

Measurement and Difference Analysis of Total Factor Productivity of Strategic Emerging Enterprises in China

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Abstract

Improving the total factor productivity of strategic emerging enterprises is of great significance for promoting the optimization and upgrading of the industrial structure and achieving high-quality economic development. Based on the data of 2,760 strategic emerging enterprises of China a-share listed companies from 2014 to 2016, this study uses Levinsohn and Pertrin(LP) method to measure the total factor productivity of China's strategic emerging enterprises, and analyzes regional differences in total factor productivity of strategic emerging enterprises. The results showed that during the sample study period, the total factor productivity of China's strategic emerging enterprises decreases first and then increases. From the perspective of different regions, the total factor productivity of strategic emerging enterprises in the four regions showed a "stepwise distribution", the total factor productivity of strategic emerging enterprises in the East, Central and Western regions showed a downward trend, and the total factor productivity of strategic emerging enterprises in the central region showed a downward trend and then an upward trend. From the perspective of regional heterogeneity, Beijing, Shanghai, Guangdong, Shandong, Jiangsu and other provinces have higher total factor productivity of strategic emerging enterprises. However, the total factor productivity of strategic emerging enterprises in Xinjiang, Gansu, Guangxi, Yunnan, Shaanxi and other provinces and cities is low. In order to promote the total factor productivity of strategic emerging enterprises, we can increase R&D investment, link financing constraint and pay attention to regional development differences.

Keywords: strategic emerging enterprises, total factor productivity, the LP method, heterogeneity analysis

1. Introduction

The total factor productivity of an enterprise can not only reflect the efficiency of fixed capital input, employee input, R&D input and output, but also reflect the core competitiveness of an enterprise (Brandt et al.,2014) is the main factor of high-quality economic development, but also an important source of high-quality economic development(Romer et al.,1990). Strategic emerging enterprises refer to companies established around strategic emerging industries such as energy conservation and environmental protection, information, and biology. Strategic emerging companies play an important role in cultivating market demand, promoting technological progress, and developing new energy. Strategic emerging companies have become the driving force behind the high-quality development of China's regional economy (Zhang et al., 2015). The 2019 China Strategic Emerging Enterprises Development Report shows that the industrial added value of China's strategic emerging enterprises increased by 10.5% and 11.0% year-on-year in 2016 and 2017, higher than the growth rate of industrial enterprises above designated size in the same period. In the first half of 2018, the industrial added value of strategic emerging enterprises increased by 8.7% year-on-year. 2% higher than the growth rate of added value of industries above designated size. Then, the question we face is: What is the input-output efficiency of strategic emerging enterprises? What is the difference of total factor productivity of strategic emerging enterprises from the perspective of north and south and east and West? The answers to these questions are of great significance for promoting the high-quality development of strategic emerging enterprises.

At present, the measurement of total factor productivity of enterprises mainly focuses on the measurement of Total factor productivity of Chinese manufacturing enterprises (Van, 2007; Lu et al, 2012; Nie et al, 2011; Yang, 2015; Zhang et al, 2015). There are also some studies on the total factor productivity of cultural service

enterprises(Zeng et al,2019)、 high-tech enterprises (Hou et al,2018)、 artificial intelligence enterprises(Hu et al,2019) and agricultural enterprises(Liu et al,2018), there are few studies on the total factor productivity of enterprises in emerging industries. In the existing related research, most of them are based on individual influencing factors such as industrial policy(Sun et al,2021) and financing constraints (Liu et al,2020)to demonstrate their impact on the total factor productivity of strategic emerging enterprises, and the research area is a local area, lacking in a nationwide overall analysis.

On the basis of existing studies, the marginal contribution of this paper is mainly reflected in the following two aspects :(1) based on the data of 2,760 a-share listed companies from 2014 to 2016, this paper measures the total factor productivity of China's strategic emerging enterprises, which is helpful to understand the overall development of China's strategic emerging enterprises. The rapid development of enterprises provides a reference for reference. (2) This paper adopts the Levinsohn and Pertrin (LP) method to measure total factor productivity, which makes up for the sample loss caused by the Olley and Pakes (OP) method using easily accessible intermediate inputs as proxy index and investment amount as proxy variable.

