Research on how the digital economy empowers retail companies to transform and upgrade under Dual Circulation View

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Abstract. Under the new development pattern, digital transformation is the best option for retail enterprises to cope with various risks in the face of changing market conditions, to enhance their efficiency and competitiveness. First, this paper uses the DEA-Malmquist index to measure the data of 20 retail enterprises that have gradually applied digital technology and have listed A-shares and to verify the operational efficiency of retail enterprises after digitalization. The empirical results show that: first, the production efficiency of digital retail enterprises is the best when the factor allocation is rationalized; second, the production efficiency of retail enterprises applying digital technology has increased year by year; third, technical efficiency and technological innovation efficiency have the same impact on retail enterprises. After the digital transformation, the level of technology in retail businesses will be improved, which will lead to an increase in total factor productivity. Finally, the paper makes some recommendations on the digital transformation of retail businesses from the perspective of enterprises and governments.

Keywords: Digital economy; Retail enterprises; Transformation and upgrading of retail enterprises; Total factor productivity

1 Introduction

The new development pattern strategy provides development opportunities for retail enterprises by expanding domestic demand, emphasizing the domestic market as the main body, and stimulating current vitality of consumption. In the 14th Five-Year Digital Economy Development Plan issued by The State Council in 2022, creating new advantages of the digital economy and promoting industrial digital transformation are set as essential tasks to promote high-quality industrial development. This task brings another opportunity for the development of retail enterprises. Where is the impact of the digital economy on retail businesses reflected in this process? How can retail businesses leverage digitalization to transform and upgrade in the post-pandemic era? In this paper, we build upon this work.

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2 Literature review

In the research process, categorization scholars believe that the digital economy has a positive impact on retail enterprises. Yao Zhengyuan (2020) [1] discusses the effectiveness of retail enterprises' transformation to digital. Liu Zhe (2021) [2] uses the theory of endogenous growth to conclude that technological progress and innovation can modify the disharmony between factors and supply and demand. Guo Meichen (2019) [3] believes that the structural upgrading of retail enterprises benefits from the digital information and communication industry. Lu Hongyan (2017) [4] and Guo Lili (2020) [5] believe that a fresh round of reform of retail enterprises has begun, and the continuous integration of "Internet +" with the e-commerce and circulation industry has gradually become a new trend. At the same time, some scholars have provided sound countermeasures for the digital transformation of retail businesses. Si Zengchuo (2015) [6] believes that digital information can enhance the role of circulation in the creation of customer value, and Lei (2018) [7] provides countermeasures for the transformation of retail enterprises in two aspects: technological innovation and channel integration. Xu Xu (2021) [8] believes that benefiting from the innovation and transformation of digital technology, retail enterprises are gradually developing towards the direction of intelligent and digital development, and scholars unanimously recognize that the digital economy can promote the high-quality development of retail enterprises. Under the new development pattern, the digital economy has a more diversified way of affecting retail enterprises, and the transformation and upgrading of retail enterprises need to be adapted to modern demands and models in conjunction with the Times context. At present, there are numerous scholars in China who use model analysis, but their methods struggle to overcome endogeneity problem, whereas the DEA model does not need to take this situation into account, so this model is studied as a benchmark.

3 Empirical study

3.1 Research method

The digital economy can optimize its elements configuration, enhance the core competitiveness of retail businesses and enhance their overall efficiency. In this paper, we use stata16.0 software and the DEA-Malmquist index, a non-parametric method, to measure the operational efficiency of 20 domestic listed A-share retail companies that have taken advantage of digital transformation and validate the improvement in their operational efficiency.

In this paper, the BBC model in DEA is used for measurement, namely: pure technical efficiency (PTE) = comprehensive technical efficiency (TE)/scale efficiency (SE). In this paper, input-oriented, the input model formula is studied. Formula (1) is used to calculate the efficiency e of the e decision-making unit [9]:

$$\begin{aligned} &\min \theta_e \\ &\sum_{j=1}^{n} \lambda_j x_{ij} \le x_{ie} \\ &\sum_{j=1}^{n} \lambda_j y_{oj} \ge \theta_e y_{oe} \\ &\sum_{j=1}^{n} \lambda_j = 1 \\ &\lambda \ge 0,\ j = 1, 2, \ldots\ldots, n \end{aligned} \tag{1}$$

In the BBC model, constraints are added $\sum_{j=1}^{n} \lambda_j = 1$ to indicate that some DUs are not operating at the optimal scale. In the formula, j indicates that there are j decision units in total. When θ_e is less than 1 compared with I (input) and O (output), the decision unit is considered invalid. When θ_e equals 1, the decision unit is regarded as valid.

