Research on the Synergy Mechanism between Omni - channel Marketing and Agile Supply Chain Enabled by Digital Finance

Zirui Zeng [1, *], Huijie Tang [2, *], Zhoufan Yu [3, c], Huanyu Liu [4, d], Huili Lei [5, *]

[1] Sukhoi State Technical University of Gomel, Belarus

[2] University of Michigan, Master of Supply Chain Management, 500 S. State St, Ann Arbor, MI 48109, America

[3] Master's in Applied Economics and Management, Cornell University, Ithaca, New York, America

[4] Johns Hopkins University Carey Business School, Master of Science in Marketing, 100 International Drive, Baltimore, America

[5] Chengdu University of Technology, Chengdu, China

* Corresponding Author Email: 1172503590@qq.com

Abstract. In the wave of digital transformation, digital finance, as an emerging financial model, plays a crucial role in the coordinated development of enterprises' omni - channel marketing and agile supply chain. This paper deeply analyzes the internal mechanism of digital finance enabling the synergy between the two. Through the construction of a theoretical model and empirical testing combined with actual data, it reveals the realization path and influencing factors of their synergy effect. The research finds that digital finance significantly promotes the coordinated development of omni - channel marketing and agile supply chain by optimizing capital allocation, providing accurate marketing support, and enhancing supply chain resilience, providing a new source of power for enterprises to enhance their competitiveness.

Keywords: Digital Finance; Omni - channel Marketing; Agile Supply Chain; Synergy Mechanism.

1. Introduction

With the rapid development of information technology, digital finance has become an important force for change in the global financial field. Relying on cutting - edge technologies such as big data, artificial intelligence, and blockchain, digital finance breaks through the time - space limitations of traditional finance and brings new opportunities and challenges to the operation and development of enterprises. At the same time, the diversification of consumer demands and the increasingly fierce market competition prompt enterprises to actively seek innovative marketing models and efficient supply chain management strategies. Omni - channel marketing emphasizes the integration of online and offline channels to provide consumers with a seamless shopping experience; agile supply chain focuses on the rapid response to market changes to improve the operational efficiency and flexibility of enterprises. Against this background, how to use the power of digital finance to achieve the coordinated development of omni - channel marketing and agile supply chain has become an important issue that enterprises urgently need to solve[1].

From a theoretical perspective, digital finance, omni - channel marketing, and agile supply chain belong to different research fields, but there are close internal connections among them. However, the current research on the synergy mechanism of the three is still in its infancy, lacking systematic theoretical analysis and empirical testing. From a practical perspective, many enterprises, during the digital transformation process, although aware of the potential value of digital finance, still face many puzzles and problems in how to effectively apply it to the coordinated development of omni - channel marketing and agile supply chain. Therefore, in - depth research on the synergy mechanism of omni - channel marketing and agile supply chain enabled by digital finance has important theoretical and practical significance[2].

2. Theoretical Overview of Digital Finance, Omni - channel Marketing and Agile Supply Chain

2.1 Connotation and Development of Digital Finance

Digital finance refers to the activities in which traditional financial institutions and Internet enterprises use digital technology to realize financing, payment, investment, and other new financial businesses (Huang Yiping, 2018). The development of digital finance can be traced back to the 1990s. With the rise of Internet technology, electronic banking, online payment, and other businesses gradually emerged. In recent years, with the continuous maturity of technologies such as big data, artificial intelligence, and blockchain, digital finance has entered a stage of rapid development, showing diverse business forms, such as mobile payment, online lending, digital currency, and robo - advice[3].

Digital finance has many remarkable characteristics. First, data - driven is one of the core characteristics of digital finance. Through the collection, analysis, and mining of massive data, financial institutions can more accurately assess the credit risks of customers and provide personalized financial products and services. For example, Sesame Credit under Ant Financial constructs a credit evaluation model by analyzing multi - dimensional data of users' consumption, wealth management, social interaction, etc. on the Alipay platform, providing users with convenient credit services. Second, digital finance is efficient and convenient. With the help of the Internet and mobile terminals, users can conduct financial transactions anytime and anywhere, greatly improving the efficiency of financial services. Take mobile payment as an example. Consumers only need to scan the QR code with their mobile phones to complete the payment without carrying cash or bank cards. The whole process only takes a few seconds. In addition, digital finance also has the advantage of strong innovation ability. New financial products and service models emerging continuously meet the diversified needs of different customer groups.

