics and beyond logarithmic performance. From 2003 to 2016, 31 finance scholars were interviewed to examine the human capital process of economic development since the new century. The first is to establish a theoretical model of industry development including human capital, operations, and capital resources; the second is to establish human capital assessment tools including education, health, technology, and population migration to determine the accuracy of the measurement system. Then, the main concepts of regression analysis are used to describe the relationships or interrelationships of various factors and the development of an industry. The results show that since the beginning of the new century, my country's human capital generally includes two major themes: "education and scientific research human capital" reflects the well-being of human beings, among which "public human capital" is the main one. Won adopts a two-stage trans-logarithmic calculation and believes that South Korea's strength and capital change one by one, and the elasticity values are 0.78 and −1.42, respectively, when added to the performance. While the growth of the economy has not been separated from the increase of human and capital, the best way is human capital, which means more than population growth.

1. Introduction

Human capital and material capital are the two key power sources of economic growth. There is a substitution effect between them to a certain extent. They rise alternately and spirally, forming the main thrust of economic development. In the long run, capital goods have played an important role in China's economic development, helping China achieve long-term economic growth and become the world's second largest economy [1]. With the emergence of emerging markets, China's economic growth will slow down from the previous double-digit growth to an average high-speed growth of 7%. The importance and rapid pace of economic growth from expansion to positive change become critical. The reorganization of industrial models, global competition, and technological advancements have led to faster industrial growth, which in turn leads to greater demand for human activities. Some studies have pointed out that since the beginning of this century, China's economy and population have entered the "normal path." A remarkable feature of the "population new normal" is the significant improvement of population quality and the substantial growth of human capital stock. Moreover, the population new normal is not only one of the decisive factors for the formation of China's economic new normal but also the basic condition for economic operation under the new normal. Under the new normal, the basic conditions of China's economic development have undergone systematic and profound changes, the number of labor force has decreased, the aging problem has become increasingly serious, and the contribution rate of traditional production factors to economic growth has decreased [2]. Behavioural beliefs hold that human emotions

are caused by certain emotions, while thoughts are caused by human needs. To meet their needs, people must determine the goal of their behavior. People achieve certain goals. Start with a need, take action to achieve a goal, then work to meet that need, and create new needs based on that, making new goals a cycle of human behavior. Need is not only the starting point of this process but also the end point of this process, which is the basis of human behavior. Maslow believes that the need to dominate people's behavior develops from low level to high level. When the needs of low level are met, there will be needs of high level. According to Maslow, the arrangement of the high and low levels of the five needs is shown in Figure 1.

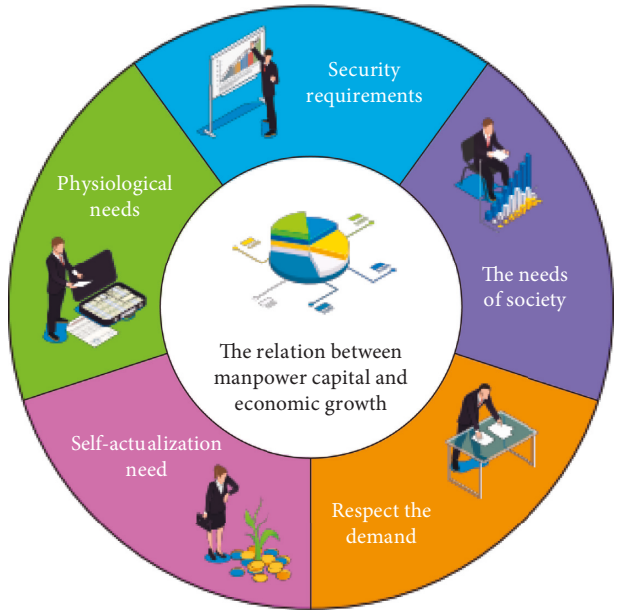

Figure 1: Required hierarchy.