Finally, Malmquist index should be used for dynamic analysis of its growth value. Therefore, Malmquist index method was used to measure the change of total factor productivity (TFP) from t to t+1. The measured total factor productivity index (TFPCH) can be decomposed into input-oriented technical efficiency change (EFFCH) and technical progress change efficiency (TECHCH), among which technical efficiency can be decomposed into scale efficiency (SECH) and pure technical efficiency (PECH), which can be expressed as:

$$\text{TFPCH} = \text{EFFCH} * \text{TECHCH} \tag{2}$$

$$\text{TECHCH} = \text{SECH} * \text{PECH} \tag{3}$$

3.2 Index selection and data processing

In the selection of the sample, the integrity and availability of the financial data of the selected firms, the consistency of the types of firms in the sample, the standardization of business operations, and the influence of the external environment are taken into account. As a result, retail enterprises that started their digital transformation in 2015-2016 were selected. Finally, a total of 20 listed A-share retail companies were selected, as shown in Table 1. The input-output data for the above samples are taken from the wind database.

Table 1. A-share listed retail enterprise code and name

Stock code	Enterprise name	Stock code	Enterprise name
601933	Yonghui Superstores	600723	Capital stock

603719	Bestore	600712	Nanning department store
600729	Chongqing Department Store	600738	Lanzhou Minbai
600859	Wangfujing	601366	Liqun Group
603708	Jia Jia Yue	603214	nursery
601116	San Jiang Shopping	600778	Friendly group
600785	Xinhua department store	002557	Chacha Food
000417	Hefei department Store	000501	Wuhan Department Store
000759	Zhongbai Holdings	002419	Rainbow Digital Commercial
000715	ZTE Commercial	002187	Guangzhou Grand buy

Source: Wind Database

Second, the input and output indices of the sample industry are chosen. When evaluating the input metrics, current assets, total number of employees and administrative expenses are selected. First, these indicators are available in depth based on published financial statements of retail businesses. Secondly, the indicators for evaluating retail enterprises selected by Lei Lei (2018) are referred to. At the same time, inventory turnover, net profit and revenue from major businesses are selected as output indicators to measure the level of resource allocation of enterprises from three aspects: profitability, operational capacity and development capacity.

After capturing the data, it was found that some businesses had suffered economic losses for a certain period of time and that the main business profits were negative, so such data had to be sorted out. This paper refers to the data standardization method of Xiong Zhengde (2014), which does not need to refer to the units of each indicator, and directly classes such data into a positive range according to the functional relationship. In this way, the operational requirements of the DEA model are satisfied. The function (4) is as follows [10]:

$$y_{ij} = 0.1 + \frac{x_{ij} - x_{ij\,\min}}{x_{ij\,\max} - x_{ij\,\min}} \tag{4}$$

In this function, X represents the original data of the index, Y represents the result of standardized processing of the data, Xij_{max} and Xij_{min} respectively represent the maximum and minimum values of the j-the index after input.

3.3 Empirical analysis

In this paper, Stata16.0 software is used, variable returns to scale (BBC) model is used, DMU is imported into the decision unit variable, and the data of 20 listed retail enterprises in 2021 is calculated statically through established indicators and model formulas. The integrated technical efficiencies of these retail enterprises and their decompositions are obtained by processing, as shown in Table 2.

Table 2. The operating efficiency of 20 A-share listed retail enterprises

Number	Company name	TE	PTE	SE	Return to scale
1	Yonghui Superstores	1.000	1.000	1.000	invariable

2	Bestore	1.000	1.000	1.000	invariable
3	Chongqing Department Store	1.000	1.000	1.000	invariable
4	Wangfujing	0.942	0.957	0.985	incremental
5	Jia Jia Yue	1.000	1.000	1.000	invariable
6	Sanjiang Shopping	0.873	0.905	0.965	incremental
7	Xinhua department store	0.956	0.989	0.966	incremental
8	Hefei department Store	0.870	0.885	0.983	incremental
9	Zhongbai Holdings	0.968	0.968	1.000	incremental
10	ZTE Commercial	0.967	1.000	0.967	incremental
11	Capital stock	0.868	0.912	0.952	incremental
12	Nanning department store	0.887	0.968	0.918	incremental
13	Lanzhou Minbai	0.878	0.904	0.972	decline
14	Liqun Group	0.916	0. 962	0.952	incremental
15	nursery	0.852	0.865	0.985	decline
16	Friendly group	0.934	0.993	0.941	incremental
17	Qiqiafood	0.997	0.999	0.999	incremental
18	Wuhan Department Store	1.000	1.000	1.000	invariable
19	Rainbow Digital Commercial	1.000	1.000	1.000	invariable
20	Guangzhou Grandbuy	0.956	1.000	0.956	incremental

Data Source: Estimated by State16.0

In the above sample, the integrated technical efficiency is = 1, which proves that the factor allocation of these digitalized retail enterprises has been rationalized and therefore their production efficiency has reached the best. Then, DEA is valid for the results of the six retail enterprises, such as Yonghui Supermarket and Chongqing Department Store, which accounted for 30 percent of the total sample, and 70 percent of retail enterprises with non-optimal utilization efficiency. If the above-mentioned enterprises want to improve their integrated technical efficiency, the development focus is on how to better play the large-scale economy. These enterprises can adjust the size of the factor input based on their data.