2. Methodology and Data

2.1 Measurement Methods

Since Ordinary Least Squares (OLS) method will lead to selection bias when measuring total factor productivity of enterprises, it is found that OP method and LP method (Zhang et al, 2018) are the most frequently used methods for measuring total factor productivity of enterprises. As the output value of intermediate products is used as the proxy variable of investment, LP method avoids the loss of sample size caused by negative investment volume, so it is more robust than OP method. This paper then uses LP method to measure the total factor productivity of strategic emerging enterprises.

2.2 Data Sources and Processing

All data used in this paper come from a-share listed companies published by Wind database(Wind database is a platform for providing accurate, timely and complete financial information and communication). According to the Strategic Emerging Enterprises Classification (2018) released by the National Bureau of Statistics in October 2018, data of 2,760 strategic emerging enterprises were manually collected to form the strategic emerging enterprise database. In estimating total factor productivity of the strategic emerging enterprise, this paper adopts the full value of the enterprise as the output of the enterprise, and uses the provincial capital goods price index in 2014, as a benchmark to the enterprise output expansion process, uses the enterprise employees as labor input, using capital as the enterprise's capital investment. Among them, the capital stock refers to the value of all the total capital of strategic emerging enterprises at a point in time. Therefore, it is necessary to convert the capital in the book of enterprises into the actual capital stock value that can be compared. Table 1 presents the basic characteristics of the relevant data.

Table 1. Descriptive statistics of variables

Variable	Observations	The mean	The standard deviation	The minimum value	The maximum
Total output value: ten thousand yuan	2760	714004.3	3622519	- 120612.	1.07 e+08
Real added value	2760	163377.7	715965.6	- 7016917.	1.34 e+07
The total number of employees	2760	4637.22	13680.18	19	241474
Industrial value per capita	2760	62.67243	544.5986	5327.78	19210.09
The capital stock	2760	242905.8	1378968	1.847504	3.19 e+07
R&D expenditure ten thousand yuan	2760	792754.7	4.07 e+07	0.469106	2.14 e+09

3. Results and Discussion

3.1 Overall Analysis of Total Factor Productivity of China's Strategic Emerging Enterprises

With the country's attention to strategic emerging enterprises, strategic emerging enterprises have achieved rapid development. Therefore, based on the data of strategic emerging enterprises of a-share listed companies from 2014 to 2016, this paper measures the total factor productivity of strategic emerging enterprises, which can provide empirical reference for the development of strategic emerging enterprises.

This paper calculates the total factor productivity of China's strategic emerging enterprises from 2014 to 2016 based on the LP method, and calculates the total factor productivity of China's strategic emerging enterprises from 2014 to 2016 by averaging all enterprises in each year. The calculation results show that the overall growth rate of total factor productivity of China's strategic emerging enterprises from 2014 to 2016 is -19.365%. Specifically, only from 2014 to 2015, the total factor productivity of strategic emerging enterprises decreased by 19.553%, and the growth rate was negative. From 2015 to 2016, the total factor productivity of China's strategic emerging enterprises increased by 0.233%. Figure 1 made strategic emerging enterprises in China from 2014 to 2016 in the evolution of the total factor productivity trend chart, we found the sample from the picture inspection period the total factor productivity of China's strategic emerging enterprises, on the whole, is on the decline, the results reflect the strategic emerging enterprises is still in its infancy stage in China, the competition ability is not strong, the momentum is still weak.

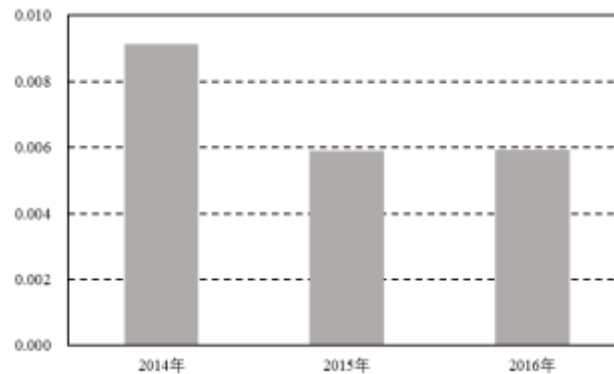


Figure 1. Total factor productivity of China's strategic emerging enterprises

In order to promote the development of strategic emerging enterprises, The State Council passed the Decision of the State Council on Accelerating the Cultivation and Development of Strategic Emerging Enterprises in 2010, and the Ministry of Industry and Information Technology issued the National Strategic Emerging Enterprises Classification Catalogue in 2012. In 2016, a number of policy documents such as the 13th Five-Year Plan for the development of National Strategic emerging Enterprises were promulgated to guide the development goals, requirements, industrial catalog definition and other aspects of strategic emerging enterprises. In the past, the development of strategic emerging enterprises benefited more from the expansion of enterprise scale, which led to the lagging development of innovation level of strategic emerging enterprises. In addition, affected by corporate financing constraints, the total productivity of strategic emerging enterprises declined in 2014~2015.

