The super efficiency data envelopment analysis of the performance level of Chinese retail listed enterprises

Shanshan Zhong, Wenting Cao and Chong Ye*
Department of Economics and Management, Fuzhou University, Fuzhou, Fujian, China

ABSTRACT

China's economy has changed from the stage of high speed growth to the stage of high quality development and emphasized the new pattern of double circulation with large domestic circulation as the main body. As an important content to build a new development pattern, the development mode of the retail also changes from scale speed type to quality benefit type. Based on the DEA-Malmquist productivity index method, this paper analyzes the panel data of 72 retail listed enterprises in China from 2015 to 2019. The results show that the pure technology efficiency change index of all retail listed enterprises shows the trend of first decreasing and then increasing, while the scale technology efficiency change index and the technology progress index show the trend of first increasing and then decreasing. The interaction of the three makes the total factor productivity index a relatively stable trend, which indicates that the steady growth of retail sales scale is mainly due to the improvement of the performance quality of retail enterprises in the industry rather than the objective external environment such as inflation.

Keywords: DEA-Malmquist, retail, enterprises performance

1. INTRODUCTION

As the basic industry of national economy, retail trade has undergone a series of changes in its development stage, environment, conditions, tasks and requirements. The construction of a new development pattern of domestic and international double cycles promotes each other brings unprecedented development opportunities for the development of retail industry. Retail development mode also changes from scale speed type to quality benefit type, development power changes from factor drive, investment drive to innovation drive. The development of quality-effective retail, enterprise performance level quality has become one of the core issues.

A good development environment creates conditions for promoting the high quality development of retail industry in China. Enterprises actively adapt to the changes of consumer demand and speed up innovation and transformation. China has a unique digital environment; the deepening of the digital process has a profound impact on the retail industry. Guided by the new development concept, driven by technological innovation, based on information network, facing the needs of high-quality development, and providing digital transformation, intelligent upgrading, integration of innovation and other services under the new infrastructure, 5G technology, Internet of things and other emerging technologies for the digital economy, mobile network data usage, third-party mobile payment, logistics and other aspects of rapid development, witnessed the arrival of a new era of retail network shopping.

The sudden outbreak of the COVID-19 in 2020 has had a profound and unpredictable impact on the world economy. The changes of industry environment, competitive enterprise strategy, consumer mentality and government policy make the retail industry full of all kinds of uncertainty, aggravate the anxiety of retail industry to the future. The retail industry is facing great pressure, and some retailers are facing the threat of survival. How to maintain the stability of performance level and its own competitiveness in the competitive industry is the key. In order to make great efforts in this unique battlefield, enterprises need to be completely promoted from strategy formulation to implementation to flexible response, strong adaptability, high cost-performance, customer-centered operation mode.

The Malmquist index method in DEA method (Data Envelopment Analysis, DEA) is used to measure the operating performance of retail enterprises. Currently, the research on retail performance level is mainly divided into two categories. First, focus on the retail industry in some specific retail types of efficiency analysis. Patel and Pande took pharmacies as an example to analyze the efficiency of Indian pharmaceutical retail enterprises[1]. Ye et al sampled the panel data of 9

*yc_510@163.com

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wholesale and retail first-level enterprises above the wholesale and retail sectors in China from 2008 to 2015, and analyzed the timing changes and individual differences of enterprises in various wholesale and retail sectors[2]. Alves used Malmquist index to empirically analyze the efficiency of Portuguese retail enterprises represented by Portuguese retail chains, supermarkets and supermarkets[3]. She et al selected 12 listed retail enterprises with new retail concepts such as Sun and Jingdong as the research objects[4], and found that new retail can analyze customer demand through online data, establish an efficient logistics and distribution system, and strengthen the construction of the new retail system, so as to improve the operating efficiency of enterprises. Xu and Ye took 66 cross-border e-commerce listed enterprises as a sample to prove that government subsidies and regional Internet level will help to improve the operating efficiency of enterprises. The second is to use the method of regional division to analyze, or from the national retail listed company scope to analysis[5]. Liu and Wei measured the total factor productivity of retail trade above quota in 31 provinces and autonomous regions of China from 2004 to 2008. It is found that the total factor productivity of retail industry increases significantly under the premise of technological progress as the main driving force[6]. Zheng analyzed the operating efficiency of retail industry in 31 regions of China[7], found that total factor productivity in retail industry has increased to a certain extent, but the main source is technological progress, and management efficiency and management level did not keep up. Xu[8] and Zhang[9] respectively analyzed the business model benefits of Shanghai and Shenzhen retail listed companies and 60 listed retail companies in China, and compared the performance differences between effective operation and non-effective enterprises. Dong and Xu used interprovincial panel data of wholesale and retail trade in China from 1993 to 2014[10], this paper made an empirical analysis on the transformation of growth mode of trade circulation industry, it is found that in 2004, the development of total factor productivity showed the trend of rising first and then decreasing, and the main factor leading to the change of total factor productivity growth is the change of technical efficiency.

