

The Effect of Transportation Digitalization on the Operating Capacity of Fresh Retail Enterprises: Evidence from Carrefour

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Abstract. Against the backdrop of the deep integration of the digital economy and the real economy, the fresh retail industry has increasingly high requirements for transportation link efficiency, whereas existing research on the relationship between transportation digitalization and operating capacity in the fresh retail sector remains inadequate. Taking Carrefour as a case study, this paper analyzes the structure, characteristics and digital transportation layout of its fresh supply chain, and examines changes in its operating capacity from the perspectives of accounts receivable, inventory and accounts payable management. This study finds that transportation digitalization in the fresh retail industry exerts a significant positive effect on corporate operating capacity. Digital transformation of transportation, procurement and warehousing processes enables data connectivity, reduces information lags and improves the operating capacity of enterprises. This paper refines the theoretical relationship between supply chain digitalization and working capital management and provides a practical reference for transportation link digitalization among fresh retail enterprises. This paper also identifies research limitations in quantitative analysis and research perspectives and proposes directions for future research.

Keywords: fresh retail industry, transportation digitalization, operating capacity

1. Introduction

Against the background of the deep integration of the digital economy and real economy, digital technologies such as big data, the Internet of Things and artificial intelligence are accelerating penetration into all supply chain links and becoming core driving forces for the transformation and upgrading of the fresh retail industry [1]. In recent years, the scale of China's fresh retail market has continued to expand, and consumers' requirements for the quality and distribution timeliness of fresh products have been increasing [2]. Driven by product perishability, delivery timeliness and inventory sensitivity, the fresh retail industry imposes higher requirements on the efficiency and accuracy of transportation links [3]. As the core circulation link for fresh products from origins to terminal stores, transportation digitalization has become the key to optimizing corporate operating capacity and enhancing market competitiveness, which constitutes the research object of this paper [4].

Digital research on fresh transportation generally focuses on technology empowerment and supply chain synergy, confirming that digital technology is the core driving force for the reconstruction of the fresh supply chain [5]. The study points out that digital transformation can strengthen the resilience of the supply chain through process integration and data exchange, and its digital transformation and the digital transformation of the overall supply chain forms a synergistic effect to provide support for the improvement of operational capacity [6]. The relevant research on operational capacity further clarifies the role of transportation digitalization and points out that core indicators such as inventory turnover and accounts receivable turnover are the key to measuring operational capacity [7]. Although the existing studies have confirmed the significant correlation between the two, the in-depth case study on the specific implementation path and localization mechanism of transportation digitalization of fresh retail leading enterprises still needs to be supplemented, especially the lack of targeted analysis of the practice of international retail enterprises in the local market, which has also become the core direction of this paper.

Operating capacity is the core indicator to measure the operating vitality of fresh retail enterprises, which directly reflects the comprehensive ability of enterprise capital turnover, inventory control, and supply chain coordination, and there is a significant internal correlation between the digital level of transportation links and operating capacity [8]. In this context, taking Carrefour as a research case, this paper systematically explores the impact path of digitalization of transportation links on operational capacity of fresh retail enterprises, aiming to reveal the application value of digitalization technology in fresh transportation links, make up for the gaps in existing research in subdivision and practice, and provide practical reference for fresh retail enterprises to optimize operational capacity and enhance operational efficiency through digitalization of transportation links. It also provides experience for the digital transformation of the industry supply chain, which has important theoretical value and practical significance.

2. Impact of the digitalization of transportation links on operating capacity

2.1. Fresh retail business overview

Carrefour Group, founded in 1959, pioneered a new model of large-scale supermarket retail in 1963. After years of development, it has become the second-largest retailer in the world and the largest retailer in Europe, covering supermarkets, convenience stores, e-commerce platforms, and other retail forms. After entering the Chinese market, Carrefour has opened more than 200 offline supermarkets in more than 70 cities. While deeply developing the local retail market, Carrefour focuses on the layout of its fresh retail business and strives to provide consumers with cost-effective, fresh and high-quality products.

Carrefour has formed distinct operational characteristics in the field of fresh retail, not only focusing on the dual control of product price and quality, but also forming core advantages in the localization and refined management of the fresh supply chain. Its supply chain management mode of fresh agricultural products provides an important reference for the development of the domestic fresh supermarket docking mode. In view of the industry characteristics of fresh products, Carrefour has built a whole-chain fresh distribution system covering direct procurement of origin, logistics distribution and terminal sales, and gradually promoted the digital transformation of transportation links, integrating digital technology into key links such as demand forecasting, route planning and whole process control of fresh transportation, which has become an important support for the stable development of its fresh retail business. It also provides a typical case sample for studying the

relationship between the digitalization of transportation links and the operating capacity of fresh retail enterprises.