2. Literature Review

Sachdev and others argue that many scientists often explore these two questions by exploring changes in energy and inertia [3]. Salimov and Stefanchuk believe that there are three main interaction relationships between energy and nonenergy factors: substitution, complementarity, and uncertainty; that is, under the same level of economic development, increasing the input of nonenergy factors has three different effects on energy consumption, namely reduction, increase, and uncertainty [4]. Originally, Xiong G. and Xiong J. W. calculated the elastic variation of advantages and disadvantages using a logarithmic numerical system based on the period data of the US industrial economy from 1947 to 1971 [5]. The research results of Al Salmi unanimously show that energy and capital complement each other [6]. At the same time, Oe, based on the cross-sectional data of four types of manufacturing industries in the United States, used two functions beyond logarithmic production and cost to draw the opposite conclusion [7]. Suarez considered that capital, labor, and natural resources replace each other, and the substitution of capital is greater than that of labor [8]. There are several different explanations for the difference: Wood, A. believes that it is due to the different types of data used. Based on the synthetic data of the manufacturing industry in the United States and eight western European countries from 1955 to 1969, using the same model as Berndt, it concludes that energy, capital, and labor are replaced by each other [9]. However, Panpan explained it with the separability and aggregation of production factors and believed that the estimated value of factor substitution elasticity was biased due to factors, such as limited data acquisition, missing variables, nesting, or binding of production factors, and changes in production structure [10]. In recent years, with the development of econometric methods and the continuous continuation of data series, scientists in many countries have used various forms of the econometric industry to conduct more research on strong and weak transitions. Choi and Ha used two force theory models to compare and analyze elastic changes in nine Swedish economies [11]. Among them, the results of the transcendental logarithm function show that there is a complementary relationship between electricity and labor, fossil fuels, and capital. Findings based on Leontief's work in general show that there is no correlation between the aforementioned resources. Ali et al. proposed the combination of energy and capital based on micropanel information of the Danish industrial sector [12].

The International Organization for Industry and Development defines human resources in terms of the knowledge, skills, abilities, and achievements of individuals capable of creating their own health, well-being, and economy, showing that human capital is a clear indicator of job quality. From this perspective, the existing research on the selection of human capital measurement indicators is still not comprehensive enough to comprehensively measure the interaction of internal and external factors in the process of human capital formation and accumulation, as well as the new requirements of the progress of the times on the constituent elements of human capital. In terms of research methods, both C-D function and Solow model assume that output elasticity is a fixed constant, while production factors change dynamically in reality. Output elasticity and substitution elasticity will change accordingly in different periods, and the matching between the theoretical model and real situation is not very good. Based on the above considerations, first, build a human capital measurement index system from the four dimensions of education, health, science and technology, and population migration. Factor analysis was used to refine and classify the indicators; then, the translog production function is used to identify the relationship between capital, human capital, and people and economic growth, compare mutual benefits, and distinguish it from business development alone or in relation to each other, presenting the design and value of the human investment.

In the measurement of human capital, there are great differences in index selection and calculation methods. Some studies divide the structure of human capital from the level of skills or whether there are skills or not, and the level of education. There are also studies that measure the stock of human capital by summing the product of the number of the

labor force at different educational levels and the weight invested to obtain the education, directly summing the sum of the years of education of the labor force, and calculating the average years of education of the labor force. Other studies have expanded the measurement of human capital from a single-scale study to multiple dimensions, such as increased health, wellness, restored appetite, and essential functioning. In terms of research methods, the most commonly used are the Cobb-Douglas production function (C-D function), Solow model or Lucas endogenous model, or principal component model regression.

3. Method

3.1. Theoretical Model. In the analysis of the relationship between human capital and economic growth, the existing research mostly uses the C-D function or Solow model. Solow model is evolved from the C-D function. Both models assume constant coefficients and fixed output elasticity and substitution elasticity. As the values of human capital and economic growth change dynamically, the annual output elasticity and substitution elasticity will change accordingly. Therefore, whether using the C-D function or Solow model to test the contribution of human capital to economic growth has certain limitations [13].

Compared with the C-D function or Solow model, the transcendental logarithmic production function can better fit the data and has the advantages of inclusiveness and easy estimation. It belongs to the square response surface model in structure, which can effectively explore the interaction of various elements in the production function, the elasticity of mutual substitution, and the differences of various input technological progress and improve the reliability of the model to a certain extent. Beyond logarithmic production function not only has the advantages of variable output elasticity and substitution elasticity but also this advantage is more suitable for the analysis of the change of China's economy from high-speed growth to medium and high-speed growth. The transcendental logarithmic production function has been applied in the input-output calculation in different fields. Based on GDP, human capital, labor force, and capital stock, the transcendental logarithmic production function model is constructed to calculate the contribution of various factors to economic growth and its change trend [14]. At the same time, in order to test the threshold effect of capital, labor, and human capital on economic growth and whether the two-to-two effects of the three elements can also play a positive promoting effect, the square term of their variables and the product term of each other are also added to the model. The function expression is shown in the following formula:

$$\begin{aligned} LnY_t = {} & \varepsilon + a_k LnK_t + a_l LnL_t + a_k LnH_t \\ & + a_{kk}\left(LnK_t\right)^2 + a_{ll}\left(LnL_t\right)^2 + a_{hh}\left(LnH_t\right)^2 \\ & + a_{kl} LnK_t LnL_t + a_{kh} LnK_t LnH_t + a_{lh} LnL_t LnH_t, \end{aligned} \tag{1}$$

where Y_t is China's GDP in year t, K_t is the capital stock in year t, L_t is the labor input in year t, HT is the human capital stock in year t, α is the estimated coefficient, and E is the random constant term.

