Analysis of Operational Benefits of Unmanned Retail Business Form based on DEA Method

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Abstract. In view of the three business forms of unmanned retail in the new retail, this paper takes the financing level, the area effectiveness and the market share as the index of DEA, and uses the DEA method to measure and analyze the operational benefits of 49 enterprises in the three forms of unmanned convenience stores, open shelves and smart retail containers. Through empirical analysis, it is concluded that the operational benefits and prospects of unmanned convenience stores are better. Therefore, reducing the investment community's overheated investment in the unmanned retail industry and further optimizing the business model centering on cost reduction and efficiency increase will effectively improve the operational benefits of the various business forms of unmanned retail.

Keywords: unmanned retail; operational benefits; DEA method; area effectiveness.

1. Introduction

With the issuance of the "Opinions on Promoting the Innovation and Transformation of Physical Retail" by the General Office of the State Council of China and the introduction of "New Retail" concept at the 2016 Hangzhou Computing Conference, the retail industry has entered a new era of upgrading and transformation. Among the many directions of realizing the new retail development goal, the most prominent representative is the unmanned retail form, which takes labor reduction as the focus of cost reduction and efficiency increase, uses the Internet of things and artificial intelligence technology to improve the degree and convenience of consumption experience, and collects and analyzes data to realize the digitization of consumption process. In 2017, the transaction volume of China's unmanned retail industry reached 20 billion yuan, and the market turnover is expected to break through 1.8 trillion yuan by 2022. Under this background, in order to promote the high-quality and efficient development of unmanned retail industry, it is necessary to analyze the operational benefits of several existing forms of unmanned retail, explore the limitations of the development that faced by unmanned retail, and study the overall investment environment of the industry. Therefore, this paper constructs the operational benefits evaluation system of companies that are engaged in the three types of unmanned retail from the three indexes of financing level, area effectiveness and market share, and uses the DEA method to objectively evaluate the development status and prospects of the three types of business forms.

2. Literature Review

At present, there are three main business forms in the unmanned retail industry, including unmanned convenience stores, open shelves and smart retail containers. The three business forms have different pattern design and management methods, and gradually form their own development trend, which requires researchers to classify and compare, and analyze quantitatively the business status and development prospect of each business form. At present, the research mainly focuses on the overall analysis of unmanned retail industry, and takes status research, characteristics analysis and trend prediction as the main research direction. Feng Junwei (2018) stated the usage characteristics and application scenarios of three business forms, and analyzed the development status and trend of unmanned retail industry from the perspective of upstream and downstream industrial chains [1]. Wang Juan (2018) conducted a SWOT analysis of the unmanned retail industry and put forward relevant suggestions for the industry's development prospect [2]. Song Dange (2018) compared unmanned retail and traditional offline retail and online retail stores, and analyzed the

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characteristics of unmanned retail from the perspectives of user experience, big data applications and supply chain management [3]. Jiang Xun and Xu Yan studied consumer shopping behavior and made targeted suggestions for the development of unmanned retail enterprises [4]. iResearch (2017) has calculated the data of unmanned retail industry, and analyzed the driving factors promoting the development of unmanned retail market, and made a forecast for the future development trend of unmanned retail industry [5].

Through the research on the existing relevant literature, it is shown that the researches on these several forms of unmanned retail that conducted by domestic research institutions and scholars are only introduce and state the operating status of these business forms [6], lacking quantitative data analysis support. In view of the current situation, this paper, on the basis of previous studies, uses DEA method to conduct a comprehensive evaluation on the operational benefits of three forms of unmanned retail industry, so as to guarantee the scientificity and availability of the research to the greatest extent.

3. Theoretical Model Construction and Empirical Analysis

3.1 Sample Selection and Index System Construction

Data encryption algorithm (DEA) is the most effective non-parametric method to evaluate efficiency. In recent years, it has been widely used not only in foreign countries, but also in China. The sample selected in this paper is emerging enterprises with certain brand awareness and market scale in three commercial forms of unmanned retail industry by the beginning of 2018 after the rise of unmanned retail concept. Among them, the unmanned convenience store market is relatively mature and stable, so this paper selects 19 representative enterprises. However, the market of open shelves and smart vending machines is relatively new and the capital is relatively scattered, so there are few large-scale enterprises with representative significance. Therefore, 16 enterprises in the market of unmanned shelves and 14 representative enterprises in the smart vending machines market are selected.