2.2. Supply chain and digital transportation layout

Carrefour takes the headquarters as the core to realize the centralized control and dynamic adjustment of the national fresh supply chain. Its fresh supply chain completely covers the whole process from fresh raw material suppliers, logistics distributors, to terminal stores to consumers, forming a network supply chain structure with headquarters supply chain management as the center and suppliers, logistics enterprises, and offline stores as nodes. As a fresh retail terminal, Carrefour is the core link of the fresh supply chain. The upstream connects with the origin of agricultural products, breeding bases, and various fresh suppliers, and the downstream directly faces the end consumers. It not only provides stable sales channels for agricultural product manufacturers, but also provides standardized and fresh products for consumers. The internal structure of Carrefour's fresh supply chain is deeply integrated by supply link, marketing link, and inventory distribution link, among which the inventory distribution link is the core link, while the transportation link is the key carrier of inventory distribution, which directly determines the circulation efficiency and product wastage level of the fresh supply chain.

Based on the characteristics of fresh products, Carrefour's fresh supply chain has formed the characteristics of differentiation with the ordinary retail supply chain, and matches the digital transformation of transportation links. First, it implements headquarters-led centralized management. Carrefour's headquarters coordinates nationwide planning for fresh product procurement, transportation and distribution, promotes headquarters-based deployment and data exchange of digital systems, and provides an organizational guarantee for digital scheduling of transportation links. Second, a consumer demand-oriented pull supply chain. Supply chain terminals directly connect with consumer demand, and reverse guide fresh procurement and transportation plans through terminal sales data, which is in line with the core logic of digital demand forecasting. At the same time, the localization layout of the direct supply of its own base. Carrefour has an exclusive vegetable base and breeding base, and the base products are directly supplied to offline stores to shorten the time of fresh transportation and provide scene support for the landing of the direct transportation mode in digital producing areas. Secondly, the supply chain operation mode combining mass procurement and high-frequency distribution is adopted. Carrefour relies on the scale of offline stores to achieve mass direct mining in the wholesale market, while implementing high-frequency and small batch distribution in stores according to the characteristics of fresh and perishable, which puts forward the need for digital planning and precise control of transportation links, and has also become a breakthrough point for digital transformation.

3. The operating capacity of fresh food business

3.1. The proportion of accounts receivable and inventory

Accounts receivable is the amount that enterprises should collect from customers for selling goods and providing services, and it is an important part of current assets. For fresh retail enterprises, the proportion of accounts receivable in current assets directly reflects the extent to which the working capital of enterprises is occupied by customers: a high proportion means that a large amount of funds remains in the collection link, which will reduce the efficiency of capital use and even increase the risk of bad debts. The stable proportion and reasonable range indicate that the

management of sales repayment of enterprises is healthy and orderly. By improving the efficiency of order performance and the punctuality of distribution, the digital transformation of transportation links helps to optimize customer settlement experience, shorten the repayment cycle, and indirectly promote the proportion of accounts receivable to remain at a reasonable level [9]. As shown in Figure 1, from the perspective of the proportion of accounts receivable, the overall stability of the index in the five years is in a reasonable range of 17% - 19%, and there is no significant fluctuation. As a fresh retail enterprise dominated by cash sales, the proportion of Carrefour's accounts receivable is at a low level, which is consistent with the settlement characteristics of the industry's cash on hand. At the same time, the stability of the proportion also reflects the positive impact of the digital transformation of transportation links. The efficiency of distribution has been improved, and the stability of performance has been enhanced. It helps to optimize customer settlement experience, maintain a healthy rhythm of repayment, reduce the risk of overdue accounts, and thus maintain a reasonable level of accounts receivable.

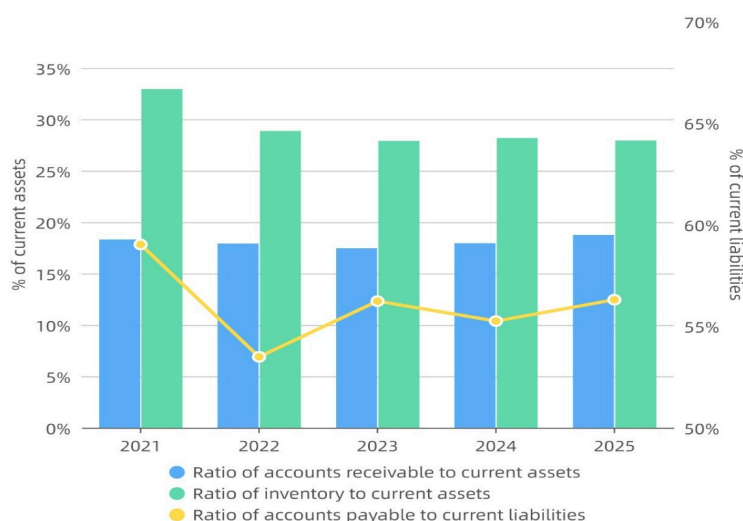


Figure 1. Ratio of accounts receivable and inventory to current assets (picture credit: original)

