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Technological Innovation Study for China Western Ethnic Areas

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ABSTRACT. *Using growth kernel algorithm to analyze the contribution of technological innovation to economic growth, this paper found that: from 2000 to 2016, economic growth in ethnic areas relied mainly on higher inputs. Technological innovations in eight provinces have contributed significantly to economic growth: Ningxia, Qinghai and Guangxi have remained between 50% and 70%, while Guizhou has been negative. Finally, it is proposed that ethnic areas should improve the regional innovation system, Vigorously develop education and promote the optimization of financial environment.*

KEYWORDS: *Technological innovation; Total factor productivity; Ethnic areas*

1. Introduction

Since Schumpeter(1912) proposed that "innovation can promote economic growth", many scholars have studied the relationship between innovation and economic growth. Solow(1956) believed that the main source of economic growth was the accumulation of factor inputs and the improvement of total factor productivity[1], that is, technological progress; some scholars used this framework to study China's economic growth, Yumin Ye(2002)[2], Yu Cheng, Xue Chen (2013)[3],etc., but due to different methods such as model establishment, variable determination, and data processing , some scholars believe that regional economic growth mainly depends on factor input, while others believe it's the capital investment and technology promotion. Jaffe(1989)[4], Feldman(1994)[5] concludes that the regional R&D stock, labor and human capital are the three main determining factors of regional innovation capability. Xiaowan Liu(2017)[6]used spatial econometric analysis to conclude that financial agglomeration has a significant positive impact on regional innovation capabilities. Dongyan Zhang(2017)[7] analyzed the construction of the regional innovation system and the innovation environment in Tibet , and proposed that the Tibet region should focus on improving its innovation capability.

Innovation development is so important that it ranked first among the "Five Development Concepts", and also, the "Notice of the State Council on Printing and Distributing the 13th Five-Year Plan for Promoting the Development of Ethnic Regions and Small Populations" proposed "innovation-driven development" in 2016;

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in the 19th National Congress report, innovation was mentioned more than 50 times, pointing out that innovation is the first driving force for development. Although the regional economy has made certain development under the influence of poverty alleviation policies in recent years, there is still a long way to go for the goal of "a comprehensive well-off society" as the harsh regional environment and fragile economy in western ethnic regions of China. Exploring the status of innovation and development in ethnic areas is of great significance to improving regional innovation level and realizing regional economic development.

At present, there are few researches on innovation in ethnic areas. Due to the unique geographical characteristics and cultural background of ethnic regions, their innovation modes and characteristics are different, this paper uses growth nuclear algorithm to calculate the contribution of technological innovation to economic growth in various regions in order to provide decision-making reference for regional economic growth.

2. The relationship between technological innovation and economic growth in Ethnic Areas

Endogenous growth theory has pointed out that innovation and technological progress are the determinants of regional economic growth, innovation affects technology, and technology promotes regional economic growth. The role of innovation in ethnic areas in economic growth is mainly reflected in the following two aspects:

2.1 The basic way of technological progress in economic growth is achieved through innovation

Innovation drives technological progress, thereby promoting economic growth in ethnic areas; the growth of regional leading industries with distinctive characteristics in ethnic regions is the main manifestation of regional technological innovation to promote economic growth.

2.2 Technological innovation promotes regional development in ethnic areas

First, regional technological innovation can change the status and function of economic factors and enhance their value and competitiveness. Second, technological innovation within the region can guide and transform regional economic growth patterns. The mode of economic growth has shifted from extensive to intensive, and technological innovation is the most important factor. Third, innovation provides new technologies and technical support for traditional enterprises in ethnic areas, which is more conducive to the promotion of innovation results and further becomes a continuous driving force for regional economic growth.

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3. Analysis of the contribution of technological innovation in ethnic regions to economic growth

This section uses the growth kernel algorithm to calculate the impact of technological innovation on economic growth in the eight provinces and regions in the year of 2000-2016; with reference to Lei Wang, Tongliang An(2007)[8], using technological advancement to replace technological innovation for empirical analysis. It is generally believed that the growth rate of technological progress is equal to the growth rate of total factor productivity.