According to relevant data, in recent years, the global digital finance market has shown explosive growth. In 2020, the global digital finance market size reached about $11.5 trillion, and it is expected to grow to about $23.6 trillion by 2025, with a compound annual growth rate of more than 15% (Statista, 2021). In China, the development of digital finance is even more rapid. By the end of 2020, the transaction volume of China's third - party mobile payment reached 271.173 billion transactions, a year - on - year increase of 18.59%; the cumulative turnover of the online lending industry exceeded 9 trillion yuan (China Internet Network Information Center, 2021). These data fully show that digital finance has become an important trend in the development of the global financial market[4].

2.2 Concept and Strategies of Omni - channel Marketing

Omni - channel marketing is a consumer - centered marketing concept that integrates all online and offline channels, including physical stores, websites, mobile applications, social media, e - mails, etc., aiming to provide consumers with a seamless shopping experience, regardless of when, where, and how they interact with the brand (Verhoef et al., 2015). The rise of omni - channel marketing mainly stems from the changes in consumers' shopping behavior. With the popularization of the Internet and mobile devices, consumers are no longer limited to a single channel in the shopping process but tend to switch between different channels to obtain more information and a better shopping experience. For example, consumers may search for product information online, then go to a physical store to try on or test the product, and finally place an order online[5].

The key strategies of omni - channel marketing include the following aspects. First, channel integration. Enterprises need to organically integrate online and offline channels to achieve real - time synchronization of information such as product inventory, price, and promotional activities, ensuring that consumers can obtain a consistent experience when switching between different channels. For example, Sephora integrates its online official website, mobile application, and offline stores. Consumers can choose to pick up products at the store after placing an order online or place an order through the mobile application after experiencing the products in the store, achieving a seamless

connection between online and offline channels. Second, personalized marketing. With the help of big data and artificial intelligence technologies, enterprises can deeply understand consumers' needs, preferences, and behavior patterns, so as to provide them with personalized product recommendations and marketing activities. For example, Amazon accurately recommends products that meet users' interests based on the analysis of users' purchase history, browsing records, and other data, greatly improving the user's purchase conversion rate. Third, customer experience optimization. Omni - channel marketing focuses on enhancing consumers' experience throughout the shopping process, including pre - sales consultation, in - sales service, and after - sales service. Enterprises enhance consumers' satisfaction and loyalty to the brand by providing a convenient shopping interface, fast logistics distribution, high - quality customer service, etc. For example, Apple provides professional product consultation and technical support for consumers in its physical stores around the world, and at the same time, through online customer service and after - sales service hotlines, it timely solves the problems encountered by consumers, creating an excellent shopping experience for consumers.

2.3 Characteristics and Construction of Agile Supply Chain

Agile supply chain is a supply chain management model that can quickly respond to market changes and customer needs. It emphasizes the flexibility, adaptability, and synergy of the supply chain. By integrating all links in the supply chain, it realizes information sharing, optimal resource allocation, and rapid decision - making, thereby improving the competitiveness of enterprises (Christopher, 2016). Compared with traditional supply chains, agile supply chains have the following remarkable characteristics. First, rapid response ability. Agile supply chains can quickly respond to changes in market demand, timely adjust production plans and logistics distribution to meet customers' personalized needs. For example, ZARA, as a representative of fast - fashion brands, can push new clothing from design to market in just 10 - 15 days through the establishment of an efficient supply chain system, which is much faster than the production cycle of traditional clothing brands. Second, high flexibility. Agile supply chains can flexibly adjust the structure and operation mode of the supply chain according to market changes and fluctuations in customer demand. For example, in the face of sudden growth in market demand, agile supply chains can quickly increase production capacity, optimize logistics distribution routes, and ensure that products can be supplied to the market in a timely manner. Third, collaborative cooperation. Agile supply chains emphasize the collaborative cooperation among all links in the supply chain. By establishing close partnership relations, they achieve information sharing, risk sharing, and benefit sharing. For example, Toyota Motor Corporation has established long - term and stable cooperative relations with its parts suppliers, jointly researching and developing new products, optimizing production processes, and achieving efficient collaborative operation of the supply chain.