In terms of the selection of indexes, considering that the total number of decision units cannot be less than twice the sum of input and output index, and combining with the characteristics of unmanned retail industry, this paper selects the following three indexes as the indexes of input and output, which takes the enterprise's financing scale as the input index, and regards the enterprise's market share and enterprise sales effectiveness as the output index. The specific calculation of the indexes is shown in Table 1:

Table 1. The evaluation index of economic efficiency of unmanned retail enterprises

Index level I	Index level II	
Economic input	Financing scale (x_1)	It reflects the total amount of financing from the angel round to strategic financing to the Pre-A round.
Benefit output	Area effectiveness (x_2)	It reflects the turnover generated in per area
	Market share (x_3)	It reflects the market penetration of enterprises in the current market scale

3.2 Data Collection and Calculation Results

The research data in this paper comes from the enterprise information provided by Tianyancha and Pencil News, and the Research Report of Unmanned Retail Industry of China in 2016 provided by iResearch. The number of samples has reached twice or more the sum of the input and output indexes, so the DEA method can be used for measuring the economic efficiency. Taking the sample data into

consideration, since the decision-making unit cannot determine its output factors, the efficiency measurement of unattended retail enterprises in this paper is based on the output perspective.

Table 2. The value of operating efficiency of an enterprise under three development situations of unmanned retail

Unmanned convenience stores		Open shelves		Smart retail containers	
Bingo box	0.658	Xiao e WeChat Shop	0.633	Deep Blue Technology	0.25
17 Shandian	0.73	Guo Xiao Mei	0.065	Xiaobanmi	0.4
Easy Go	0.458	Yonwan	1	51 Tea Time	0.525
F5 Future Store	0.523	Yoho	0.684	JUMIAI	0.4
Xiaohui Bianlicang	0.296	MISS FRESH	0.769	Youpeng	0.6
Fx BOX	0.386	51 Snack	0.539	Hgo Box	0.75
24 Igo	0.741	Sokbuy	0.422	Gump Come	0.617
Magic Home	0.664	Seven koalas	0.766	Haha Bianli	0.4
Xiao Yeshou	0.547	Fanqie Bianli	0.547	Future Mr.	1
Yikesong	0.502	Lingwa	0.602	City BOX icitybox	0.321
Cloud Mirror	1	Blkee	0.55	Meiweishenghuo	0.3
69 room	0.4	Antfre	0.503	Convenisun	0.797
Yihao Yuansu	0.46	Xingbianli	0.177	X-Banli	0.85
ALL DAY	0.47	Hami Technology	0.593	E-Bee Intelligent Community	0.45
Jian 24	0.528	Koalabl	0.356		
Xiao e WeChat Shop	0.862	Bianlifeng	0.246		
Bianlijia	0.632				
Take go	0.466				
The rabbit mall	0.48				
Average value:	0.56858	Average value:	0.52825	Average value:	0.54714

3.3 Analysis of Statistical Results

1. Through the analysis of the data, it can be seen that under the three business forms, the three companies “Cloud Mirror”, “Yonwan” and “Future Mr.” respectively achieved PE (comprehensive efficiency)=1, which was evaluated as effective. Among the unmanned convenience store enterprises,

the values of operating efficiency of “17 Shandian”, “24 Igo” and “Little e WeChat Shop” were relatively high, reaching 0.73, 0.741 and 0.862 respectively. And in the open shelf enterprises, the operation of “MISS FRESH” and “Seven Koalas” is relatively effective. And in the unmanned retail container, the PE values of “Hgo Box” and “Convenisun” are 0.75 and 0.797, and the overall efficiency is relatively high. These enterprises need to further consider reducing costs while maintaining the original market penetration rate, so as to reduce investment and improve operating efficiency.