As the importance of strategic emerging enterprises has risen to the national strategic level, China's national finance department has set up a special fund for the development of strategic emerging enterprises, and local governments have also issued preferential policies to alleviate the financing constraints of strategic emerging enterprises. For example, in November 2018, China Construction Bank (CCB) announced that its subsidiaries planned to invest 5.3 billion yuan in the development fund for strategic emerging enterprises. In addition, in recent years, the development of multi-level capital market has brought new opportunities for the financing of strategic emerging enterprises, and the new Third Board market, A-share market and venture capital market have gradually strengthened their support for strategic emerging enterprises. At the same time, with the progress of science and technology, big data, such as artificial intelligence technology to the development of strategic emerging enterprises provides a strong technical support, especially the development of the "Internet +" (Which is a new business form developed by the Internet under the impetus of Innovation 2.0) for the development of strategic emerging enterprises provided the intrinsic motivation, promote the development of strategic emerging enterprises gradually realize the pulled by used to depend on capital investment to technology to effectively. The total factor productivity of strategic emerging enterprises increased from 2015 to 2016 due to the easing of financing constraints and the improvement of technological innovation level.

3.2 Regional Analysis of All-Factor Productivity of Strategic Emerging Enterprises

From different regions, the total factor productivity of strategic emerging enterprises in eastern China was the highest in 2014, which was much higher than that in Central, Western and Northeast China. In 2015, the total factor productivity of strategic emerging enterprises in the eastern region decreased, but it was still higher than that in the Central, Western and Northeast regions. In 2016, the total factor productivity of strategic emerging enterprises in the Eastern region continued to decline, and the total factor productivity of strategic emerging enterprises in the

Central region increased and exceeded that in the Eastern region. The ranking of total factor productivity in the four regions became Central, Eastern, Northeast and Western. Table 2 further reports the total factor productivity of strategic emerging enterprises in the eastern, central, western and northeastern regions from 2014 to 2016. During the sample study period, the total factor productivity of strategic emerging enterprises showed a downward trend in the East, West and Northeast regions, except for the central region, the total factor productivity of China's strategic emerging enterprises shows a downward trend.

Table 2. Total factor productivity of strategic emerging enterprises in four regions.

region	2014	2015	2016
The eastern region	0.010685	0.007481	0.006467
The central region	0.009456	0.002919	0.008648
In the northeast	0.004176	0.003669	0.003541
In the western region	0.003813	0.002428	0.002444

According to the changes of the four regions, it can be seen from Figure 2 that the total factor productivity of strategic emerging enterprises in the China's Eastern provinces and cities is higher than that in the Central and Western provinces during the sample investigation period, and the total factor productivity of strategic emerging enterprises shows a "ladder distribution" of high in the East and low in the West.

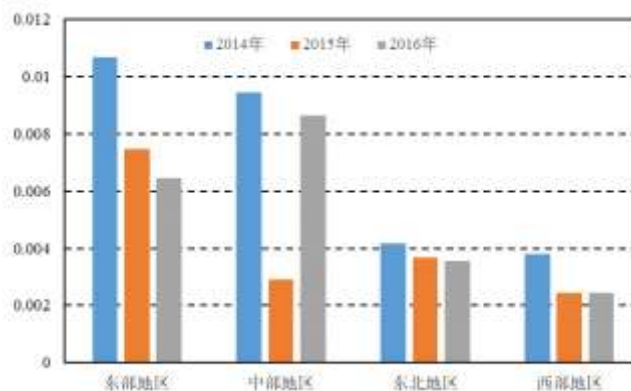


Figure 2. Total factor productivity of strategic emerging enterprises in four regions

The development of China's strategic emerging enterprises to gradually get attention and recognition in recent years, various provinces and cities is still the main strategic emerging enterprises at the initial development stage, and the Eastern region in technical level, the financing channels, the respect such as economic development level is the Central and Western regions is superior, so the East strategic emerging enterprise total factor productivity is higher. With the implementation of the regional coordinated development strategy, the Central region has attracted excellent technology, capital and talents from the Eastern region in the process of undertaking the transfer of high-quality enterprises from the Eastern region, which has laid an important foundation for the improvement of total factor productivity of strategic emerging enterprises.