3.1 Model description

Use the Cobb-Douglas production function:

$$Y = A(t)K^{\alpha}L^{\beta} \tag{1}$$

Where Y , K , L , α , β , $A(t)$ means output, capital input, labor input, capital output elasticity, labor output elasticity, input-output efficiency parameters (reflecting technological progress) total factor productivity, respectively. Assume $A(t) = A_0 e^{rt}$, and A_0 for the technical level of the base period, r for the technical progress coefficient of some stage, from Eq. 1 we can get $\frac{\Delta Y}{Y} = \frac{\Delta A}{A} + \alpha\frac{\Delta K}{K} + \beta\frac{\Delta L}{L}$, and $y = a + \alpha k + \beta l$ (the general form of the Solow growth equation), where y, k, l, α denotes the growth rates of output, capital investment, labor input and technological progress, respectively. Then there is

$$a = y - \alpha k - \beta l \tag{2}$$

That means total factor productivity growth rate=output growth rate-capital investment growth rate- labor input growth rate, let $\alpha + \beta = 1$ and perform a natural logarithmic transformation on each variable to eliminate the existence of analysis heteroscedastic does not change the trend relationship between the original variables. we can also get

$$Ln\frac{Y}{L} = LnA_0 + rt + \alpha Ln\frac{K}{L} \tag{3}$$

from Eq. 1, Using the Y, K, L data, the regression can estimate the parameters LnA0, r, a and calculate β.

3.2 Indicators and data selection

This study involved three indicators: *Y* means output, represented by the region's GDP (one hundred million yuan); *K* means capital investment, represented by the regional capital stock (million) per year; *L* means labor input (people), represented

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by the number of employees in the whole society in each province. The annual growth rate of Y, K, L is calculated by the geometric mean method. which is:

$$y = \sqrt[t]{Y_t / Y_0} - 1, k = \sqrt[t]{K_t / K_0} - 1, l = \sqrt[t]{L_t / L_0} - 1 \quad (4)$$

Where Yt, Kt, Lt represents t year's level and Y0, K0, L0 for the levels of the base period. The contribution of technological progress (total factor productivity), capital investment, and labor input to economic growth can be expressed as:

$$Ea=(a/y)*100\% \quad Ek=(ak/y)*100\% \quad El=(\beta l/y)*100\% \quad (5)$$

Through the "New China 60 Years Statistical Data Collection", China Statistical Yearbook, Eight Provinces Statistical Yearbook and the statistical data of the eight provinces and districts , the Y and L values from 2000 to 2016 can be obtained ; for the determination of K value, 2000-2004 reference Jun Zhang (2004) [9] data, data from 2005 to 2016 year calculated according to Zhang's method, which required the investment in fixed assets price index, and we use the retail price index over the same period calculation due to the absence of Tibet. Y and K are converted to the constant price of 1952.

3.3 Results

Using E-views7.0 to regress the data of the eight provinces and regions, the corresponding data of the eight provinces and regions are shown in Table 1:

Table 1 Parameter estimation results

Area	α	β	Area	α	β
Inner Mongolia	0.83	0.17	Tibet	0.30	0.70
Guangxi	0.27	0.73	Qinghai	0.16	0.84
Guizhou	0.92	0.08	Ningxia	0.10	0.90
Yunnan	0.84	0.16	Xinjiang	0.78	0.22

Taking the real output growth, the growth rate of capital stock and labor force growth data from Eq 4, with α, β to Eq.2, we can get the factor productivity growth rate in 2000-2016. From Eq.5, the contribution of capital, labor, and total factor productivity to economic growth can be calculated (shown in Table 2, Fig. 1).

Table 2 Contribution of total factor productivity in eight provinces (unit: %)

Year	Inner Mongolia	Guangxi	Guizhou	Yunnan	Tibet	Qinghai	Ningxia	Xinjiang
2001	18.72	58.27	-73.70	-7.85	68.63	66.95	74.95	-2.99
2002	5.66	62.76	-66.09	5.32	53.86	66.93	75.03	-15.90
2003	-3.75	62.84	-56.20	1.10	44.71	67.18	70.26	-11.39
2004	-11.63	61.44	-43.13	0.90	31.80	69.91	69.14	-7.34
2005	-14.64	58.15	-34.68	-8.46	25.70	71.48	71.36	-8.54
2006	-18.02	56.14	-29.62	-10.57	25.42	70.93	70.55	-9.52
2007	-19.48	56.76	-23.03	-11.00	24.16	69.97	72.65	-5.90

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2008	-20.36	55.96	-23.10	-8.01	23.52	70.53	76.04	-2.09
2009	-22.09	53.12	-21.12	-8.93	24.43	74.29	69.76	-2.83
2010	-23.45	50.52	-20.15	-3.03	24.02	73.91	71.91	-3.26
2011	-23.97	48.96	-18.12	-7.44	23.73	73.82	70.31	-3.05
2012	-25.78	51.84	-19.25	-10.98	21.74	73.10	70.58	-5.92
2013	-28.81	52.33	-21.93	-14.09	23.13	75.36	70.22	-3.74
2014	-29.05	52.57	-24.64	-19.62	33.30	74.02	69.49	-7.70
2015	-28.28	52.60	-27.02	-20.38	26.47	72.72	68.97	-10.77
2016	-26.57	52.57	-29.04	-22.18	27.56	71.96	68.26	-12.51