The calculation formula of output elasticity of capital stock is shown in the following formula:

$$\delta k = \frac{dY/Y}{dK/K}. \tag{2}$$

The calculation formula of output elasticity of labor is shown in the following formula:

$$\delta t = \frac{dY/Y}{dL/L}. \tag{3}$$

The calculation formula of output elasticity of human capital is shown in the following formula:

$$\delta k = \frac{dY/Y}{dH/H}. \tag{4}$$

In formulas (2) to (4), the annual capital stock, labor force, and human capital change, so the output elasticity also changes, rather than the fixed output elasticity in the C-D function [15].

The calculation formula of substitution elasticity of capital stock and labor is shown in the following formula:

$$E_{kl} = \left[1 + \left(-a_{kl} + \frac{\delta_k}{\delta_l} a_{ll}\right)\left(\delta_l - \delta_k\right)^{-1}\right]^{-1}. \tag{5}$$

The calculation formula of substitution elasticity of capital stock and human capital is shown in the following formula:

$$E_{kh} = \left[1 + \left(-a_{kh} + \frac{\delta_k}{\delta_h} a_{hh}\right)\left(\delta_h - \delta_k\right)^{-1}\right]^{-1}. \tag{6}$$

The calculation formula of substitution elasticity of labor and human capital is shown in the following formula:

$$E_{lh} = \left[1 + \left(-a_{lh} + \frac{\delta_l}{\delta_h} a_{hh}\right)\left(\delta_h - \delta_l\right)^{-1}\right]^{-1}. \tag{7}$$

Then, the contribution rate of capital investment to economic growth is obtained, as shown in the following formula:

$$Ek = \delta k \frac{\Delta K/K}{\Delta Y/Y}. \tag{8}$$

The contribution rate of labor input to economic growth is shown in the following formula:

$$El = \delta \frac{\Delta L/L}{\Delta Y/Y}. \tag{9}$$

The contribution rate of human capital investment to economic growth is shown in the following formula:

$$Eh = \delta h \frac{\Delta H/H}{\Delta Y/Y}. \tag{10}$$

At present, the method commonly used to calculate the capital stock is the perpetual inventory method; that is, after estimating a base year, the perpetual inventory method is used to calculate the annual capital stock at constant prices. The mathematical expression is shown in the following formula:

$$K_t = k_{t-1}(1 - \delta_t) + I_t. \quad (11)$$

Human capital is composed of knowledge, technology, ability, and good health, which condenses the economic interests of employees and is the premise of excellent employees [16]. In the research on the relationship between human capital and economic development, some focus on the research of human capital, and some focus on the health of human capital, or the integration of education and health, including education, rehabilitation, physical and mental health, and proper operation in the framework of human capital analysis. In the era of knowledge economy, the speed of technological progress and knowledge renewal is becoming faster and faster. The ability of scientific research and technological development plays a more and more important role in measuring the level of human capital in a country or region. Moreover, the investment and accumulation in science and technology cannot be completely measured by the level of education. It reflects the comprehensive and sustainable investment of the government, units, and individuals in science and technology [17]. Therefore, the indicators of the science and technology dimension are also included in the indicator category of human capital. Human capital is measured from the four dimensions of education, health, science and technology, and population migration. Then, the constituent dimensions of human capital are refined and classified through factor analysis, and the change trend of China's human capital stock from 2003 to 2016 is analyzed and compared to test the rationality of the selection of measurement indicators of human capital variables. The demand for a high-quality labor force in the economic era adopts the method of calculating the education years of the labor force by stages and years, and the final results are shown in Tables 1 and 2.

The data of the China Statistical Yearbook from 2003 to 2016 are selected, first, the original data are standardized, and then, Spss19.0 is used for factor analysis of human capital index data. Based on the measured values of the KMO and Bartlett sphericity tests, the data model suitable for the analysis is determined. The human capital index KMO is 0.620, the chi-square approximation of the Bartlett sphericity test is 571.658, the degree of independence is 92, and the critical level is 0.000, indicating that the human capital index is suitable for analysis [18].

Statistical analysis was used to exclude points, and features with an eigenvalue greater than 1 and a result difference greater than 85% were selected as shown in Table 3. There are two cases where the eigenvalue is greater than 1, and the cumulative contribution rate is as high as 92.545%. Both can be extracted, and the matrix components can be obtained by orthogonal rotation as shown in Table 4.