3.3 Provincial Analysis of Total Factor Productivity of Strategic Emerging Enterprises

In order to better understand the variation characteristics of total factor productivity among different provinces, this paper calculates the mean of total factor productivity of each province according to the total factor productivity of China's strategic emerging enterprises from 2014 to 2016, and conducts ranking according to the mean value of total factor productivity. Table 3 shows the total factor productivity of strategic emerging enterprises in each province.

As can be seen from Table 3, the top 10 provinces of total factor productivity of strategic emerging enterprises are: Beijing, Shanghai, Guangdong, Shandong, Jiangsu, Liaoning, Hubei, Hunan, Chongqing, Sichuan, which belongs to the Eastern region has six provinces, belong to the provinces in Central China has 2, belong to the western provinces and cities have 2. The bottom 10 are Xinjiang, Gansu, Guangxi, Yunnan, Shaanxi, Jiangxi and Ningxia, which are mainly in the Western region. This is mainly due to the poor level of economic development and technology in Western China, and the single financing channel of strategic emerging enterprises, so the total factor productivity of strategic emerging enterprises in these provinces and cities is relatively low.

Table 3. Total factor productivity of China's inter-provincial strategic emerging enterprises.

The serial number	Provinces	2014	2015	2016	The mean
1	Beijing	0.005897555	0.002823205	0.003389415	0.004036725
2	Tianjin	0.00217485	0.00172270	0.00112170	0.00167308
3	Hebei	0.000544500	0.000429091	0.003543268	0.001505620
4	Shanxi	0.000665083	0.000898325	0.000986388	0.000849932
5	Inner Mongolia	0.001287924	0.000052899	0.004123030	0.001821285
6	Liaoning	0.005337807	0.005774306	0.005959447	0.005690520
7	Ji Lin	0.003880092	0.001791085	0.003002427	0.002891201
8	Heilongjiang	0.002788990	0.002826382	0.000998439	0.002204604
9	Shanghai	0.001674842	0.021103409	0.022605162	0.015127804
10	Jiangsu	0.006363830	0.001814213	0.002120145	0.003432729
11	Zhejiang	0.000975834	0.000580186	0.000787292	0.000781104
12	Anhui	0.000798455	0.001100582	0.000631868	0.000843635
13	Fujian	0.002425479	0.002106645	0.000845692	0.001792605
14	Jiangxi	0.000243297	0.000999806	0.000179820	0.000474307
15	Shandong	0.084716859	0.009512149	0.005931189	0.033386732
16	Henan	0.001763218	0.001762788	0.002031696	0.001852567
17	Hubei	0.028075163	0.005940919	0.008215152	0.014077078
18	Hunan	0.002999003	0.003618874	0.032620779	0.013079552
19	Guangdong	0.003330648	0.013812647	0.009759383	0.008967560
20	Guangxi	0.000763103	0.000468617	0.000510697	0.000580806
21	Hainan	0.000195925	0.000057897	0.000012192	0.000088671
22	Chongqing	0.012394923	0.007742631	0.011897086	0.010678213
23	Sichuan	0.009549170	0.005576050	0.004557524	0.006560915
24	Guizhou	0.000110720	0.006861034	0.001814678	0.002928811
25	Yunnan	0.000676444	0.000241580	0.000300847	0.000406290
26	Shaanxi	0.000212458	0.000306476	0.000462505	0.000327146
27	Gansu	0.000262590	0.000086906	0.000022613	0.000124036
28	Qinghai	0.001160303	0.006771640	0.001754373	0.003228772
29	Ningxia	0.000009705	0.000012837	0.000204875	0.000075806
30	Xinjiang	0.000142611	0.000052097	0.000778686	0.000324465

4. Discussion

The total factor productivity of China's strategic emerging enterprises varies across regions, and the influencing factors are different. Related research by Sun Yangyang (2021) shows that government subsidies can help improve the total factor productivity of strategic emerging enterprises, but there are differences in the incentive effect in the eastern, central and western regions. Differences in the degree of marketization and enterprise investment in industrial policies will also affect the changes in total factor productivity of strategic emerging enterprises (Liu et al,2020). From the perspective of the whole country, this paper discusses the evolution trend of total factor productivity of China's strategic emerging enterprises, and analyzes the reasons for the differences between regions and provinces. It has important reference value for developing strategic emerging industries and improving enterprise total factor productivity. However, it should be noted that strategic emerging industries include new energy, new materials and other fields with strong scientific and technological content, and the development level and influencing factors of total factor productivity of strategic emerging enterprises in different fields will be different. The development characteristics of the total elements of the types of strategic emerging enterprises and the discussion of their characteristic influencing factors are the focus of the next research.

