Research on the Economic Development Model of Chinese Self -Service Stores

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Keywords: Self-service; Economic development; Industrial economics; Unmanned retail market; Chinese market

Abstract: Although China's convenience store has existed for almost thirty years, with the development of self-service technology, and the eager for a larger market space, Chinese retail industry calls for a transform. Hence, the self-service stores appear and are now exerting an unconscious influence on the whole retail industry. This paper researches on the economic development model of Chinese self -service stores. It first introduces self-service, the self-service market and its application categories in China, and then it analyzes the development factors of China's self-service stores, including favorable external conditions, government's support, technological advancement, and the public attention. The JD. X self-service store and the EATBOX are introduced to demonstrate the China's self-service store model and industry chain. Finally, this paper concludes the challenges that exist during the development, which are technological flaws and the constraint of regional market and then it puts forward the future perspective of China's self-service store development.

1. Introduction

1.1 The introduction of Self-service

Self-service originally stands for a shop, restaurant, petrol station, etc., where the customer serves himself or herself. One of the most common example of self-service is the Automatic Teller Machines, namely, ATM, which is an automatic machine that helps people withdraw and deposit funds individually. The self-service technology has begun over half a century ago. Yet in the twenty-first century, self-service appears as a new business model that applied in the customer service nation. Nowadays, self-service denotes a retail pattern that in the absence of a salesperson, cashiers and other store staffs, customers can help themselves automatically by entering the store, selecting the products and purchasing. Despite the fact that no one is on guard, the management inside the system or besides the self-service models still require the personnels who distribute the goods, stock the products and do the cleaning of the whole area. The self-service store greatly enhances the efficiency and will change the future of the retail business.

1.2 Self-service market and the application categories

The map of China unmanned retail industry classification is shown in Table 1.

Self-service market is the brand new form of a retail business and is in a burgeoning development. Self-service patterns are the physical retailers including the opening shelves, vendor machines, self-service convenience stores and self-service based large supermarkets [1]. It's worth being mentioned that the self-service retailer is under close beta now and still cannot be applied to a large-scale development yet. We will explain the reason in the following context.

Open shelf	small footprint(<10m ²)	open	closest to consumers
Vending machine	small footprint(<10m ²)	closed-end	relatively close to consumers
Unmanned	relatively large	different modes	relatively far to consumers
convenience store	footprint(10-30 m ²)		
Unmanned	large footprint(>100 m ²)	half-open	farthest to consumers
supermarket			

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The vendor machine appears at first. It was built in 1888 and it covers a large number of products. The pursue of standardization and conformity brings huge convenience to the management of a standard vendor machine. The vending machines have also "progressively, though at a much slower pace, evolved into smart vending machines". Nowadays, China's famous vendor machine company is You Bao, which mainly place their machines in a semi-closed area of a office building or universities. The appearance of opening shelves is rather late. This form of self-service retail pattern mostly apply in a closed area of a company and E store, the representative of opening shelves retailer in China, has now embarked on developing and launching over 150000 products all over the country. The appearance of self-service stores or supermarkets can be traced back to roughly ten years ago, whereas the rapid development of self-service industry before, marketing sales and the results were not satisfying. It was the development of Amazon Go and China's domestic brand Tao Coffee that lighted up Chinese self-service market and these actions of the tycoons drove the rapid advancement of the entire market. China's Alibaba also promoted unmanned convenience stores in the later years.

In recent years, unmanned retail is developing rapidly in China. The transaction volume and growth rate of China's unmanned retail industry from 2017 to 2022 are shown in the Figure 1.



Figure 1 The transaction volume and growth rate prediction of China's unmanned retail industry from 2017 to 2022

