Study on total factor productivity of forestry in China ——- maquist index based on Data Envelopment Analysis

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Keywords: Total Factor Productivity, Forestry Industry, Technical Efficiency Change.

Abstract: Power load forecasting is very important for power dispatching. Accurate load forecasting is of great significance for saving energy, reducing generating cost and improving social and economic benefits. In order to accurately predict the power load, based on BP neural network theory, combined with the advantages of Clementine in dealing with big data and preventing overfitting, a neural network prediction model for large data is constructed.

1. Introduction

1.2 Forestry industry

Forestry industry is a basic industry with forest resources as processing object. The particularity of the processing object makes the industrial development special (renewable resources, degradable products, industrial community, three-dimensional concept, industrial cluster, primary, secondary and tertiary industry collection). Primary industry: reeding industry, Secondary industry: processing industry, Three industries: Tourism and intermediary services (Ecotourism and intermediary services).

Forestry industry is an important part of the national economy. The development of the national economy and the improvement of people's living standards need forest products. It can meet some or some material needs. This is its natural attribute. More importantly, its social attribute also needs the development of forestry industry. Social attributes have different characteristics due to different times and development stages.

Forestry industry is a sunrise industry (evergreen industry) with broad market space. It is decided by the stage of development, by the characteristics of the times, by building a well-off society in an all-round way, by a circular economy and a conservation oriented society. It is decided by the current situation that consumption is low, import substitution and export-oriented. Forestry industry is an industry that enriches the people, and the key to a well-off society in an all-round way is the well-off society of farmers. According to the national conditions, 69% of the population is in mountainous areas, and 56% of the population is in mountainous areas. The output of forest land is 22 yuan / mu, and that of farmland is 686 yuan / mu.

1.2 The concept of total factor productivity

Total factor productivity is the most important and direct means of growth accounting, and it is an important tool to analyze the source of economic growth. It develops with the development of economic growth theory. It is also different from the national output value accounting system, because the national output value accounting system can be said to account for the quantity of economic growth of a country or region, while the total factor productivity reflects the quality of its growth, and can also explain the contribution of factors to growth. Due to part of the investment

There is mutual substitution between factors. Single factor productivity is not a good indicator of productivity change. Therefore, total factor productivity and its change are usually used to measure productivity level and its change in economic research. By analyzing the contribution of various factors to economic growth, total factor productivity can identify whether the type of economic growth is input-oriented or efficiency oriented.

American economist Solow thinks that TFP is equal to productivity minus labor productivity and capital productivity, that is, TFP is the part of productivity growth that cannot be explained by labor and capital productivity. It is often recorded as Gy = GA + AGL + BGK

Where: Gy -- economic growth rate

GA -- total factor productivity growth rate

GL -- labor growth rate

GK -- capital growth rate

A -- labor share.

Samuelson, Nordhaus and others think that the factor resources considered by TFP include education, innovation, scale efficiency, scientific progress and so on. Total factor productivity is affected by many factors, such as government reform policy, external competition and changes in economic structure, learning effect of enterprises, new technology, new equipment and innovation of products and services. Generally speaking, the growth of TFP is composed of three parts: one is technological progress, such as the adoption of new technology or the invention of new products; the other is technical efficiency, such as the improvement of management efficiency and the accumulation of production experience; the third is scale efficiency.

Theoretically, TFP is the unexplained part of each input factor. With the continuous improvement of research methods, TFP will tend to zero. Therefore, many economists believe that the specific definition of TFP is not important, but how to measure its growth rate and calculate the contribution of TFP growth to economic growth.

2. Total factor productivity of the forestry industry

2.1 Data selection and index selection

The data in this paper mainly comes from China forestry statistical yearbook from 2014 to 2018. For individual missing data, linear interpolation method is used to supplement. In addition, in order to maintain the comparability of data in different years, this paper reduces all monetary data to the constant price level in the base year.