The construction of an agile supply chain needs to start from multiple aspects. First, enterprises need to establish an efficient information system to achieve real - time sharing and rapid transmission of information in the supply chain. Through the information system, enterprises can timely grasp key information such as market demand, inventory level, and production progress, providing support for rapid decision - making. For example, Walmart has established a world - leading retail information system, realizing real - time monitoring and management of its global stores, and can timely adjust product procurement and distribution plans according to sales data. Second, optimizing the supply chain network layout is also an important part of constructing an agile supply chain. Enterprises need to rationally layout production bases, warehouses, and distribution centers according to market demand and geographical distribution, shortening the transportation time and cost of products. For example, Huawei has established multiple R & D centers, production bases, and logistics centers around the world. By optimizing the supply chain network layout, it has improved its response ability to the global market. In addition, strengthening the collaborative cooperation with suppliers and partners and establishing long - term and stable strategic partnership relations are also the keys to constructing an agile supply chain. Enterprises need to jointly formulate production plans with

suppliers, optimize the procurement process, reduce inventory costs, and achieve the overall optimization of the supply chain.

3. Construction of the Theoretical Model of Digital Finance Enabling the Synergy between Omni - channel Marketing and Agile Supply Chain

3.1 Theoretical Basis of the Synergy Mechanism

The theoretical basis of digital finance enabling the synergy between omni - channel marketing and agile supply chain mainly includes transaction cost theory, resource - based theory, and synergy effect theory.

Transaction cost theory believes that enterprises will generate various costs in the market transaction process, such as information search costs, negotiation costs, and supervision costs. The emergence of digital finance reduces information asymmetry through information technology means, reduces friction and uncertainty in the transaction process, and thus reduces transaction costs. For example, in omni - channel marketing, digital finance platforms can provide enterprises with consumers' credit information and consumption behavior data, helping enterprises more accurately assess customer risks and reducing credit review costs; in agile supply chains, digital finance realizes the transparency and traceability of supply chain information through blockchain technology, reducing the supervision costs between enterprises.

Resource - based theory emphasizes that the uniqueness and non - imitability of internal resources of enterprises are the source of enterprise competitive advantage. Digital finance, as a new type of resource, provides strong support for the coordinated development of enterprises' omni - channel marketing and agile supply chain. Digital finance platforms have massive user data, advanced technical algorithms, and powerful capital allocation capabilities. These resources can be organically integrated with enterprises' marketing resources and supply chain resources to form a unique competitive advantage. For example, enterprises can use the data analysis capabilities of digital finance platforms to deeply understand consumer needs and formulate accurate marketing strategies; at the same time, with the financial support of digital finance, optimize the capital flow of the supply chain and improve the operational efficiency of the supply chain.

Synergy effect theory believes that when two or more systems interact, a synergy effect will be generated, making the overall performance greater than the sum of the performances of each part. The coordinated development of omni - channel marketing and agile supply chain enabled by digital finance precisely realizes the optimal allocation of resources and maximizes value by giving play to the synergy effect. In the synergy process, omni - channel marketing provides more accurate market demand information for the agile supply chain, helping the supply chain better allocate resources and plan production; the agile supply chain provides efficient product supply and logistics distribution support for omni - channel marketing, ensuring that consumers can obtain products and services in a timely manner. Digital finance plays the role of a bridge and link in it. By providing financial support, optimizing capital flow and information flow, it promotes the deep integration of omni - channel marketing and agile supply chain, maximizing the synergy effect.

3.2 The Empowerment Mechanism of Digital Finance for Omni - channel Marketing

3.2.1 Accurate Marketing Support

Digital finance platforms have accumulated massive user transaction data, credit data, and behavior data. Through big data analysis and artificial intelligence algorithms, they can deeply tap consumers' needs, preferences, and purchase intentions, providing enterprises with accurate market segmentation and target customer positioning. Enterprises can formulate personalized marketing strategies based on the data analysis results provided by digital finance platforms, push product information and promotional activities that meet consumers' needs, and improve the accuracy and effectiveness of marketing. For example, Alipay analyzes users' consumption behavior data on the

platform and provides user portraits and consumption preference information for cooperative merchants. Merchants can carry out targeted marketing activities based on this information, such as pushing exclusive coupons to high - consumption - potential users and recommending relevant products to specific interest groups, effectively improving the marketing conversion rate.