1.3 The self-services stores aboard

Self-service stores have also been a popular retail business model aboard. Global self-service technology market is expected to garner \$31.75 billion by 2020, registering a CAGR of 14.0% during the forecast period from 2015 to 2020. Asia-Pacific region was the major revenue generating region for the overall self-service technology market. This region is estimated to dominate the market with regard to revenue contribution throughout the forecast period. In attempt to launch selfservice store globally, Amazon took the lead and opened the "Amazon GO" in Seattle in January 2018 [2]. With the technological application of computer vision, deep learning algorithms, and sensor fusion, "Amazon GO" now has become one of the most renowned self-service business models all over the world. On its official website, "Amazon GO" contends that it "featuring the world's most advanced technology [3]. No lines, no checkouts". It is to be expected that "Amazon Go" could enters the retail market as an entity and exceeds the sales of ordinary grocery stores one day. As a matter of fact, self-service stores have been popularized in developed countries for years and have become the core mode of the retail business. Another example is the self-service retail business in Japan. Japan has the highest per ca-pita volume in the world, and its self-service retail structure has already been upgraded [4]. The Japan's logistics cost is controlled to 5%, while this figure remains as high as 15% in China (some smaller chains account for about 20%). In 2017, Japanese 7-Eleven also developed a small vending machine to put perishable goods of the convenience store into it. Above all, the future outlook of the global self-service store market is promising.

2. The favorable Conditions for the development of unmanned retail market in China

Due to the application and the development of self-service store, Chinese retail business has developed faster than ever. In 2017, the unmanned retail market (including vending machines market) is 20 billion yuan in total. It is estimated that the market size in 2019 will be around 40 billion yuan and is expected to exceed 65 billion in 2020, with a compound annual growth rate of 50% [5]. At the end of November 2017, there are about 200 unmanned convenience stores in the Chinese retail market. The booming development of self-service store can be attributed to the consequences as follows.

2.1 Favorable external conditions

Firstly, the expansion of unmanned CVS has definitely eased the labor force. As the aggravating trend of aging population brings impact to Chinese labor market, the development of the self-service stores can partly neutralize the labor shortage. China has also embark upon the second half of the demographic dividend. The total population has entered negative growth and, the labor costs have risen. Labor costs are the most important operating costs for retailers in addition to rent, especially for convenience stores. Therefore, unmanned trend can be a significant attempt for the entities to reduce these costs.

Moreover, since the Ministry of Commerce actively adapts to the transformation of major social contradictions, promotes the consumption upgrade, and cultivates new growth points for consumption, China's retail industry is facing a rather bright future. From January to October in 2018, the retail sales of China's goods was 27.6 trillion yuan, a year-on-year increase of 9.1% [6]. Since 2014, the national retail sales of commodities have maintained a continuous growth trend. As of 2017, the overall double-digit growth was maintained, but by the end of October 2018, the growth rate dropped to a single digit. Despite the drop, it is still estimated that after 2019, China's retail sales will continue to grow at a rate of more than 8%. In 2019, the national retail sales will be 38.9 trillion yuan, and in 2024 it will increase to 58 trillion yuan. The promising prospective of the retail market lays the foundation to the development of self service business.

2.2 The Support of the government

In the recent years, both The State Council and provincial governments have established corresponding legislation to support the transformation and innovation of physical retails, with particular emphasis on the role of innovative technologies in promoting the transformation of traditional retails. In 2017, The State Council issued Opinions of the State Council on Promoting the Transformation and Innovation of Entity Retail, mentioning that it is essential to strengthen the application of next-generation information technology such as the big data and to vigorously develop new formats and new models in order to support enterprises carrying out humanized and intelligent transformation of service facilities. In 2018, the Ministry of Commerce issued China Convenience Store Prosperity Index Report, in which the Ministry of Commerce first mentioned the "unmanned retail industry" and defined it as a "positive push" to the development of whole retail industry. From now on, unmanned retail business has received close attention from the Ministry of Commerce as a retail innovation. The current policy will still remain to support the transformation of the retail business and the innovation of the self-service technology, which is favorable to the development of self-service stores and the whole retail industry.

2.3 Technological advancement

The development of intelligent technology is also a significant driving force in upgrading the transformation of the retail industry. The rapid development of science and technology provides the possibility of innovation in the retail market. With the continuous improvement of artificial intelligence and multi-skilling application, these technologies will become the mainstream in the future and bring the customers a better shopping experience. At present, the technical genre that applied in the market is mainly divided into three types [7]: two-dimensional code technology, RFID tag recognition and Artificial Intelligence. QR code and RFID technology are mainly used in the payment and settlement process to optimize the labor cost and settlement efficiency of the cashier

link. AI's and the QR code's application will be introduced as follows.