According to formulae (2)–(10), calculate the average annual growth rate, output elasticity, annual benefit, average annual percentage of the industry driven by the industry, and change elasticity from 2003 to 2016 industry as shown in Tables 5, 6 and Figure 2.

Table 1: Human capital measurement indicators.

Primary index	Secondary index
Science and technology	Full-time equivalent of scientific researchers (10000 persons)
	Number of authorized patent applications (10000 pieces)
Population migration	Population dependency ratio (%)
	Proportion of urban population (%)

Table 2: KMO and Bartlett test.

KMO measure		0.620
Bartlett sphericity test	Approx chi-square	571.658
	df	92
	Sig	0.000

Table 3: Interpretation of total variance.

	Extract sum of squares load		
Common factor	Characteristic value	Variance contribution rate (%)	Cumulative variance contribution rate (%)
*Y*1	11.459	81.847	81.847
*Y*2	1.498	10.698	93.545

Table 4: Factor composition matrix.

	Factor	
	1	2
Full-time equivalent of scientific researchers	0.985	0.049
Number of patent applications authorized	0.974	0.212
Population dependency ratio	−0.711	0.652
Proportion of urban population	0.911	−0.034

Based on the transcendental logarithm production function, considering that it is easy to obtain a stationary series by logarithmically processing the time series data, and does not change the characteristics of the time series data, the logarithm of each variable is used in the actual analysis. The VEC model requires that all variables have a long-term cointegration relationship, and the premise of the cointegration relationship is that the time series of all analyzed variables has the same stationary order [19]. Therefore, first, the augmented Dickey fuller method is used to test the stationarity of each variable. The results show that at the significance level of 5%, the four time series of real GDP, total energy consumption, capital stock, and labor force are first-order single integer series. Second, the Johansen method is used to carry out a cointegration test for the above four variables. The results show that at the significance level of 5%, there are three cointegration equations between the four variables, and there is a long-term cointegration relationship between the variables. The prerequisites for VEC

Table 5: Contribution of various factors to economic growth.

	Average annual growth rate (%)	Output elasticity	Contribution rate (%)	Driving economy (%)
Capital stock	13.78	0.348	36.21	4.514
Labor force	0.478	0.556	1.819	0.218
Human capital	16.103	0.315	27.366	4.912

Table 6: Substitution elasticity of various elements.

	Substitution elasticity		
	K/H	K/L	L/H
Mean value	1.025	1.002	1.004

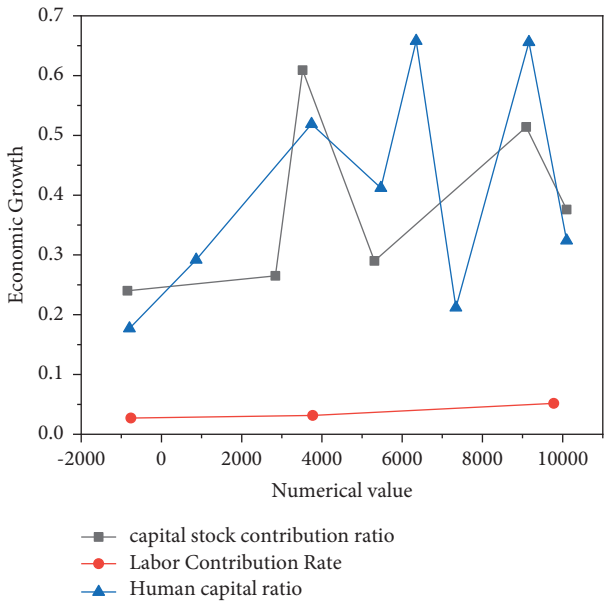

Figure 2: Contribution rate of various factors to economic growth.

model design are met. Meanwhile, according to SiC and SC standards, the recommended market resolution is 2 [20]. The results are shown in Table 7.

As can be seen from Table 7, at the critical level of 5%, our economic growth, energy consumption, and capital investment equations, namely real GDP, electricity consumption, and investment, have significant error correction coefficients. Stocks will dynamically affect variance through early secular variance. Therefore, in the long run, there is a long-term two-way causal relationship between energy consumption and real GDP and capital stock. At the 5% significance level, energy consumption, capital stock, and labor force are the reasons for real GDP, and in the energy consumption equation, real GDP, capital stock, and labor force show strong significance [21]. Therefore, in the short term, there are also two interrelationships between economic growth and electricity consumption, and the exchange of capital and labor, which will have a certain impact on electricity consumption.