Secondly, we analyzed pure technical efficiency. Pure technical efficiency refers to the investment scale at which a retail business can achieve the highest level of efficiency in the production process. When pure technical efficiency = 1, the factor input is reasonable. Conversely, when the purely technical efficiency is less than one, it indicates that the input factor is improper and needs to be rectified. Finally, let us look at the shift in the scaling of the return. When the scale efficiency = 1, it means that the factor input scale of the retail business is in the optimal state and does not require any adjustment for the time being. However, when the size efficiency is less than 1, it means that the evaluation of a retail business results in an increase in size or a decrease in return on size.

These retail businesses should not expand significantly and their factor ratios should be watched. Continuing to use the Stata16.0 and Malmquist productivity index models for the dynamic measurements of the 20 listed retail firms, we obtain the average change in the Malmquist productivity index of the 20 retail firms over the past 7 years, as shown in Table 3.

Table 3. Changes in Malmquist productivity index of sample enterprises from 2015 to 2019

Year	EFFCH	TECHCH	PECH	SECH	TFPCH
2015-2016	1.006	1.013	0.993	1.014	1.019
2016-2017	1.007	1.021	0.998	1.011	1.028
2017-2018	1.008	0.991	0.994	1.015	0.999
2018-2019	1.011	1.011	1.002	1.006	1.023
2019-2020	1.013	1.018	1.003	1.014	1.031
2020-2021	1.015	1.022	1.008	1.014	1.037
Average	1.010	1.012	0.999	1.012	1.022

Data Source: Estimated by State16.0

The shift index of total factor productivity (TFPCH) reflects the change of productivity and efficiency of retail enterprises, which is an essential index to evaluate the production and management of enterprises. With an average value of 1.022, the index shows that the total factor productivity of retail enterprises has increased by 2.2 percent annually over the past seven years, indicating that the production efficiency of retail enterprises has improved year-on-year after the integration of digital technologies. According to the decomposition of TPFCH index, the technical efficiency (EFFCH) index and technical shift (TECHCH) index are 1.010 and 1.012, which continuously affect the total factor productivity. Since the mean values are nearly the same, it is not difficult to see that the two play an equally significant role.

Taking the above two indices apart, the average value of the Technical Efficiency Index is 1.010, indicating that the average annual growth of the Technical Efficiency Index over the last seven years has been 1%. As mentioned above, scale efficiency affects the growth of technical efficiency, so it can be understood that digital technology can continuously optimize the size and distribution of enterprises and improve the technical efficiency of retail businesses. The average value of the Technology Progress Index is 1.012, indicating an average annual growth rate of 1.2 percent in the efficiency of technological progress over the past seven years. It is not difficult to see that the progress of technological efficiency is reflected in the optimization and innovation after the enterprise integrates digital information technology, such as digital management, electronic payment, intelligent logistics and transportation, and the update and iteration of technology promotes the shift of technological progress efficiency of enterprises.

3.4 Result analysis

From the static analysis, it is found that there are 6 companies with effective DEA in 2021. It shows that retail enterprises can optimize their resource allocation and improve their production efficiency when they undertake digital transformation. Dynamical analysis shows that, first, the production efficiency of retail enterprises applying digital technology has increased year on year. Second, technological efficiency and technological innovation efficiency have the same impact on retail businesses. After the digital transformation, the improved level of technology in retail enterprises has led to an increase in total factor productivity, which can lead to higher benefits and profits in the context of internal circulation and domestic demand expansion.

4 Conclusion and suggestion

According to the above analysis, when digital information technology enables retail businesses, they can improve their technical level and optimize their element allocation, thus increasing their business efficiency. In order to give full play to the transformation and upgrading of retail enterprises empowered by the digital economy more effectively, retail enterprises can build "advanced manufacturing + modern logistics", take advantage of the background of internal circulation to expand domestic demand, combine with the innovation of digital economy, gradually form a digital and intelligent information technology system, realize the fine project management of retail enterprises, and effectively improve the core competitiveness of enterprises. Finally, the joint efforts of government and business are needed. To promote the investment and application of digital information technology, the government should strengthen policy guidance, formulate relevant policies and improve construction standards to create a decent operating environment for it.

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