AI, namely artificial intelligence, is concerned with machine vision, deep learning, biometric and other technologies. The AI systems, as well as the face recognition, big data analysis, electronic settlement systems, and electronic access control systems, can be efficiently used in product identification and the analysis of consumer's behavior. Unlike the traditional convenience stores, the self-service convenience stores can record the entire purchase process of the customer through images, videos, data by using AI systems and big data. The fragmented information purchased by the customer can also be collected in order to facilitate the study of the customers' buying habits and preferences. Due to the advancement of the AI and big data, the self-service stores can collect data on various aspects such as consumer flows data, consumption data, and financial data and then apply them to the entire retail industry. Although the application of AI technology in unmanned business is under exploration and the stability requires adjustment, it still facilitates the development of the self-service store by turning this business model easier to apply into practice. Smart devices like AI are reconstructing our future retail stores to be smarter and more automated.

Mobile payment is widely used in the China's retail market and also benefits to the development of China's self-service business. In the Internet era, consumer consumption tends to be fragmented. In the consistent pursue of catering to the market demand, mobile payment has greater advantages than traditional payment. Due to the promotion of the popular applications such as Alipay and WeChat, China's mobile payment business has attracted worldwide attention and has been infiltrated into all aspects of people's daily lives. In 2016, Alipay and WeChat completed a transaction volume of 2.9 trillion dollars, which is nearly half of China's total consumer goods sales. The mobile payment utterly revolutionizes the public's consumptive habits and meanwhile, markedly affects the payment behavior in the convenience store.

According to the statistics, over 55.3% of the Chinese convenience stores use mobile payment as the dominant way of daily purchasing [8]. And an approximate 32.3% of the Chinese convenience store use mobile payment as their daily purchasing method, which indicates the significance of mobile payment in the retail business. Mobile payment is a brand new vitality for the offline real economy, especially for the retail industry. The main function of mobile payment in the self-service business is to promote the digital transformation of offline business operations, marketing and management. By scanning QR code, payment can be readily completed. The mobile payment reduces the work costs and improves efficiency.

2.4 The public attention

As the self-service stores developing at a staggering rate, the netizen are paying more and more attention to the self-service retail business. People visit the unmanned store with curiosity and in the meantime, promote the self-service stores as a web celebrity. This phenomenon also coincides with the alteration of Chinese consumer structure. According to the research, in the sixth nationwide census, the population of the millennial accounts for a 30.6% of the mass consumption in total and the age distribution ranges from 11 to 30 years old [9]. In 2017, the age group lies between 18 and 37 years old and they are currently the major consumption force. On the other hand, the middle-income population continues to expand. It is estimated that by 2020, the middle-income population with a disposable income between 8,300 and 24,000 yuan will reach at a maximum population of 158 million, an increase of 53.9% compared with 2015. Therefore, the consumer structure is changing and the high purchasing power is rising more than ever before.

With the transformation of consumer group, costumers in the new era are no longer concerned with commodity prices, but rather focus on pursuing a series of personalized, high-quality products. According to the China Unmanned Retail User's Behaviors Research, 66.5% of users who have never used unmanned stores express their willingness to give it a try [10]. By using the technological sense, novelty and reality of the unmanned retail stores, users can be attracted by this new way of purchasing products and thereby enhance the development of the self-service business.

Other than attracting new consumers, the booming advancement of self service business also attracts the financing and capitalization of a larger corporation. In order to satisfy the needs of customers, companies are expending their self-service capacities, which requires financial and funding support. In 2017, the total amount of financing of unmanned retail sales was substantial, and the capital market favored the self-service business, which in turn, promoted the development of the domestic unmanned retail market. The Convenience Bee, the F5 future supermarket, the Bingo Box, and the Wheat Shop are the four companies currently competing in the unmanned retail business area in China, and they are all in the initial round of financing [11]. It is estimated that the total financing of the unmanned retail industry in the fourth quarter of 2018 has reached nearly 1.7 billion yuan. The financing assists the self-service retail business by both expanding their businesses' scales and resolving their current technological problems.

3. The paradigms of unmanned industry in China

China's unmanned retail industry is currently focusing on the consumer experiences, the expansion of scales, the collective analysis and application of big data through various technical ways. The traditional retail supply chain is linear, and the information exchange between the participants is separately. The comparison chart of traditional Chinese retail and unmanned retail supply chain is shown in Figure 2.