3.2. Transcendental Logarithmic Production Function. Since electricity consumption is closely related to industrial development, investment and employment serve as the main factors supporting industrial growth. Changes in elasticity are studied by using electrical equipment production [22]. Additionally, to explore the benefits of tech jobs for industry development, operations beyond logarithms including capital, energy, labor, and technological progress are established, and its function form is shown in the following formula:

$$\mathrm{In}GDP_t = \mathrm{In}a0 + \sum_i ai\mathrm{In}Xi + 0.5\sum_i\sum_j \beta ij\mathrm{In}Xi\mathrm{In}Xj. \quad (12)$$

It can be seen from Table 8 that the coefficient of each difference becomes larger with the actual operation through the significant regression points, eliminating the collinearity problem of the difference. First, from the regression coefficients of capital, labor, energy, and neutral technology, the coefficients of each input factor are positive and decrease in turn [23]. This is consistent with China's extensive economic growth mode relying on the increase of factor input. At the same time, it shows that since the reform and opening up, the contribution share of each input factor in China's rapid economic growth is capital, labor, energy, and neutral technology from large to small. Second, the sum of the direct elasticity coefficients of each input factor to economic growth is shown in formula (13). The sum of the elastic coefficients of the cross action of each input factor is shown in formula (14), which shows that the technological progress in the process of China's economic growth is not Hicks neutral. This is because the scarcity of each input factor and the difference in supply price have different guiding effects on technological progress. Under the action of technological progress, the improvement of production efficiency of each input factor shows the phenomenon of nonequalization as shown in Table 8.

$$\sum ai \neq 1, \quad (13)$$

$$2\beta_{ii} + \sum \beta i_j \neq 0. \quad (14)$$

4. Results and Analysis

Ferguson believes that the change rate of marginal substitution rate between the two input factors over time can be used to measure the technological progress difference

Table 7: Causal test results based on vector error correction model.

Dependent variable	Short-term single independent variable				Long-term t-test
	ΔLnGDP	ΔLnE	ΔLnK	ΔLnL	ECT
ΔLnGDP	—	18.17′	27.65*	8.73*	−5.00
ΔLnE	8.429	—	24.10*	9.48*	−4.779
ΔLnK	6.84*	11.21*	—	2.63	−3.679
ΔLnL	10.17*	2.82	13.33*	—	−0.37

Table 8: Parameter estimates of transcendental logarithm production function based on principal component regression.

Variable	Parameter estimate
Ai	0.00798
Ak	0.11987
aL	0.10478
Ak	0.51475
akl	0.00748

between the two input factors [24]. It is equivalent to the difference in the interaction between factors and time in the output elasticity of each factor. Therefore, the difference in technological progress between the two input factors i and j is shown in formula (15) and Figure 3.

$$Bia_{sij} = \frac{\beta_{it}}{S_t} - \frac{\beta_{jt}}{S_j}. \tag{15}$$

It can be seen from Figure 3 that during the sample period, Biasek > Biasel > 0, and the two decrease year by year. In terms of decreasing speed, Biasek is greater than Biasel [25]. This conclusion shows that since the reform and opening up, China's technological progress is energy intensive. Compared to capital and labor, state-of-the-art technology increases power generation capacity, slowing the demand for energy. However, with the modernization of business models, the shortage of capital and high performance, and the shift from capital technology to weak resources, the technological output of inertial products accelerates, and finally technological improvement. This is in line with the reality of China's economic development. First, a minimum energy consumption is important before retrofitting and opening. On the one hand, in the strategic stage of prioritizing the development of heavy industry, the state invested a lot of money and resources to improve the economy, reducing the shortage of some weak materials. On the other hand, due to historical reasons, China's energy production foundation is weak, and the production facilities, equipment, and scientific and technological level are low, resulting in extremely poor energy exploration, production, processing, and supply capacity [27]. According to statistics, in 1949, China's largest energy producer only had 237 million tons of coal, and more than 90% of the world's oil resources were imported. Second, after the maintenance and opening, the shortage of electrical equipment has been reduced. In order to meet the demand for electricity from the rapid development of my country's economy and improve the supply capacity of power generation, the state has increased capital and scientific and technological investment, built energy production bases, and improved the level of energy production

