

A Study on the Contribution of Human Capital to Economic Growth of Graduate Students in Xinjiang

Yinhui Zhai¹, Hui Sun^{1,2,*}, Yongfang Dou¹

¹College of Economics and Management, Xinjiang University, Urumqi, China

²Innovation Management Research Center, Xinjiang University, Urumqi, China

*Corresponding author: shuixju@qq.com

Abstract: Based on the Cobb-Douglas production function model, the data of the number of graduate students, physical capital stock, education expenditure and regional gross national product in Xinjiang from 2002-2019 were selected as the basis for calculating the human capital stock of graduate students by using the method of years of education to further analyze the impact of graduate education on economic growth. The results show that postgraduate education in Xinjiang region promotes the national economic growth of Xinjiang region and the contribution rate reaches 0.1360%, and the stock of social physical capital and the investment of the whole society in education funding have a greater role in promoting economic growth. On this basis, relevant countermeasures and suggestions are given for economic development and improving the quality of postgraduate education in Xinjiang region.

Keywords: graduate education, production function, human capital, economic growth

1. Introduction

The economic construction cannot be separated from the national training of various talents, the training of higher talents plays a positive role in the economic development, postgraduate education is a form of education for the training of high-level talents, in 2000 China implemented the western development strategy, and strived to achieve fast and good development in the western economic region, the people's living standards continue to step up to a new level, infrastructure construction continues to develop and improve, and constantly meet the social development and people's On July 15, 2022, General Secretary Xi Jinping came to Xinjiang for inspection and research, during which President Xi highlighted the need for Xinjiang University to strengthen talent training, promote ethnic interaction, highlight advantages and characteristics, build a high-level faculty, and promote This fully reflects the importance that the state attaches to talents, so it is significant to study the contribution of talents and postgraduate education to economic growth. In recent years, the annual number of graduate students has increased significantly compared with the previous years, and it is expected that the number of graduate students will continue to grow in the future. In today's society, graduate degrees have become a common door knocker for companies and enterprises, because for these companies and enterprises, graduate degrees mean the introduction of higher-level talents, and high-level talents are indispensable for the future development of companies. They can bring greater economic benefits. Undergraduate and postgraduate education cultivate innovative talents for national economic and social development, and innovative talents and high-level talents profoundly influence the economic strength and competitiveness of a country in today's fast-changing era. In the economic and social progress and development of northwest China, high-level talents play an important role, and it is because of the relationship between high-level talents and economic and social development promotion that this paper studies the impact of graduate education on economic growth in Xinjiang region, so as to take relevant initiatives to further improve the quality of graduate education, which is of great significance to promote the economic development of Xinjiang region. Based on the overview of previous research results, this paper makes an empirical study of the impact of graduate education on national economic growth in Xinjiang region in the past 18 years.

2. Literature review

Researchers in China have drawn relevant conclusions from studies on the contribution of master's graduate education and doctoral graduate education to economic growth, the contribution of graduate education to economic growth in different regions, and the contribution of graduate education and sub-