2. METHODOLOGY AND DATA DESCRIPTION

2.1. Research methods

Malmquist index is used to evaluate the performance of retail listed enterprises. Malmquist (MST) index method is a measure of individual productivity in samples derived from DEA methods. Malmquist index (MI) measure total factor productivity. The total factor productivity index is divided into technical efficiency (Effch) change index and technological progress (Techch) index. Meanwhile, the pure technical efficiency change index is equal to the product (Pech) pure technical efficiency change index and scale efficiency (Sech) change index. Namely:

$$\mathrm{MI} = \mathrm{Effch} \times \mathrm{Techch} = \mathrm{Pech} \times \mathrm{Sech} \times \mathrm{Techch}$$

Malmquist index can verify the dynamic performance development of an enterprise (the ability to integrate internal resources into good retail business performance) and how much progress the enterprise technology has made due to the relative performance change of the dynamic ability of the enterprise. And then affect the technology model (changes include all enterprises in the industry).

2.2. Indicator setting

Considering the objectivity and independence of input and output indicators, we should follow two basic principles: one is the consistency of type between input and output indicators to ensure that the indicators have the same objectives and tasks as well as the external environment; the other is to avoid strong linear relationship and control the quantitative proportional relationship between DMU, input and output indicators. Finally, this paper combines the characteristics of retail business and draws lessons from the related research of Zhang[11] and Lei[12]. On the basis of this, the following indicators are selected:

Input index: total assets; operating cost; number of employees; salary payable to employees. Output indicators: operating income; operating profit; net profit.

The investment of retail enterprises is concentrated in capital and labor. The reason why total assets are selected as one of the investment indicators is that total assets, as assets directly owned and controlled by enterprises, can reflect their market scale and development degree. Therefore, this paper hopes to consider whether the allocation and utilization of resources is optimal from the perspective of total assets. As another input index, operating cost can point to the sum of the main business cost and other costs of retail enterprises. The level of operating cost greatly affects the size of profit space of enterprises. The number of employees changes with the change of enterprise management scale and mode, which can reflect the management level and scale of retail enterprises. Finally, the salary of employees is the labor cost produced by the enterprise in the process of management. With the change of the number of employees in the enterprise, it can also

reflect the scale of the labor input of the enterprise.

Output index as an index to reflect the business situation and effect of the enterprise. Among them, the operating income of retail enterprises represents the operating conditions of enterprises, which can reflect the ability of enterprises to sell their main products and operate other business. Operating profit and net profit reflect the performance level of retail listed enterprises and the overall profit of listed enterprises.

2.3. Data sources

This paper selects the original panel data of 79 retail listed enterprises in China from 2015 to 2019 as a sample, and the original panel data are all from the annual report of listed enterprises in CHithink RoyalFlush Database from 2015 to 2019. In order to ensure the continuity and universality of the data, the research time range is set to 2015-2019. The selected sample research objects are retail listed enterprises, and the published data are relatively complete and easy to obtain. In addition, mainly considering that listed enterprises usually have a stable development scale and market share, their development strategy and dynamics can become industry vane to a certain extent, and they are representative in the retail industry. It can provide reference for other small and medium-sized retail enterprises and has certain research value.