Figure 2 Comparison chart of traditional Chinese retail and unmanned retail supply chain

Smart retail, represented by unmanned retail, gradually builds a linked network between the supply chains. Consumers' demands are transmitted to the suppliers through this network and when the demands change, the stores adjust accordingly. This network is also conducive to eliminate information asymmetry of all parties and can result in efficient information transmission. In order to maximize the interests, all parties serve as information hubs in this network. Through the process, the self-service businesses will eventually achieve the comprehensive data-oriented and service-oriented consumption process as well as the intelligent upgrade of its industrial chain. Here are two paradigms of Chinese self-service stores' business model.

3.1 JD. X Self-service store

On October 17, 2017, JD.com Smart Store Technology, X Unmanned Supermarket and Unmanned Convenience Store was debuted on the Double 11 Initial Conference. The X Unmanned Supermarket is under the charge of the X Business Department which is located at the headquarters of JD.com. The D-Mart smart store, behind the unmanned convenience store, is independently developed by JD.com AI and the Big Data Department. The department provides modular and technical solutions, which can be used for low-cost upgrades of the existing offline stores. X Unmanned Supermarkets covers an area of approximately 60 square meters, about 300 SKU in total, including snack foods, fruits, daily necessities, office travel supplies, etc. [12], and the supermarket does not limit the number of people entering the store. The Unmanned Convenience store covers an

area of 36 square meters, and outside the convenience store is the face recognition systems, smart advertising panels and in-store heat distribution screens. The flowchart of shopping in Jingdong X unmanned supermarket and unmanned convenience store is shown in the Figure 3.



gure 3 The flowchart of shopping in Jingdong X unmanned supermarket and unmanned convenience store

When people entering X Unmanned Supermarket, they are required to go through the facial landmark detection and the face recognition systems which would record their facial landmark in sequences. Next, when going down the storage racks, the highly sensitive sensors would detect the consumer's movements by analyzing their walking routes and physical behaviors. When purchasing the products, the facial systems would scan each customers' face automatically to complete the payment. After confirming the payment, the exit would be open. These are the purchasing process in X Unmanned Supermarket. JD. com's Unmanned Convenience Store, however, is slightly different. This store applies the "JD ME" facial recognition systems and smart shelves, smart sensor cameras, smart billboards to make the purchase more convenient. As for the method of settlement, Unmanned Convenience Store adopts the RFID technology plus intelligent weighing counter, and the purchase must be made by scanning payment QR code. After successfully paying the products, the facial recognition systems again to confirm the payment.

JD. X self-service has huge potential in developing the self-service retail business. The company has substantial investment in smart logistics technologies such as drones and unmanned warehouses. Combined with technologies such as big data, cloud computing and artificial intelligence, JD.com self-service store is suitable for supermarkets, convenience stores, gas stations, airports, hotels and any other offline scenes. JD.com self-service store also has an advantage on supply chains since the booming advancement of JD's e-commence creates a strong and reliable foundation for the self-service business [13]. As its warehouse-integrated logistics network covers the vast majority of the country, JD undoubtedly has the competitive advantage over the logistics systems. For now, JD.com is about to launch Jingdong RaaS "Retail-as-a-Service" Solution and in the meantime, teaming up with Tencent to develop the "Jingdong Unbounded Retail" program so that it can seize more offline resources.

3.2 EATBOX

The EATOWN, a subsidiary of the Ju Ran Group, opened EATBOX Supermarket in Beijing on January 14, 2017. The current layout of EATOWN includes: overseas direct selling platform "Sea Cat", gourmet supermarket "Faust Theater" and the unmanned convenience store "EATBOX" [14]. EATBOX is a 24-hour unmanned intelligent convenience store launched by the core team of Yi shijia Supermarket. Based on face recognition, visual recognition, pressure sensing and RFID tag technology, the process of purchasing and ordering are freely controlled by consumers. EATBOX covers an area of 35 square meters and contains 600-950 SKUs. It mainly sells snacks, drinks and beverages, most of which are imported directly from overseas. EATBOX emphasizes the "slow food culture" and it targeted the high-end purchasers.

The shopping process of EATBOX is shown in the Figure 4.