graduate education to economic growth, etc. scholars such as Fengliang Li (2021) [1] selected inter-provincial panel data for 2017 and a total of 18 years prior to 2017 for individual provinces in China, and put The contribution of master's graduate education and doctoral graduate education to economic growth is studied in comparison, and the empirical analysis is conducted using the Solow model and Rhodes' endogenous growth model, and the study puts graduate education variables into the research model, and the results find that many provinces have a positive contribution of master's graduate education to economic growth, and there are spatial differences in this effect, with the largest effect in the western region, followed by the central and eastern regions. Li Liguó (2020) and other scholars [2] cited beyond log production function as an econometric model to measure the contribution of graduate education in regional national economic growth, and graduate education was measured using human capital, and the results of the analysis found that the contribution of graduate education human capital to economic growth was the largest in the eastern region and the lowest in the western region among the studied eastern, central and western regions. Liu Xinqiao (2014) [3] conducted an empirical analysis using panel data from 28 provinces, municipalities and autonomous regions in China, using a Solow model that includes human capital accumulation, and found that the expansion of graduate student enrollment and the government and social investment in graduate education have a positive contribution to the growth of China's national economy, and the effects of both can be superimposed. Tao Jun (2011) and other scholars [4] used inter-provincial data of Yunnan Province for a total of 17 years before 2010 to conduct a study, and used a four-factor model of production function based on the Cobb-Douglas production function to conduct an empirical analysis, and the authors divided the human capital of employed people into human capital with graduate degrees and those employed people under graduate degrees The results of the analysis show that the contribution of graduate human capital to the national economy is greater than that of employed people with less than graduate degree in Yunnan Province. Sun Shujun et al [5] calculated the contribution of higher education to regional national economic growth in 31 provinces, municipalities and autonomous regions of China by using the C-D production function to do empirical analysis. There are spatial differences in the positive effect of higher education on national economic growth. Wei Ping et al [6] used panel data of 31 provinces (cities and districts) in China spanning 16 years to construct static panel and spatial Durbin models for empirical analysis. The analysis results show that graduate human capital positively contributes to national economic growth by way of labor factor accumulation and promoting technological progress, but this contribution is smaller than the contribution of physical capital stock to economic growth. Fang Chao [7] used provincial panel data spanning 8 years before 2014 to derive the contribution of graduate human capital to national economic growth, and the results of the study showed that: graduate human capital and spillover effects have a positive contribution to economic growth in China between 1996 and 2013[8-9], and the average annual GDP growth is 8.07% for every one percent increase in graduate human capital. Based on the overview of previous research results, this paper makes an empirical study on the impact of graduate student human capital on national economic growth in Xinjiang region in the past 18 years[10-11].

3. Study design

3.1 Data source and description

Table 1: Time series data

Time	GDP	HC	PC	L	G
2002	100.00	100.00	100.00	100.00	100.00
2003	113.99	146.76	105.42	486.78	97.72
2004	130.72	234.37	111.81	555.77	97.68
2005	152.50	300.28	119.01	1092.87	98.76
2006	178.76	458.59	127.82	438.99	113.39
2007	209.30	632.11	138.44	397.06	113.28
2008	250.40	784.79	150.11	356.74	120.01
2009	262.99	850.99	163.25	378.24	123.17
2010	325.18	946.48	182.02	568.05	125.26
2011	390.27	963.66	203.82	1132.51	127.73
2012	444.02	1147.32	238.41	1034.00	128.57
2013	507.31	1345.07	283.84	1471.89	129.23
2014	565.11	1380.56	338.01	608.47	129.74
2015	573.95	1536.06	392.92	909.68	128.31
2016	601.11	1570.14	441.65	983.04	129.35
2017	695.90	1587.61	502.46	607.52	130.89
2018	810.05	1732.68	569.79	-47.40	130.17
2019	859.06	1871.27	634.48	346.21	129.04

The research data involved in this paper are mainly from Xinjiang Statistical Yearbook, China

Statistical Yearbook, China Population and Employment Statistical Yearbook, China Fixed Asset Investment Statistical Yearbook, China Investment Field Statistical Yearbook and National Bureau of Statistics. Due to the absence of some data in Xinjiang region in 2020 resulting in the absence of values of the studied variables, this paper selects the data of each element from 2002-2019 for the study, calculates the graduate human capital, physical capital stock for each year according to the method of years of education and perpetual inventory, and queries to obtain 18 sample data each of education cost, real GNP, and labor force, taking into account the unit, between the data of each variable The paper takes 2002 as the base period and standardizes the data (the remaining years are the relative values of 2002), and for the convenience of the study expresses total output, physical capital stock, graduate human capital, labor force, and education expenses as GDP, PGDP, PC, HC, L, and E, respectively, and finally obtains the time series data of each factor (Table 1).

3.2 Variable Definition

(1) Explained variables

Total output(Y_t), real GNP calculated by the GDP deflator was chosen as the total output of Xinjiang region in billion yuan.