Through searching CHithink RoyalFlush Database database, it is concluded that there are 86 listed retail enterprises in this database. Considering the data integrity ,8 listed retail enterprises with partial data missing and 6 listed retail enterprises with delisting risk are screened out in order to avoid false conclusions caused by inaccurate data.

3. ANALYSIS

From Figure 1, it can be concluded that the technological progress index of all retail listed enterprises selected between 2015 and 2019 shown an overall growth trend, indicating that the selected retail listed enterprises in this sample range shown a state of technological progress. The reverse trend of the two reflects not only the internal relationship between the management level and the scale of retail enterprises, but also the positive exploration of different management methods and enterprise scale among the selected retail listed enterprises in 2015-2019, and the retail enterprises improved the management level of enterprises themselves, cultivated their core competitiveness. The steady growth of the technological progress index has offset the negative effects of the fluctuation of the pure technology change index and the scale efficiency change index, which made the total factor productivity index of the retail listed enterprises basically shown a growth trend (Table 1). From the specific data level, the following conclusions are drawn:

Between 2015 and 2016, the technical progress index of retail listed companies decreased by 1.1%, and the pure technical efficiency change index and the scale efficiency change index decreased and increased by 0.8%, respectively. It shows that in 2015-2016, although retail listed companies strive to adjusted their own development strategy and improved their management level, there were still problems of objective technical stagnation or even backwardness. But the technical condition and the management level could not adapt, caused the total factor productivity index to be unable to rise.

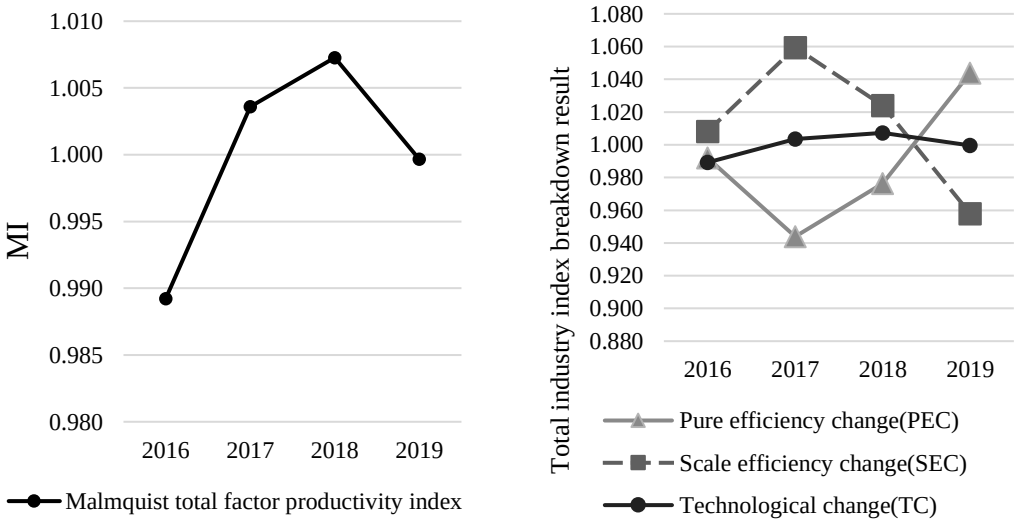

Figure 1. Total factor productivity change and decomposition index trend of retail listed enterprises in 2015-2019.

Table 1. Change rate and decomposition of total factor production of retail listed enterprises in 2015-2019.

Time	MI	PEC	SEC	TC
2015-2016	0.989	0.992	1.008	0.989
2016-2017	1.004	0.944	1.059	1.004
2017-2018	1.007	0.976	1.024	1.007
2018-2019	1.000	1.044	0.958	1.000

Data Source: Based on MaxDEA software output.

In 2016-2017, the technical progress index of retail listed companies rose 0.4 percent, the pure technical efficiency change index and the scale efficiency change index decreased, rose 0.56 percent and 0.59 percent, respectively, and the total factor productivity index of retail listed companies rose 0.4 percent. It shows that the scale of retail listed enterprises had not adapted to the progress of technology level in 2016-2017, and there were still some problems in the management level, so the total factor productivity index of retail listed companies had not been greatly improved.