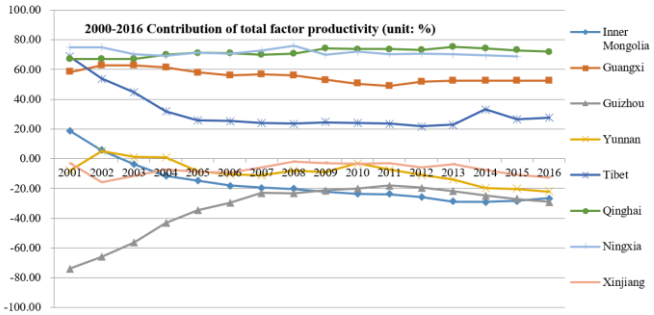

Figure.1 Contribution of total factor productivity in eight ethnic provinces and areas (2000-2016)

3.4 Result analysis

First, there are large differences between regions from the perspective of total factor productivity growth rate. Guangxi, Qinghai, Ningxia maintained at 5%-8%, although Tibet maintained a positive growth rate, but the volatility is relatively large, with maximum at 8.716% in 2001, and then fluctuated between 2% to 3%. Inner Mongolia, Guizhou, Yunnan, and Xinjiang have basically maintained negative growth.

Second, as can be seen from Table 2 and Figure 1,the contribution difference of total factor productivity of the eight provinces and regions was very obvious between 2000 and 2016.In the horizontal direction, Ningxia, Qinghai and Guangxi are basically maintained between 50% and 70% , of which Qinghai gradually grows with occasional small fluctuations; Ningxia and Guangxi show a gradual decline, while Ningxia has gradually kept at 68% in recent years and Guangxi basically maintained at around 52% .Tibet has dropped from 68.63% in the beginning to 23.52% in 2008, and has remained at around 23%.Inner Mongolia and Guizhou basically kept below -20%,and Xinjiang and Yunnan are slightly higher, but both are negative.

Thirdly, the contribution of the labor force is relatively small in the eight provinces and regions between 2000 and 2016; The economic development of ethnic areas is dominated by capital investment and the total factor productivity is low. The

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contribution of total factor productivity in Guangxi, Ningxia and Qinghai is relatively high, but it has gradually shown a downward trend in recent years. Therefore, economic growth in ethnic areas is mainly based on factor inputs on the whole.

4. Suggestions

In order to change the mode of promoting economic growth with factor input in ethnic areas, realize innovation and development, realize the transformation of economic growth mode, it is necessary to rely on the full cooperation of all sectors of society such as vigorously promoting the guidance of government policies, the leadership of innovation, and the active participation of enterprises and individuals.

4.1 Strengthening government guidance, improving regional innovation system

Firstly, government departments should actively promote infrastructure construction, provide material basis for regional innovation; accelerate the construction of innovative intermediary systems, and enable innovative intermediary systems to play a role as a bridge and link in regional innovation. Secondly, formulate corresponding industrial policies, optimize industrial structure, encourage technological innovation, promote the transformation of scientific and technological achievements, and promote the industrialization of scientific and technological achievements. Thirdly, establish and improve the resource property rights system and improve the ecological compensation system, develop more differentiated incentives for SMEs.

4.2 Forming a company-centered technological innovation system

Enterprises are the mainstay of innovation, carrying product innovation, technological innovation, organizational innovation and so on. Enterprises in ethnic areas can formulate development strategies based on their geographical location and industry characteristics. At the same time, focusing on the cultivation and introduction of R&D personnel, forming an innovation support system centered on enterprises and assisted by other institutions. Last but not the least, strengthening investment and rational use of research and development funds.

4.3 Improving regional human capital level

Research shows that talent factors are an important factor affecting innovation. The overall education level in ethnic areas is not high, which has greatly restricted the innovation and development of the region. Therefore, through the policies of finance, taxation, finance, education, etc., we can vigorously develop education, especially secondary education and vocational and technical education, and encourage individuals to deepen their own quality training and improvement

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through various channels, and raise the average human capital level in the region; promoting cooperation between local enterprises and universities and research institutions, and the transformation of scientific research results.

4.4 Building a good financial environment

With the acceleration of regional innovation and development, various financial institutions should innovate service methods, strengthen financial innovation, and play its role as a propeller in regional innovation. In addition to appropriately adjusting the capital market access conditions in ethnic areas, the government can also innovate the financing model for regional development and provide more convenient conditions for enterprises and self-employed individuals in the region. For ethnic areas, financial institutions should innovate on the application of credit funds according to the characteristics of the region, and change their mortgage collateral according to the industrial characteristics and cycle of the ethnic regions, so as to provide more loanable funds for the subjects in need.

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