(2) Explanatory variables

Production technology level(A_t) is set to be a constant, which remains constant over a certain period of time. Workforce(L_t), The labor force growth rate for the selected Xinjiang region is calculated from the economically active population at the end of each year / economically active population at the beginning of the period - 1. Education Funding(G_t), The ratio of regional financial education costs to education costs was chosen to measure. The physical capital stock is calculated using the perpetual inventory method, which is based on the following formula:

$$K_t = K_{t-1}(1 - \delta) + I_t \quad (1)$$

Among them, K_t indicates t physical capital stock for the period, K_{t-1} indicates t-1 physical capital stock for the year, δ represents the capital depreciation rate, I_t is t net investment in fixed assets in the period. In this paper, we refer to the calculation method of Professor Zhang Jun of Xiamen University, and first find the total fixed asset formation and fixed asset investment price index in Xinjiang region from 2002 to 2019, and then use 2002 as the base period for investment price deflator calculation, Depreciation rate (δ) Selected scholars such as Jun Zhang Measured 9.6%, According to the formula (1) Calculations were performed to derive the physical capital stock for the years 2002-2018. Graduate human capital (H_t) is calculated using the years of education method, and according to the calculation method of the years of education method, the education level is divided, and graduate students include master's students and doctoral students, so the years of education method is used to calculate human capital by assigning a weight of 19 for master's students and 23 for doctoral students, so that the corresponding human capital stock (H_t) is the number of graduate students of regional colleges and universities multiplied by the corresponding weight of years.

According to the above division, the human capital stock of graduate students = the number of graduate students in colleges and universities \times 19 + the number of doctoral students in colleges and universities \times 23.

3.3 Model Construction

Cobb Douglas production function is Cobb (C.W. Cobb) and Paul Douglas (Paul H. Douglas) in the study of the relationship between inputs and outputs together to establish a production function research model, the basic equation of this production function is:

$$Y_t = A_t K_t^\alpha L_t^\beta \quad (2)$$

Among them, Y_t 、 A_t 、 K_t 、 L_t denote respectively the total national economy in the time period (GDP)、Social productivity, physical capital stock and labor force, α and β denote the physical capital stock, the elasticity coefficient of labor to national economic growth (1990), Romer Miller and Upadhyay (2002) and others [9] proposed a four-factor model of the production function based on the Cobb Douglas production function:

$$Y_t = A_t K_t^\alpha L_t^\beta H_t^\theta e^\varepsilon \tag{3}$$

Among them, A_t indicates t production technology level in the period, H_t indicates t level of human capital during the period, e^ε is the random error term, θ is the coefficient of elasticity of human capital to the growth of total output, the meaning of Y_t , K_t , L_t is the same as the formula. This paper studies the contribution of graduate education to national economic growth, while the society-wide spending on education has an impact on regional graduate education, and related studies show that education spending has a positive contribution to economic growth, Therefore consider the district education funding(G)Put into equation (2) to get the model:

$$Y_t = A_t K_t^\alpha L_t^\beta H_t^\theta G_t^\gamma e^\varepsilon \tag{4}$$

Taking logarithms for both sides of equation (3), the model becomes
 $\ln Y_t = \ln A_t + \alpha \ln K_t + \beta \ln L_t + \theta \ln H_t + \gamma \ln G_t + \varepsilon$ (5)

Using linear regression equations, the elasticity coefficients of each variable to total output growth can be obtained by bringing the data of each variable into the above model, and it is possible to determine the form of the equation of the above model, so that the contribution of each factor to total output growth can be calculated.

4. Calculation of coefficients and contribution rates of each factor

4.1 Smoothing test

Table 2: Variable stability tests

Variables	Test statistic	5%Critical Value	Smoothness
LnHC	-2.498	-3.600	Unstable
LnGDP	-1.235	-3.600	Unstable
LnPC	1.564	-3.600	Unstable
LnL	-2.538	-3.600	Unstable
LnE	-0.804	-3.600	Unstable

The time series data may have a random trend term or a deterministic term, and the regression model established in this case may have a spurious regression (also known as pseudo-regression), and the smoothness test of the above time series can be well reduced to the regression case. This paper uses the unit root test of smoothness, this method includes DF test, ADF test, because the t-statistic obtained from the regression results will be affected by the irrelevant parameters, so this paper selects the ADF test method which is expanded on the basis of the DF test method to test the time series, the smoothness test of the time series of each element of Table 1, the smoothness results of the first order difference of each variable are shown in Table 2.