2. Through comparing and analyzing the data of the industry, and taking the average value of the DEA efficiency values of representative enterprises, it can be seen that among the three unmanned retail forms, the average efficiency value of the unmanned convenience store reached 0.5685, which is the highest value in the three business forms. And the unmanned retail containers ranked second, while the average DEA efficiency value in the open-shelf enterprises is the lowest. In view of its industrial characteristics, the reason for this result may be that unmanned stores generally prefer commercial street and community center in the site selection, with the advantages of operational independence, human traffic and demand. While for open shelves and smart retail containers, the choice of application scenarios is still a common problem faced by the industry. And at present, the good application scenario is in the office building. In addition, due to different products and technologies used, the damage rate of unmanned shelves is generally high and that of unmanned convenience stores is low. The combination of these factors led to the differences that mentioned above in the efficiency values of the three forms.

3.In summary, the average industrial efficiency of the three commercial forms of unmanned retail is between 0.5 and 0.57. And the operating efficiency is lower than traditional industries such as traditional retail industry and traditional tourism industry. This shows that a large part of the retail enterprises has relatively low operating efficiency, and capital investment cannot reasonably generate the economic benefits as it should be. Therefore, it is necessary for these enterprises to make coordinated improvements in business strategy, market strategy, profit model and hardware equipment, increasing the area effectiveness and reducing the cost consumption and investment level per unit.

4. Summary

This paper selects 49 start-up companies engaged in unmanned retail, and chooses the financing status, area effectiveness and market share data of these companies, and uses DEA software to analyze the operational benefits of three unmanned retail business forms. Then, this paper finds out the reasons for restricting the development of all forms of unmanned retail and draws the following conclusions.

1) From the evaluation results of the operational benefits of three commercial forms of unmanned retail, it can be seen that there is not much difference in the operational benefits of the unmanned retail companies engaged in these three retail forms, and they all have the space to further improve the operational benefits. The complexity and uncertainty of personalized operation design based on application scenarios, as well as the lag established by user habits make it difficult to reach the expected effect in terms of area effectiveness, which is an important reason that restricts the development of unmanned retail at present.

2) From the investment community's investment status in the three commercial forms of unmanned retail, there is no significant difference in the total financing of the three types of industry. However, due to the relatively low threshold for the entry of open shelves and smart vending containers, and the existence of a large number of start-ups with low operating efficiency and small scale, these two business forms will be in a more stressful competitive environment compared with the unmanned convenience stores, and it is expected that there will be fierce merger and reshuffle in the future.

According to the above conclusions, in order to improve the operational benefits of three types of unmanned retail and promote the high-quality and efficient development of unmanned retail industry, the following suggestions are given from the perspectives of investment community and enterprises.

1) It is difficult to break through time and space restrictions and support the company's listing through local regional operations, and it is hard to quickly monopolize the industry to give investors the expected return because the unmanned retail industry comes with a high regional limit. According to the current investment layout of investment institutions, investment in unmanned retail in the investment community can be roughly divided into two groups: unmanned convenience store direction, unmanned directions in office and other application scenarios (open shelves, smart vending containers). While the investment community is particularly keen on the latter, which objectively intensifies the competition of the same industry. Therefore, for the investment community, on the one hand, it is necessary to improve their cognition and view the wave of unmanned retail rationally, which is conducive to the benign development of unmanned retail industry and helps them avoid excessive investment risks. On the other hand, they should plan and prepare for investment in the market with frequent mergers and acquisitions.

2) From the perspective of the unmanned retail industry as a whole, cost reduction and efficiency increase are the core objectives of development. Therefore, the high area effectiveness characteristic that is better than traditional retail should be the direction in which the enterprises adhere to and further optimize. Moreover, enterprises should truly create a consumption-scenario atmosphere, test and develop better application scenarios, at the same time establish procurement systems and channels to communicate with upstream suppliers, and use the Internet of things technology and big data to support the construction of a complete logistics supply system.

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