The total factor productivity index of retail listed companies rose 0.7 percent in 2017-2018, as its technological progress index rose 0.7 percent, and the pure technology efficiency change index and the scale efficiency change index decreased and increased 2.4 percent, respectively.

Between 2018 and 2019, total factor productivity of retail listed companies was DEA effective because of the mutual offset of technological progress index, pure technical efficiency change index and scale efficiency change index. It can be seen from the data that the continuous progress of Internet technology had prompted retail enterprises to constantly learn and explore new management methods and improve their own management level, so that the total factor productivity index can still be maintained at 1.

Between 2016 and 2019, the pure technical efficiency change index and the scale efficiency change index fluctuated and offset each other, and the technological progress index remained stable between 1.00-1.01, which made the total factor productivity increase stable. It shows that the objective progress of technology and the continuous adjustment of enterprises' own strategy and development scale promoted the improvement of enterprise performance. In particular, in 2017-2018, retail listed companies total factor productivity index rose 0.7. The reason is that the development and popularization of Internet technology in retailing had made 2017 the first year of new retail. Some enterprises began to expand online channels and sales scale, and the rapid release of traffic dividends had promoted sales. To some extent, it alleviated the problem of high input cost of physical retail stores and improved the total factor productivity index.

Overall, the total factor productivity index of all retail listed enterprises showed a relatively stable growth trend between 2015 and 2019. First of all, thanks to the relatively stable macroeconomic development and policy support, it provides a good external environment for the development of retail industry. China's consumer market has great potential, strong toughness, sufficient vitality and good growth, which is an important basis for the continued healthy and coordinated development of retail industry, and the overall policy environment is very favorable. The CPC Central Committee and the State Council have issued a series of steady growth and consumption promotion policies to further stimulate residents' consumption potential. With the implementation of policy advice, and through strengthening the construction of social credit system to standardize market order, improve the market environment, accelerate the construction of a new supervision mechanism with credit as the core, to promote the development of high quality industry, stimulate consumption potential to provide strong support. Secondly, the new information technology and Internet technology brought about by the electronic payment of money, automation and so on for the transformation of retail industry laid the foundation. Between 2015-2019, the scale and management level of all retail listed enterprises fluctuate, which reflects that retail enterprises adjust their own development strategy with the change of complex market environment to achieve performance improvement.

4. CONCLUSION AND RECOMMENDATION

By using the DEA-Malmquist method of non-parametric estimation, this paper makes a dynamic study on the performance of listed enterprises in retail industry in China from 2015 to 2019, analyzes its total factor productivity index and decomposition index, and draws a conclusion that the scale of retail market sales is growing steadily. Between 2015 and 2019, the total factor productivity index of all retail listed enterprises had increased steadily, and the operating performance

had reached a relatively high level. The trend of total factor productivity of listed enterprises in retail industry reflects the overall characteristics of the continuous improvement of macroeconomic operation and the great potential of retail development in China. On the one hand, with the development of social economy, people's income level has been increasing, and the transformation and upgrading of residents' consumption structure has put forward new demand for retail trade; on the other hand, the national strategy of "insisting on expanding domestic demand" provides a policy environment for releasing the potential of domestic demand. In addition, the rapid development of information technology such as computer technology, network security technology and remote communication technology has also promoted the transformation and upgrading of retail industry. While the external environment brings opportunities for the development of retail industry, retail enterprises actively explore their own development strategy through the integration of internal resources, accurately judge the trend of the industry, and make the correct decision conducive to the economic development of enterprises.

Based on this conclusion, this paper puts forward two suggestions for retail enterprises to improve their operating efficiency. First of all, the digital construction capacity of enterprises should be improved. At present, China vigorously supports the digital new infrastructure to provide an opportunity for the development of retail online channels. Retail enterprises should speed up the process of enterprise channel integration by improving the digital level of retail consumption. At the same time, the integration of online and offline channels into the overall strategic planning of enterprises for unified management. Improve retail talent literacy, cultivate a comprehensive quality professional management team familiar with online and offline business, promoting supply chain management reform and improve supply chain management level. Secondly, new technology to analyze customer characteristics should be made full use of, so as to provide more accurate service to customers, so as to maintain loyal customer groups in the fierce competition industry.

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