Inventory is another core component of the current assets of fresh retail enterprises, and its proportion in the current assets directly reflects the efficiency level of inventory management and supply chain synergy. Digital transformation of transportation links can effectively reduce unnecessary safety inventory and reduce the occupation of working capital by inventory by optimizing the distribution path, reducing fresh loss, and improving the response speed of replenishment. Therefore, this paper selects the proportion of accounts receivable and inventory in current assets as the core observation index to characterize the optimization effect of digital scheduling on Carrefour's working capital occupation from the structural level, so as to provide basic support for the follow-up analysis of operating efficiency. Carrefour's ratio of accounts receivable and inventory to current assets in 2021-2025 shows significant structural optimization characteristics. The change in the proportion of inventory in current assets more intuitively reflects the optimization effect of transportation digitalization. In 2021, the proportion was about 33%, and then it gradually declined to about 28% in 2025, a decline of nearly 5% in five years. This trend directly confirms the improvement of fresh inventory management by digital transformation of transportation links, that is, through intelligent distribution path planning, dynamic replenishment scheduling, and precise loss control. Carrefour effectively reduces unnecessary safety inventory,

reduces the occupation of working capital by fresh inventory, and promotes the continuous improvement of inventory turnover efficiency.

On the whole, the changes of the two indicators jointly reflect the optimization of Carrefour's working capital structure. The proportion of accounts receivable remained stable, and the management of repayment was healthy and orderly. The proportion of inventory continued to decline, and the efficiency of capital occupation increased significantly. This result is highly consistent with the implementation rhythm of digital transformation of transportation links, indicating that the improvement of enterprise operating capacity by digital scheduling has been reflected at the structural level.

3.2. Analysis of accounts payable

Accounts payable is the amount that an enterprise should pay to suppliers but has not yet paid due to business activities such as purchasing commodities and accepting labor services, which belong to the operating current liabilities of an enterprise [10]. The proportion of accounts payable to current liabilities reflects the proportion of operating liabilities in the short-term debt structure of enterprises, and to a certain extent reflects the dependence of enterprises on supplier credit funds and the bargaining power of the supply chain. Rational use of the supplier accounting period can effectively alleviate the pressure of working capital. However, if it is excessively occupied or overdue, it may damage the credit of enterprises and trigger the risk of supply interruption.

From the perspective of data changes, the proportion of Carrefour accounts payable in current liabilities reached a high of 59% in 2021, fell back to about 53% in 2022, and then stabilized at about 55% in 2023-2025, with the overall fluctuation tending to be flat. This change shows that Carrefour actively optimized the short-term debt structure in 2022 and reduced its dependence on supplier credit funds. The follow-up was maintained at about 55%, indicating that the supply chain cooperation relationship of enterprises has gradually returned to stability, and the accounting period policy has also returned to the conventional level. Overall, Carrefour has not seen the proportion of accounts payable continue to rise, excessive occupation of supplier funds, nor has it caused a credit crisis due to arrears, and its accounts payable management is overall in a healthy and controllable state.

4. Conclusion

In view of the core research problems of this paper, combined with Carrefour's case analysis, it can draw the following conclusions: the digitalization of supply chain transportation links of fresh retail enterprises has a significant positive effect on operating capacity, and the impact is not a direct effect, but a transmission with procurement links and inventory links as the core intermediaries. Through the digital transformation of the transportation process, enterprises can connect procurement and warehousing data, reduce information lag, and then enhance the overall operating capacity. Specifically, digital means improve the key problems such as purchasing capital occupation and inventory turnover efficiency from the source by optimizing the demand forecast, whole process control, and information coordination of fresh transportation, and finally realize the all-round optimization of enterprise operating capacity. At the theoretical level, this paper reveals the specific transmission mechanism of transportation digitalization of fresh retail enterprises to operating capacity, improves the theoretical relationship between supply chain digitalization and working capital management, and provides a theoretical framework and analytical ideas for follow-up empirical research. At the same time, taking Carrefour as a typical case of localization, this paper

combines digital technology with the actual operation of fresh retail enterprises, enriches the application of case study in the field of fresh supply chain management, makes relevant theoretical research more suitable for industry practice, and improves the landing and explanatory power of the theory. At the practical level, this paper combs the digital practical measures of Carrefour's fresh transportation links, such as digital demand forecasting, the construction of direct procurement and distribution platform in origin, and the whole process control of the Internet of things, which provides a landing digital transformation path for fresh retail enterprises, and can guide enterprises to combine their own scale and business characteristics to improve the efficiency of digital transformation and operating capacity.

There are still some limitations in this paper, which only focuses on the perspective of internal operation of enterprises and does not include the regulatory role of external environmental factors, such as market competition and logistics infrastructure. Future research can be carried out from two aspects: one is to expand the research perspective, incorporate external environmental factors such as market competition, logistics infrastructure, and policy support into the research framework, analyze their regulatory role in the relationship between digitalization of transportation links and operating capacity, and improve the comprehensiveness and systematicness of the research framework. The second is to deepen the research on digital practice, excavate the specific practical details of the digitalization of transportation links of fresh retail enterprises through enterprise research and in-depth interviews, analyze the application scenarios and landing effects of different digital technologies such as big data and the Internet of things, and summarize the key success factors and potential problems of digital transformation, so as to provide more targeted practical guidance for enterprises.

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