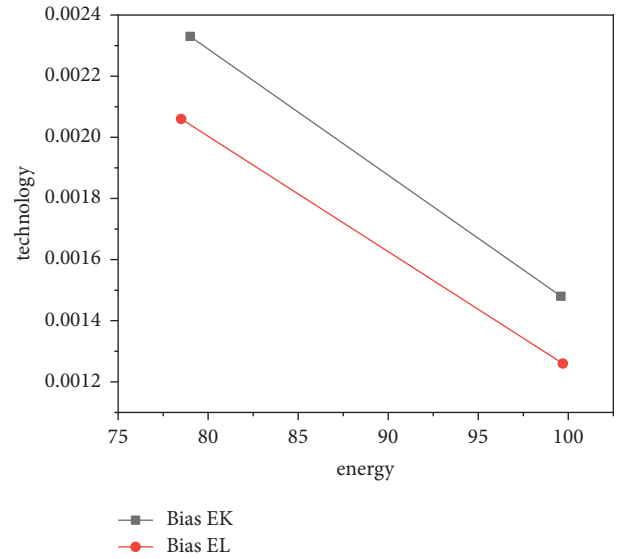

Figure 3: Differences in the technological progress of input factors.

technology. At the same time, reform the management system and management mode of the energy industry, improve the investment environment, relax price control, and gradually carry out energy market-oriented reform, so as to fundamentally change the situation of energy supply and demand [28]. Since the 1990s, the energy "bottleneck" of my country's economic and social development has basically been eliminated. Since then, with the advent of the information economy era, the optimization and upgrading of the industrial structure has put forward higher requirements for the production capacity of various input factors. On the one hand, the rapid development of high-tech industries with computers, biotechnology, and new materials as the main contents has led to a huge demand for "high, precision and advanced" equipment and knowledge-based talents. The investment in science and technology has begun to turn to the field of science and education characterized by new technology research and development and new knowledge learning. On the other hand, with the deterioration of environmental quality and the shortage of primary energy, it is urgent to improve energy efficiency and develop renewable new energy. Finally, the difference in technological progress among various factors is gradually reduced, and the technological progress of factors shows an equalization trend.

An empirical analysis of economic growth in a province is conducted using a transcendental log production function [29]. The results show that the industrial output value, capital stock, labor force, and construction land in a

Table 9: Component score coefficient matrix.

Variable	Factor
Lnk	0.108
Lnl	0.119
Lng	0.119
Lnk2	0.119
Lnl2	0.118
Lng2	0.118
Lnkl	0.118
Lnkg	0.118
Lnlg	0.118

Table 10: Parameter estimates of transcendental logarithm production function based on principal component regression.

Variable	Parameter estimate
C	−2.781
Ak	0.07
Al	0.287
Ag	0.608

province are typical time series, with significant trend and nonstationary characteristics. Nonstationary pseudo-regression of time series has always been a major challenge for traditional econometrics. In order to eliminate the interference of the two, the differential data are implemented as follows: first, in order to avoid the interference of different data, the natural logarithm of all original files is taken, which are recorded as LnY, InK, LnL. The following is the correlation coefficient matrix between variables made with the help of Spss19.0, as shown in Table 9.

From the coefficient matrix, all keypoints can be represented as a combination of several different factors, the job score. All variables are standardized and replaced by the factor score function. Through Eviews analysis, lnY series and D series are tested for ADF stationarity and cointegration as shown in Table 10.

It can be seen from Table 10 that through the key regression points, the coefficient of each variance is consistent with the actual situation of the industry, eliminating the problem of collinearity of the equation. First, from the regression coefficients of capital, labor, land, and neutral technology, the input factor coefficients are positive and decrease in turn. This is consistent with the extensive economic growth mode of a province relying on the increase of factor input. At the same time, it shows that since the reform and opening up, the contribution share of each input factor in the rapid economic growth of a province is capital, labor, land, and neutral technology from large to small. Second, the sum of the direct elasticity coefficient of each input factor to economic growth and the sum of the elasticity coefficient of the cross action of each input factor are shown in formula (16). It shows that in the process of economic growth in a province, technological progress is not Hicks neutral, which is due to the scarcity of various input factors and the difference in supply price, which have different guiding effects on technological progress. Under the effect of technological progress, the improvement of production efficiency of various input factors shows the phenomenon of nonequalization.

$$2\beta_{ii} + \sum \beta i_j \neq 0. \tag{16}$$

5. Conclusion

According to the theory of industry development, the growth of the industry is often driven and influenced by various factors, such as natural resources, capital resources, human resources, human resources, product development, and transformation volume. Among them, capital and human capital are the two most important factors that affect the growth of enterprises. Capital information refers to the long-term sources of equipment, such as machinery, plant, equipment, housing, land, and transportation. Schultz believes that human capital is the physical, intellectual, and intellectual power embodied in people by investing in their capital layer. This is another form of investment that is combined with capital investment to make the country financially viable. From the 1940s to the 1960s, more attention was paid to the role of capital goods and the role of capital in economic development, which led to capital decision-making, arguing that the measurement and balance of capital were the determinants of economic development growth of an industry. Material capital is regarded as the only driving force of modern economic growth. It is believed that economic growth depends entirely on the accumulation of material capital. Some phenomena in the economic growth of industrialized countries after World War II have attracted the attention of economic circles. American economists Schultz and Becker found that human capital played a greater role in economic growth than material capital. The results of these studies have led to an increased awareness of human capital. Human capital policymakers believe that improving skills combined with human capital is the growth of today's economy. With the rapid development of developed countries, human capital plays an increasingly important role in economic development, and the decision of capital goods gradually turns to the ordering of human capital.