According to Equation 4 with both sides of the equation in the logarithmic form of the variables, it can be seen from Table 2 that the variables LnHc, LnGDP, LnPC, LnL, and LnE do not reject the original hypothesis (existence of unit root) at the critical value of five percent, and the time series data of these variables are non-stationary. To further verify the stability and reliability of the research model, the next step is to conduct a cointegration test on the research variables, rely on the regression results to find out the residuals of the regression model, and then use the ADF test to test the smoothness of the found residuals, if the smoothness of the test residual series is smooth, it can indicate that the constructed research model is reliable and true. If the result of the test is non-stationary, it means that the regression model established by the variables has pseudo-regression and the model is unreliable. The results of the test using stata16.0 are shown in Table 2, from which it can be seen that all the tested variables are not smooth.

4.2 Regression equation estimation

The elasticity coefficients of each factor in the regression equation on total output can be obtained by substituting the data of each factor into the research model constructed above, and the results obtained from the regression analysis using Stata 16.0 are shown in Table 3. from Table 3 we can see that the adjusted square of R is 0.9934, and the F-statistic value also passes the test. By conducting cointegration test on the residual series derived from the above unsteady time series, the test result is that the residuals

reject the original hypothesis with 0.55% probability, that is, the residual series is steady, it can be determined that there is cointegration relationship between variables, the regression model is true and reliable, and the regression results of each variable are significant.

Secondly, in order to exclude the existence of multicollinearity in the regression equation, this paper uses the judgment of the size of the variance inflation factor for exclusion, the size of the variance factor affects the coefficient variance of the explanatory variables, the variance factor is too large to make the test difficult to pass, and the following results are obtained by using Stata software to analyze the test as Table 4, from Table 4, it can be seen that the variance inflation factor detected passes the test with a size of 9.37 The test.

Table 3: Model regression results

Variables	Coefficient	Standard deviation	t-statistic	Probability	
LnHc	0.1360	0.0681	2.00	0.069	F-statistic value = 603.99
LnPc	0.6558	0.0475	13.81	0.000	F probability=0.0000
LnL	0.0676	0.0276	2.45	0.031	Adj R-squared=0.9934
LnG	1.5722	0.4274	3.68	0.003	D-W value=1.365571
C	6.6047	1.7580	-3.76	0.003	

Table 4: Variance inflation factors

Variable	VIF	1/VIF
lnhc	19.31	0.051785
lng	12.32	0.081144
lnpc	4.18	0.23895
lnl	1.65	0.606437
Mean VIF	9.37	

4.3 Contribution rate measurement

From Table 3, we can see that graduate human capital (HC) has a contribution to national economic growth with a probability value of 6.9% and the elasticity value of graduate human capital to national economic growth is 0.1360, therefore, the contribution of graduate human capital to national economic growth is 0.1360%, indicating that a 1% increase in graduate human capital will increase the real GNP of Xinjiang region by 0.1360%, and Fengliang Li and other scholars [1] obtained the contribution of graduate education in Xinjiang to economic growth by studying the contribution of the variable of the number of graduate students to provincial economic growth, which is in the sixth place in the country, after Shanxi, Gansu, Ningxia, Shanxi and Qinghai, thus it can be seen that the importance of graduate education in Xinjiang for economic development. Table 3 also shows that the elasticity value of physical capital stock to economic growth is 0.6558, which indicates that for every 1% increase in physical capital stock, the GNP of Xinjiang region will increase by 0.6558%, and the elasticity value of education expenditure to economic growth is 1.5722, which indicates that for every percentage point increase in education expenditure, the GNP of Xinjiang region will increase by 1.5722%.

5. Conclusion

By analyzing and studying the data related to graduate students in Xinjiang from 2002-2019, it is found that graduate education in Xinjiang has a greater contribution to national economic growth, and the contribution of physical capital stock to national economic growth is greater than the contribution of graduate human capital to national economic growth at this stage, and the contribution of education funding to economic growth in Xinjiang region is the greatest.

The above results show that the contribution of physical capital stock and education funding to national economic growth in Xinjiang region is greater than that of graduate human capital, while the contribution of labor force growth rate to economic growth is smaller, and it can be concluded that the source of economic growth in Xinjiang region mainly relies on government and social investment in physical capital in the selected study time frame, so this paper proposes the following suggestions and countermeasures.