Table 1. descriptive statistics of variables

	(I)Area (10000 HA)	(I)Number of employees	(I)Completed investment (10000 yuan)	(O)Total output value (10000 yuan)
average	984.1368	37081.67	1551886	21680910
Standard error	73.84628	3911.906	162498.3	1642162
median	834.505	23768.5	1084497	14715280
standard deviation	904.4286	47910.87	1990189	20112297
variance	817991	2.3E+09	3.96E+12	4.05E+14
kurtosis	5.048211	14.23076	14.70196	0.332796
skewness	2.033915	3.600163	3.732482	1.052629
region	4491.44	279486	11489032	81442981
minimum	7.73	704	123328	232787
maximum	4499.17	280190	11612360	81675768
Sum	147620.5	5562251	2.33E+08	3.25E+09
observations	150	150	150	150

2.2 Total factor productivity by Region

Table 2 total factor productivity and its decomposition items by Region

Region	Changes in technical efficiency	Technical progress	Pure technical efficiency change	Scale efficiency change	Total factor productivity
Beijing	1.1358	0.9095	1.0948	1.0088	1.1127
Tianjin	1.0560	1.0460	0.9945	1.0503	1.1183
Hebei	0.9260	1.0570	0.9465	0.9790	0.9583
Shanxi	0.9900	1.0760	0.9965	1.0305	1.0473
Inner Mongolia	0.7913	1.0823	1.0738	0.8263	0.8707
Liaoning	0.9683	1.0355	0.9943	0.9808	0.9987
Jilin	0.9108	1.0498	0.9180	0.9865	0.9547
Heilongjiang	0.8933	1.0578	0.9735	0.9080	0.9773
Shanghai	1.0005	0.9180	1.0000	1.0005	0.8907
Jiangsu	1.0213	1.0715	1.0175	1.0403	1.0953
Zhejiang	1.0160	1.0915	1.0000	1.0160	1.1220
Anhui	1.0630	1.0730	1.0615	1.0130	1.1530
Fujian	1.0688	1.0745	1.0533	1.0233	1.1673
Jiangxi	0.9518	1.1930	1.0053	1.0695	1.0527
Shandong	1.0325	1.0225	0.9983	1.0305	1.0497
Henan	1.0870	1.0680	1.0610	1.0148	1.1840
Hubei	1.0548	1.1083	1.0813	1.0165	1.1453
Hunan	1.0168	1.0810	1.0650	0.9765	1.0957
Guangdong	0.9848	1.0608	1.0000	0.9848	1.0810
Guangxi	1.0310	1.0655	1.0483	1.0095	1.0990
Hainan	0.9830	1.0710	1.0528	1.0270	1.1133
Chongqing	1.1643	1.0968	1.1765	1.0310	1.3243
Sichuan	0.9838	1.0890	1.0788	0.9733	1.0647
Guizhou	1.1200	1.2110	1.2158	1.0203	1.3393
Yunnan	0.9813	1.0703	1.0638	0.9228	1.0853
Shaanxi	1.0145	1.0858	1.0498	1.0230	1.0940
Gansu	0.9458	1.0900	1.0115	0.9608	1.0187
Qinghai	0.9570	1.0783	0.9368	1.0468	0.9903
Ningxia	0.9688	1.1120	0.9505	1.1218	1.0090
Xinjiang	0.9615	1.1060	0.9818	0.9950	1.0430
mean	1.0026	1.0717	1.0300	1.0029	1.0752

According to the results in Table 2, the analysis is as follows:

First of all, in terms of total factor productivity, the average of total factor productivity of each region during the sample period is 1.0752, which shows that, on the whole, China's provincial total factor productivity shows a strong growth trend during the sample period, with an average annual growth of 7.52%. Among them, the average annual total factor productivity of 23 regions is greater than 1, showing a positive growth. By region, Guizhou (1.3393), Chongqing (1.3243), Henan (1.184), Fujian (1.1673) and Anhui (1.153) ranked the top five in total factor productivity. It is not difficult to find that the average annual growth rate of total factor productivity in these areas is more than 10%, of which Guizhou and Chongqing have increased by more than 30%. The top five regions with TFP scores were Heilongjiang (0.9773), Hebei (0.9583), Jilin (0.9547), Shanghai (0.8907) and Inner Mongolia (0.8707). The total factor productivity of these regions is less than 1, showing negative growth. It is worth noting that as China's economic and financial center, Shanghai's total factor productivity score is only 0.8907, with an average annual decline of more than 10%.

Secondly, from the decomposition of TFP, the technology progress index is 1.0717, with an average annual growth of 7.17%. The technology progress index is very close to TFP, and its contribution to TFP reaches 95.35%. Among them, Guizhou (1.211), Jiangxi (1.193), Ningxia (1.112), Hubei (1.1083) and Xinjiang (1.106) are the top five regions in the technological progress index. It is not difficult to find that TFP in these areas is also good. On the other hand, the technical efficiency change index is only 1.0026, with an average annual growth of only 0.26%. Although the technical efficiency has been improved slightly in the sample period, it can not support the strong growth of TFP. This also shows that in the sample period, it is the better regional technological progress that supports the growth of TFP, rather than the improvement of technical efficiency.