Figure 1 The shopping process of EATBOX

When entering EATBOX, customers are required to record their facial information. Although this process is currently guided by a clerk, in the future there will be a display screen which will show people how to completing this process on their own. After the recording the information, customers will be scanned by the security camera again. Inside the store, EATBOX's product identification is based on RFID technology. Each product has an RFID tag that can be identified at the settlement counter and generates a QR code on the display screen. The consumers will scan the code to complete the payment. When leaving the store, the security camera will scan their face once more and open the door automatically if nothing goes wrong. The weight-sensing device (the weight change of the person before and after shopping) underfloor is monitored to detect the theft.

The application of RFID technology is the particularity of EATBOX self-service store. Each product has an RFID tag on it for item identification, collecting the sales data, checking the synchronization with the background inventory, and anti-theft. The cost per label is about 4 cents, which is quite cheap. However, since the aluminum foil on the product packaging is likely to interfere with the RFID chips, the tags still need to be manually attached, which is quite a cumbersome process. Therefore, RFID tag is just a transition, and the technology for visually identifying goods is about to put into practice. Meanwhile, EATBOX will adopt a hybrid method of both RFID and visual recognition technology to ensure the system's stability.

EATBOX owns advantages in operating the self-service business. First, relying on the Ju Ran Group, EATBOX takes advantages of their head office and actively applies the Ju Ran Group's early incubation and location strategies. Yi Shijia Supermarket also provides them with original management team, the logistics, and warehouse resources. Moreover, EATBOX's location is in the mall, which enable them to maintain strict property compliance audit (firefighting and other compliance considerations) and access to relevant business licenses (circulation licenses) easily. By contrast, the indoor site is better than an outdoor one, since the consumers flow conversion rate is substantially larger and easier to monitor.

As for the future, EATBOX will not only lay emphasis on the layout and site selection, but also on the large-scale operation. For the site selection, EATBOX will expand the stores to high-end residential areas, CBD centers, high-technology zones, and universities. They will be widely spread in the North China, and attach importance to regional development. For the large-scale operation, it will focus on enhancing standardization capabilities in order to achieve rapid expansion and will carry out the goal of larger market. EATBOX will be future of high-end retail business.

4. Challenges of the Self-service business

Typical and high-quality enterprises could be the paradigms of self service business. However, what cannot be ignored is that the self-service market has just developed for approximately two years: it is still in a early stage. Despite the seemingly prosperous that the new retail market appears to look like, behind all these booms is the blind pursuit of new retail and the panic after the end of the Internet dividend. There are some difficulties through the process of unmanned retail's development.

4.1 The technological constraint

Product technological improvement is a prerequisite for the stabilization of self-service stores. The current technological drawbacks including several aspects. First, the sensors applied in the entry required timely calibration and should avoid humidity, temperature alteration and excessive pressure. This sensor systems are also required to be adjusted based on identical stores and therefore will incur high costs. Second, in order to achieve the omnibearing monitor of the store, multiple security cameras needs to be installed and the cost is high. Third, the AI technology is unstable and causing the cumbersome purchasing steps and poor user experience. As a result, unmanned retailers need to update the technology in order to achieve the corresponding goals during the development and reducing the errors that occurred through this process.

4.2 The inefficient regional market

The retail market is large yet the region that has applied self-service stores is rather small, and the stores are too scattered and therefore requires a further integration within the self-service retail market. The inefficient regional market may result in the low speed of products replenishment. The front-end market feedback is seriously mismatched with the back-end supply chain demand, and therefore, the supply is not timely, resulting in poor public praise of the whole self-service retail business. For a new business model which is still growing, this phenomenon is lethal.

4.3 The handicaps in large-scale expansion

In order to satisfy the customers, companies are increasingly expending their self-service capacities. However, the speed of this expansion is significantly limited and is much slower than the expansion of traditional convenience stores. The reason behind is that the unmanned convenience stores are smaller than traditional convenience stores and have fewer stocks. The frequency of the products replenishment is rather high, which requires higher standards of the supply chain as well. However, current supply chain fail to accomplish this task. Moreover, the speedy product iteration and the high standards of quality controls are also the unfavorable conditions for the large-scale expansion.

4.4 The competitive effect

The competitive effect is hard to achieve in the self-service retail market. It is known that the lower the entry barrier, the more competitive the market is. Since there is utterly no difference between the snacks, drinks, instant noodles, or other goods that different self-service stores supplied. If the enterprises do not form their unique products or user experiences, it is difficult to form differentiated competition. In the competition of unmanned stores, only the company which has a refined operation and better user experiences forms the competitive effect and gains trust form the consumers.