First, the contribution rate of education funding in Xinjiang region has been relatively high according to the experience of domestic and foreign data, and Xinjiang region should adjust the structure of human capital education level at the right time, further release the policy dividend, and promote the innovation

drive to enhance the contribution of graduate human capital to a higher level.

Second, Xinjiang region should increase investment in fixed assets, improve infrastructure construction and transportation facilities, and give good environment and conditions to attract high-quality talents for better development of graduate education in Xinjiang region.

Third, the unbalanced development within the Xinjiang region, the big gap between the economic development in the north and south of Xinjiang, the overall economic development level is relatively lagging behind, the reason for this is because of the low regional human capital, the lack of high-quality labor force, unable to adapt to the development needs of modern society, the implementation of 12-year compulsory education in some areas of southern Xinjiang is to improve the local human capital, so the Xinjiang region should strengthen the education and training work, give full play to the advantages of the system. Therefore, Xinjiang region should strengthen education and training, give full play to the advantages of the system, improve human capital in Xinjiang region, and enjoy the great economic benefits brought by high degree of human capital.

Fourth, with the deepening and steady promotion of the western development strategy, the government should set the goal of talent introduction, strengthen the policy support for talents, promote the introduction of talents, and effectively solve the problems of talent settlement and family problems faced by the introduction of talents, etc. At the same time, the government and the relevant departments of society should strengthen the training of talents, so that all kinds of talents can give full play to their advantages and creativity and make full use of them.

Finally, Facing the development of the international situation and the new challenges in the new era of postgraduate education development, Xinjiang should implement the new era of talent training programs and ideas, strengthen the training of innovative capabilities, deepen the adjustment of the discipline system, and focus on cultivating the urgent high-level talents for the development of the country and the region.

References

- [1] Li Fengliang, Wu Fangu, Yuan Chao, Liu Huiqin. *The contribution of master's degree education to provincial economic growth*[J]. *Degree and Master's Studies*, 2021, (04): 64-70.
- [2] Li Liguang and Du Fan. *Research on education development*[J]. *Educational Development Research*, 2020, (21): 28-36.
- [3] Liu Xinqiao. *Analysis of the contribution of graduate education scale and input to regional economic growth-evidence from regional economic growth* [J]. *Journal of Chinese People's Education*, 2015, (01): 138-147
- [4] Tao Jun, Bai Yubing, Wang Hua, Han Chunxiu. *Study on the contribution of graduate education to economic growth in Yunnan Province* [J]. *Journal of Yunnan University of Finance and Economics*, 2011, (04): 149-155
- [5] Sun Shujun and Xu Xiaohui. *An empirical study on the contribution of higher education to regional economic growth in China* [J]. *Higher Agricultural Education*, 2020, (05): 27-34.
- [6] Wei P, Zhou W. *The mechanism of the role of graduate students' human capital on economic growth-an empirical analysis based on the three-dimensional perspective of stock, increment and structure*[J]. *Degree and Graduate Education*, 2011, (11): 16-28
- [7] Fang Chao and Luo Yingzhi. *Research on the impact of graduate education on China's economic growth--and on the spatial mobility of graduate human capital* [J]. *Higher Education Research*, 2017, (02): 52-60
- [8] Li Fengliang and Wang Yuqi. *An empirical study on the impact of graduate education size on economic growth - based on country panel data* [J]. *China Higher Education Research*, 2020, (08): 43-49.
- [9] Miller, Stephen M. & Upadhyay, Mukti P. *Total Factor Productivity and the Convergence Hypothesis* [J]. *Journal of Macroeconomics*, 2002, 24(2): 267- 286.
- [10] Zhang Fengxia. *Energy consumption, human capital accumulation and economic growth in resource-based regions* [J]. *Journal of Statistics*, 2021, (05): 35-48
- [11] Zhang J, Wu GY, Zhang JP. *The mechanism of the role of graduate students' human capital on economic growth-an empirical analysis based on stock, incremental and structural three-dimensional perspectives* [J]. *Interprovincial physical capital stock estimation in China*, 2004, (10): 35-44