Finally, from the decomposition of technical efficiency change index, the annual average of pure technical efficiency change index and scale efficiency change index are 1.0300 and 1.0029 respectively.

2.3 Total factor productivity change

Table 3. changes in total factor productivity and its decomposition items2

	2014-2015	2015-2016	2016-2017	2017-2018
Technical efficiency change (TEC)	1.0777	0.9232	1.0865	0.9986
Technical progress (TR)	1.0023	1.1741	1.0056	1.0598
Pure technical efficiency change (PTRC)	1.0473	0.9652	1.0800	1.0436
Scale efficiency change (SEC)	1.0313	0.9715	1.0090	0.9560
Total factor productivity (TFP)	1.0749	1.0782	1.0910	1.0563

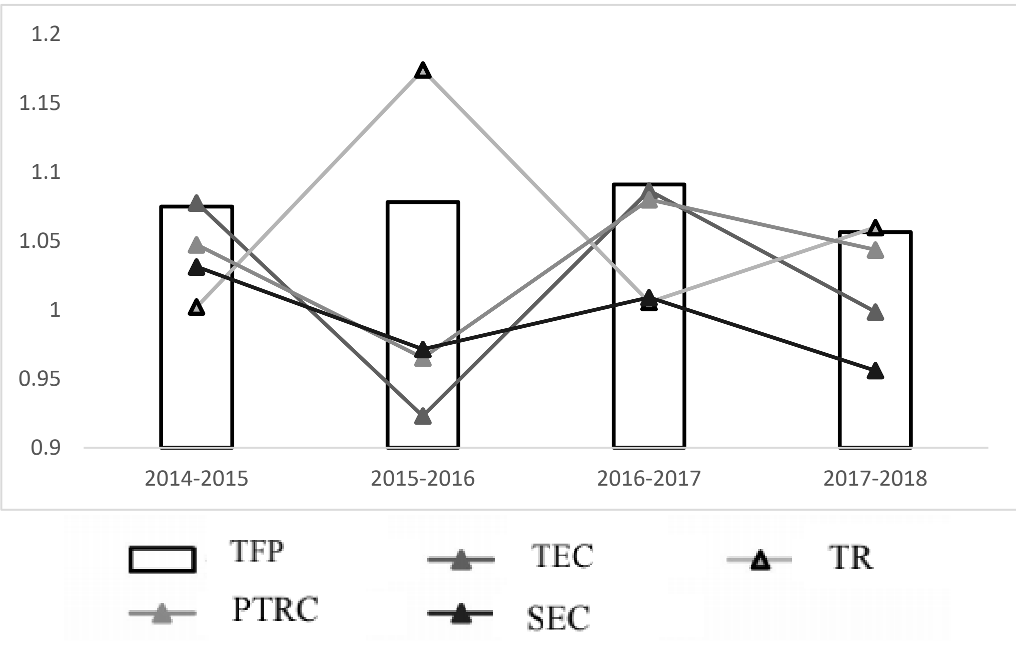

Figure 1. changes in total factor productivity and its decomposition items2

According to table 3 and figure 1, the following analysis is carried out:

First of all, during the sample period, China's provincial total factor productivity showed a strong growth in each period, with the growth range of 5% to 10%. From 2014 to 2017, it showed an increasing trend year by year. Although the growth rate of TFP dropped from 2017 to 2018, it was still higher than 5%, and the performance was very good.

Secondly, technological progress showed a trend of growth first and then decline in the sample period. In the previous paper, we found that although technological progress showed a good growth in the whole sample period, it showed opposite performance in different years. During 2015-2016, its growth rate reached a peak of 1.174, and dropped to the bottom of 0.956 at the end of the sample period, This shows that the fluctuation of technological progress in the sample period is more intense, and policy makers should pay attention to it.

Third, the change trend of technical efficiency, pure technical efficiency and scale efficiency is relatively consistent, showing a fluctuating downward trend as a whole, and the upward trend is not obvious. In particular, these three indexes all fell to the bottom in 2015-2016, and the decline is very obvious. Policy makers should pay attention to the index anomalies in this year.

3. Results

3.1 Analysis of the total factor productivity by region results

According to the results in Table 2, The average value of pure technical efficiency change index is ten times that of scale efficiency change index, showing a good growth trend. Therefore, the weak growth trend of technical efficiency index is attributed to scale efficiency change index, which also shows that during the sample period, all regions do not pay attention to optimizing their own production scale, resulting in a far cry from the target state of scale efficiency, Thus, the technical efficiency change index is lowered, and it is difficult to promote the rapid growth of total factor productivity.