It is proved that the empirical analysis of economic growth in a province based on China's statistical data from 2003 to 2016 and beyond logarithmic production function can find the relationship between human capital beyond logarithmic production function and economic growth which is useful. It effectively solves the identification problem of human capital in the process of industrial development and meets the needs of human capital to understand the operation of the industry. A general description of a human capital measurement system is considered. Using the data from 2003 to 2016, the analysis method was used to analyze and classify the indicators, the weight scale was used to calculate the human capital, and the human capital growth graph was drawn and compared with other clinical studies. The results show that all secondary measures permeate the segregated product, and two main points can be ruled out, one is that "education and human research capital" affects the functioning of human capital, and the other is that "public human capital" acts as a scope. However, in the formation of human resources, there is a

significant difference in the proportion of the two main factors, and the proportion of the former is greater than that of the latter. From the perspective of human capital appreciation, after entering the new century, the total stock of human capital in my country is still increasing year by year, which is consistent with the conclusions of existing research. However, the growth of China's human capital stock after the new century shows obvious structural characteristics: before 2012, the growth was above double digits. After 2013, the growth rate fluctuated between double digits and single digits and was less than 10% most of the time. This is consistent with the characteristics of the "new population normal" after China enters the new economic normal, which shows that the constructed human capital measurement index system has good theoretical and practical rationality.

Data Availability

The labeled data set used to support the findings of this study is available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This work was supported by Yangzhou Polytechnic Institute.

References

[1] C. Zhan, M. Huang, X. Yang, and J. Hou, "Mlkl: functions beyond serving as the executioner of necroptosis," *Theranostics*, vol. 11, no. 10, pp. 4759–4769, 2021.

[2] M. Novello and A. E. S. Hartmann, "Beyond the equivalence principle: gravitational magnetic monopoles," *Gravitation and Cosmology*, vol. 27, no. 3, pp. 221–225, 2021.

[3] V. Sachdev, ""Beyond" human enhancement - taking the developing country's perspective seriously," *Asian Bioethics Review*, vol. 14, no. 2, pp. 169–182, 2021.

[4] R. R. Salimov and M. V. Stefanchuk, "Logarithmic asymptotics of the nonlinear cauchy-riemann-beltrami equation," *Ukrainian Mathematical Journal*, vol. 73, no. 3, pp. 463–478, 2021.

[5] G. Xiong and J. W. Xiong, "The logarithmic capacitary minkowski problem for polytopes," *Acta Mathematica Sinica, English Series*, vol. 38, no. 2, pp. 406–418, 2022.

[6] M. R. Al Salmi, S. K. Nadaf, M. D. Mbaga, R. R. Janke, and W. M. Al-Busaidi, "Potential for vegetable production towards food security in arabian peninsula: a case study of Oman," *The Open Agriculture Journal*, vol. 14, no. 1, pp. 43–58, 2020.

[7] K. Oe, "An electrolarynx control method using myoelectric signals from the neck," *Journal of Robotics and Mechatronics*, vol. 33, no. 4, pp. 804–813, 2021.

[8] D. Suarez, "Rhetoric beyond arguments: thinking about the role of fictional audiences in plato's gorgias," *Elenchos*, vol. 41, no. 2, pp. 217–243, 2020.

[9] A. Wood, "Book review: beyond the algorithm: qualitative insights for gig work regulation, by deepa das acevedo," *ILR Review*, vol. 75, no. 2, pp. 518-519, 2022.

[10] F. Panpan, S. I. Jeon, and M. Park, "The effect of political connections on the relationship between stock price crash risk and the quality of accounting earnings: evidence from China," *Korean Management Review*, vol. 49, no. 1, pp. 1–29, 2020.

[11] W. Choi and J. Ha, "The moderating effect of brand image in relationship between service guarantees and repurchase intention: focusing on customers using commercial travel agencies," *Journal of Tourism Management Research*, vol. 25, no. 2, pp. 755–775, 2021.