5. Conclusions and Policy Implications

Based on the data of 2,760 strategic emerging enterprises of China a-share listed companies from 2014 to 2016, this paper uses the LP method to measure the total factor productivity of China's strategic emerging enterprises, and analyzes the regional differences of strategic emerging enterprises.

5.1 Research Conclusions

The total factor productivity of China's strategic emerging enterprises in the sample survey period showed a trend

of clustering decline and then slowly rising. In general, the overall growth rate of total factor productivity of China's strategic emerging enterprises from 2014 to 2016 was -19.365%. Specifically, only from 2014 to 2015, the total factor productivity of strategic emerging enterprises decreased by 19.553%, and the growth rate was negative. From 2015 to 2016, the total factor productivity of China's strategic emerging enterprises increased by 0.233%.

From the regional level, the total factor productivity of strategic emerging enterprises in Eastern China, Central China, Western China and Northeast China showed a "stepwise distribution" from 2014 to 2016, with high in the East and low in the West. From the perspective of different regions, except for the Central region, the total factor productivity of strategic emerging enterprises in the Eastern, Central and Western regions showed a downward trend. Specifically, in 2014, the total factor productivity of strategic emerging enterprises in Eastern China was the highest, much higher than that in Central, Western and Northeast China. In 2015, the total factor productivity of strategic emerging enterprises in Central China rose rapidly.

From the provincial level, the top 10 provinces in total factor productivity of China's strategic emerging enterprises are: Beijing, Shanghai, Guangdong, Shandong, Jiangsu, Hubei, Hunan, Chongqing, Sichuan and Liaoning, and these provinces have higher total factor productivity of strategic emerging enterprises. The bottom 10 are Xinjiang, Gansu, Guangxi, Yunnan, Shaanxi, Jiangxi, Ningxia and other provinces and cities. The main reasons for the difference in TFP of strategic emerging enterprises are that compared with Eastern provinces, Western provinces have a lower level of economic development and limited technical conditions, and strategic emerging enterprises have relatively narrow financing channels, which makes it difficult to effectively improve TFP of enterprises.

5.2 Policy Recommendations

In order to better promote the improvement of total factor productivity of strategic emerging enterprises, combined with the research results, this paper puts forward the following policy suggestions:

First, increase R&D investment and give full play to the decisive role of the market in the technology market. In order to improve the total factor productivity of strategic emerging enterprises, the technological constraints of strategic emerging enterprises should be gradually eased, the resource allocation system combined with market decision and government guidance should be improved, the position of enterprises as innovation subjects should be fully brought into play, and the efficiency of transforming science and technology into productive forces should be enhanced. While giving full play to the scale economy effect of strategic emerging enterprises, it is necessary to avoid both the efficiency loss caused by some enterprises' technological monopoly and the transaction cost caused by vicious competition.

Second, ease the financing constraints of strategic emerging enterprises and play the role of multiple subjects. While giving full play to the position and role of the banking system in indirect financing, we should pay attention to the direct financing role of the multi-level capital market and encourage the new third board enterprises to strengthen their support for strategic emerging enterprises. We will guide strategic emerging enterprises to finance through the multi-level capital market, vigorously strengthen the construction of the New Third Board market, make it the main venue for strategic emerging enterprises to finance, and constantly improve the market competitiveness of strategic emerging enterprises.

Finally, narrowing disparities in development among regions and achieving balanced development to promote the improvement of total factor productivity of strategic emerging enterprises, governments at all levels should pay full attention to regional differences and formulate relevant policies according to local conditions when developing strategies to promote the development of strategic emerging enterprises. Regional cooperation mechanisms should be established and improved, and regional mutual assistance mechanisms should be established. In terms of promoting regional cooperation mechanism, cooperation and interaction between regional strategic emerging enterprises should be promoted to gradually improve the level and level of regional cooperation and encourage cross-industry technology, innovation and talent exchanges between strategic emerging enterprises and other fields.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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