3.2 Analysis of the total factor productivity change results

According to table 3 and figure 1, This shows that the fluctuation of technological progress in the sample period is more intense, and policy makers should pay attention to it.The change trend of technical efficiency, pure technical efficiency and scale efficiency is relatively consistent, showing a fluctuating downward trend as a whole, and the upward trend is not obvious. In particular, these three indexes all fell to the bottom in 2015-2016, and the decline is very obvious. Policy makers should pay attention to the index anomalies in this year.

4. Conclusions

1. During the sample period, TFP showed a strong growth trend, with an average annual growth of 7.52%. Among them, the technical progress index and technical efficiency change index are 1.0717 and 1.0026 respectively, and the corresponding annual growth rates are 7.17% and 0.26% respectively. It can be seen that technological progress, rather than the improvement of technical efficiency, leads and contributes to the growth of TFP.

2. In the decomposition of technical efficiency change index, scale efficiency is obviously weak, with an average annual growth of only 0.29%, which undoubtedly lowers the technical efficiency change index.

3. From the perspective of time evolution, although the total factor productivity keeps a growth rate of 5% - 10% in the sample period, its technological progress index and technical efficiency change index have large fluctuations.

5. Suggestions

Forestry production income is in the stage of increasing returns to scale, when the allocation of various production factors is in an optimal state. An important reason for the low economic benefits of forestry and the poor quality of economic growth in China is that there is no economies of scale, and the narrow scale of forest industry enterprises also hinders the adoption of new production technologies and the transformation of economic growth mode of enterprises. Due to the insufficient role of market mechanism and the simple pursuit of economic development speed by enterprises and localities from their own interests, China's forest industry enterprises generally have the problems of small scale and poor economies of scale. The poor economies of scale, repeated production and construction of forest industry enterprises, on the one hand, cause a large waste of China's scarce forest resources, on the other hand, cause the low economic benefits of forestry enterprises. This situation has seriously restricted the further development of China's forest industry and the sustainable growth of forestry economy. Therefore, in order to change this situation, improve the quality of forestry economic growth and realize the transformation of economic growth mode, we must implement the development strategy of economies of scale, vigorously develop forestry enterprise groups, and encourage and support forest industry enterprises to take the road of competition, annexation and combination to implement large-scale production. Only when enterprises form economies of scale can they ensure the effective utilization of resources, adopt new technologies and improve labor productivity.

From the above analysis, it is not difficult to find that the technical effect of China's forestry still has great potential. Whether it is forestry or forest industry, technological progress is an important factor to promote forestry economic growth. Improving the technical level of forestry is conducive to the improvement of the overall benefits of forestry. The economic growth of western developed countries is achieved by the factors of scientific and technological progress. Technological progress can not only promote economic growth, but also improve the quality of economic growth. Since the founding of the people's Republic of China, especially since the reform and opening up, China's forestry science and technology has made rapid development. Technological progress has made important contributions to the development of China's forestry production and the improvement of forestry economic benefits. Of course, the overall scientific and technological content in China's forestry economic growth is not high, and there are many obstacles in the transformation of forestry scientific and technological achievements into real productivity. Due to the low coverage of promotion, it is difficult to form economies of scale. In addition, the operation mechanism conducive to the promotion of achievements has not been formed, especially the forestry enterprises do not have a deep understanding and awareness of the practical role of scientific and technological progress, and the enterprises lack the necessary financial support and necessary incentive mechanism for the promotion of scientific and technological achievements.

1. Increase scientific and technological innovation, improve management and process efficiency through technology introduction and technology diffusion, and induce technological progress, so as to ultimately promote the growth of total factor productivity. Enterprises scale to expand the industrial area, extend the industrial chain, improve the added value, circular economy, for the primary industry, improve the utilization rate of forest land and the output rate of forest real estate. For the second industry, we should increase the content of high technology.For the tertiary industry, the formation of point, line, surface network

2. Maintain the stability and continuity of the policy, and avoid the drastic fluctuation of technical efficiency and technological progress caused by the fluctuation of the policy. The reform of collective forest right system, the reform of state-owned forest farms, the reform of state-owned forest areas, private is the main force

3. Each region should reasonably set up the industrial scale, which can't make the whole industry bigger and make the industrial returns to scale decrease. On the other hand, it should prevent the phenomenon that the scale is too small to form the brand premium and the returns to scale increase. Based on geographical advantages, based on resource advantages, highlight key points, and make processing park bigger and stronger

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