[12] N. Ali, M. Wahdan, T. Taha, and M. Maher, "The significant relationship between education and cognition among elderly patients at ain shams university hospitals," *The Egyptian Journal of Geriatrics and Gerontology*, vol. 8, no. 1, pp. 1–7, 2021.

[13] M. S. Chun, "The relationship between religious ngos and the government: an analytical approach to korea christian environmental movement solidarity," *Studies in Religion*, vol. 80, no. 1, pp. 119–145, 2020.

[14] J. M. Yun and S. Y. Lee, "The relationship between workplace bullying victimization and displaced aggression: the mediating effects of perceived organizational injustice and state anger," *THE KOREAN JOURNAL OF CULTURE AND SOCIAL ISSUES*, vol. 27, no. 1, pp. 1–18, 2021.

[15] D. Temirbekov, E. Sakallı, and G. Kılıç, "The relationship between the long-term non-rehabilitated benign paroxysmal positional vertigo and vestibular hypofunction," *Medical Bulletin of Haseki*, vol. 59, no. 1, pp. 25–31, 2021.

[16] V. S. Gromov, "Relationship between the social structure and potential reproductive success in muroid rodents (rodentia, myomorpha)," *Biology Bulletin*, vol. 48, no. 10, pp. 1740–1746, 2022.

[17] B. Pu, L. Zhang, Z. Tang, and Y. Qiu, "The relationship between health consciousness and home-based exercise in China during the covid-19 pandemic," *International Journal of Environmental Research and Public Health*, vol. 17, no. 16, p. 5693, 2020.

[18] C. Putra, M. S. Ni, G. Novitasari, and M. Setini, "Management exploring the relationship between social capital, innovation capability and innovation during the coronavirus pandemic," *Uncertain Supply Chain Management*, vol. 8, no. 4, pp. 457–465, 2020.

[19] N. Aida and N. S. Khumairoh, "Causal relationship between economic growth, unemployment, poverty and the impact to human development index (hdi)," *International Journal of Psychosocial Rehabilitation*, vol. 24, no. 03, pp. 71–81, 2020.

[20] M. A. Flynn, E. Cotchett, and L. Lin, "The relationship between men's peer and social media muscularity ideal discrepancies and body satisfaction," *Journal of Social and Personal Relationships*, vol. 37, no. 5, pp. 1534–1553, 2020.

[21] H. Lee and D. Kim, "A study on the relationship between cultural capital and the use of social media: focusing on narcissism, relative deprivation and immersion," *Journal of Communication Science*, vol. 21, no. 1, pp. 153–187, 2021.

[22] G. C. d. O. oNeto, J. M. F. Correia, H. N. P. Tucci, P. C. d. Silva, and D. D. Silva, "Relationship between cleaner production practices and company size in the brazilian textile industry," *Environmental Engineering and Management Journal*, vol. 20, no. 2, pp. 203–216, 2021.

[23] M. Kachouri, B. Salhi, and A. Jarboui, "The impact of gender diversity on the relationship between managerial entrenchment and corporate social responsibility: evidence from UK companies," *Journal of Global Responsibility*, vol. 11, no. 3, pp. 197–217, 2020.

[24] Z. Wei, W. Ruimei, and G. C. Rocheleau, "Confounding bias in the relationship between problem gambling and crime," *Journal of Gambling Studies*, vol. 37, no. 2, pp. 427–444, 2020.
[25] Z. Wei and W. Ruimei, "The relationship between economic growth and agricultural land-use intensity," *Russian Journal of Agricultural and Socio-Economic Sciences*, vol. 107, no. 11, pp. 160–168, 2020.
[26] L. A. Neff, M. E. J. Gleason, E. E. Crockett, and O. Ciftci, "Blame the pandemic: buffering the association between stress and relationship quality during the covid-19 pandemic," *Social Psychological and Personality Science*, vol. 13, no. 2, pp. 522–532, 2022.
[27] H. Parlar, M. Polatcan, and R. Cansoy, "The relationship between social capital and innovativeness climate in schools," *International Journal of Educational Management*, vol. 34, no. 2, pp. 232–244, 2019.
[28] S. J. Pegou and C. Chiatchoua, "The long run relationship between population growth and economic growth: a panel data analysis of 30 of the most populated countries of the world," *PANORAMA ECONÓMICO*, vol. 31, no. 77, pp. 205–218, 2020.
[29] N. T. Ho, N. Thuy, and D. T. Nguyen, "The relationship between foreign direct investment and local economic growth: a case study of binh dinh province, vietnam," *Journal of Asian Finance Economics and Business*, vol. 8, no. 4, pp. 33–42, 2021.