5. The future outlook of Self-service store development in China

The development of unmanned retail market, which is represented by the unmanned stores, has just begun. The professionals have pointed out that the convenience store market needs to continue investing for at least five years before it produces significant growth. Therefore, the market needs to accumulate experiences and develop gradually. Under the circumstances of continuous policy regulations and further encouragement of unmanned retail development, the data, technologies, supply chains and other aspects are jointly promoted. The unmanned retail market will be mutually compatible and closely integrate with the traditional business format. Moreover, the consumption habits of unmanned retail users will force the traditional market reform continuously (reducing costs and increasing efficiency). Unmanned retail business will generates breakthroughs in infrastructure technologies such as intelligent manufacturing and intelligent logistics. Self-service stores, unmanned warehouses, and unmanned aerial vehicles will cooperate with each other, and the intelligent space of the entire chain will be further improved. The breakthroughs of these technologies will further complement the development of the self-service stores will become one of the significant elements in promoting smart city.

For the technological aspects, the technology advancement will be oriented to the needs of consumers, operators and the industry chain. Optimizing the three mainstream technologies (Internet,

Internet of Things and Artificial Intelligence) in the existing self-service retail sector, including multi-technology integration with AI as the core is also the main direction of the development. Visual identification will be widely used. At the same time, system iterations will be carried out to achieve the most convenient shopping process. According to changes in consumer demands, timely adjustments, hardware upgrades and multiple technologies will be used, allowing consumers to ensure system security, flexibility and stability in an fully "self-service" state. It is to be expected that in the near future, technological providers will evolve from a single technology services to the full-solution services.

For the individual enterprises, they will mainly focus on technology upgrade, the expansion scale, supply chain optimization, and refined operation in stages. In the short term, the operation of unmanned retail enterprises will lay emphasis on technology optimization and the self-service market scale. By financing and expanding the franchise model, the stores will expand the market further. For example, the enterprise which has a drawback in logistics should cooperate with companies that obtain a substantial supply chain superiority such as MISSFRESH or Ele.me Food Delivery Service. In the medium term, the companies should improve the supply chain and management efficiency, including the promotion of technological algorithms, and the transformation of the supply chain. At the same time, the companies should seek to develop the mufti-scenarios which cover the major consumer scenarios, categories and commodity combinations of a better selection mode and a personalized push according to different users' preferences. In the long term, the companies will focus on the further improvement of refined operations, including attracting more users based on data feedback, analyzing multi-dimensional data, business extensions, and product innovation so that they can further enhance the user experience.

For the development of the self-service retail business, with the multiparty promotion, it is expected that industry will start a comprehensive development next season. In the first half of 2018, most of the self-service stores were in the trial operation stage. In the latter half of the year, leading companies will be quickly iterated and release new versions of their products. It is estimated that the significant technology optimization of unmanned stores will appear next year, and the industry will enter into a period of rapid expansion. In the next two years, there will be an increase in the number of enterprises, users' scale, single store output, frequency of consumption, and the overall transaction size of the retail market. At the same time, mergers and acquisitions will occur simultaneously between enterprises, and the competitive effect will be expanded after the large-scale integration, there will be a small number of companies remaining in the market, leading in the scale, technology, management and other aspects.

Self-service stores and intelligentization are the means to promote the development of the retail industry and it can solve the problems of efficiency, quality and cost of transitional retail industry. To achieve this goal, we must closely integrate with the essence of the retail business. If we can't fully apprehend the self-service retail business model, even the best technology applied is unable to produce desirable results. The development of future consumption patterns will coincide with the information era. Last year, bike-sharing promoted China's economy, and although self-service convenience stores are still in the early stage, it will be the future tendency of the retail industry.

6. Conclusion

This paper first introduces the status quo of the domestic and oversea self-service retail industry, and then it analyzes the favorable conditions for the development of China's unmanned retail market, including favorable external conditions, government's support, technological advancement and the public attention. The paper then gives JD. X self-service store and EATBOX as the examples to indicate the retail business model of self-service stores in China. Finally, the paper explains the challenges in technology, regional market, large-scale expansion and competitive effects that the self-service stores in China currently face. This paper is of importance to China's self service retail industry for it points out the problems and the direction of the self-service stores' future development.

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