3.2.2 Innovative Marketing Models

The development of digital finance has given birth to a series of innovative marketing models, such as consumer finance marketing and social finance marketing. Consumer finance marketing stimulates consumer demand by providing consumers with financial services such as installment payment and small - amount loans, reducing the purchase threshold for consumers. For example, "JD BaiTiao" launched by JD Finance provides users with the service of consuming first and paying later. Users can choose to pay in installments when shopping, greatly improving users' purchasing power and shopping experience. Social finance marketing combines financial products and services with social interaction by virtue of the communication power of social media platforms, achieving word - of - mouth communication and accurate marketing. For example, WeChat Pay, through its deep integration with the WeChat social platform, has launched social finance functions such as red envelopes and transfers. When users use these functions, they naturally come into contact with the relevant financial services of WeChat Pay, and at the same time, bring more user traffic to WeChat Pay through social sharing.

3.2.3 Optimizing Customer Experience

In omni - channel marketing, the payment link is one of the key factors affecting the customer experience. Digital finance provides a variety of convenient payment methods, such as mobile payment, QR code payment, face - recognition payment, etc., meeting consumers' payment needs in different scenarios and improving the efficiency and security of payment. At the same time, digital finance platforms also optimize consumers' post - shopping experience through services such as real - time settlement and rapid refund processing. For example, in e - commerce shopping, after consumers use Alipay or WeChat Pay to complete an order, they can immediately receive a payment success notice, and merchants can also receive the payment in real - time, realizing the rapid transfer of funds; if consumers need to return the goods and get a refund, the digital finance platform can complete the refund operation in a short time, allowing consumers to feel convenient and efficient services.

3.3 The Empowerment Mechanism of Digital Finance for Agile Supply Chain

3.3.1 Optimizing Capital Flow Management

The efficient operation of an agile supply chain cannot do without sufficient financial support. Digital finance provides diversified financing channels for enterprises in the supply chain through the supply chain finance model. For example, accounts receivable financing, inventory pledge financing, order financing, etc., help enterprises solve the problem of capital shortage and optimize capital flow management. Take accounts receivable financing as an example. Suppliers of core enterprises can transfer the accounts receivable they hold to digital finance platforms or financial institutions to obtain funds in advance and relieve financial pressure; while core enterprises can extend the payment period to improve their own capital use efficiency. Digital finance platforms can accurately assess the credit risks of enterprises through the analysis of transaction data in the supply chain, provide enterprises with reasonable financing amounts and interest rates, and achieve the optimal allocation of funds.

3.3.2 Improving Supply Chain Visibility

Digital finance, with the help of technologies such as the Internet of Things and blockchain, realizes the real - time collection and sharing of supply chain information, improving the visibility of the supply chain. By deploying sensors and intelligent devices in all links of the supply chain, digital finance platforms can real - time obtain information such as the location, status, and transportation

track of goods, and ensure the authenticity and non - tampering of information through blockchain technology. Enterprises can monitor the operation of the supply chain in real - time through digital finance platforms, timely discover and solve problems, and improve the transparency and controllability of the supply chain. For example, in the logistics transportation process, cargo owners and logistics enterprises can view the transportation location and estimated arrival time of goods in real - time through digital finance platforms, make advance preparations for receiving and distributing goods, and avoid problems such as cargo delays and losses.

3.3.3 Enhancing Supply Chain Resilience

In the face of market fluctuations, natural disasters and other sudden situations, agile supply chains need to have strong resilience and anti - risk capabilities. Digital finance can conduct real - time monitoring and early warning of supply chain risks through big data analysis and risk early - warning models, helping enterprises make advance preparations. At the same time, digital finance platforms can also provide emergency financial support for enterprises, helping enterprises maintain the normal operation of the supply chain in times of crisis. For example, during the COVID - 19 pandemic, many enterprises faced the risk of capital chain. Digital finance platforms quickly launched a series of emergency loans and financial support policies for small and medium - sized enterprises, helping enterprises tide over difficulties and ensuring the stability of the supply chain.

3.4 The Synergy Mechanism between Omni - channel Marketing and Agile Supply Chain

3.4.1 Information Sharing and Collaborative Decision - making

Omni - channel marketing collects a large amount of consumer demand information, market feedback information, and sales data by integrating online and offline channels. These information can be transmitted in real - time to the agile supply chain, providing a decision - making basis for the supply chain's production planning, inventory management, and logistics distribution. At the same time, the agile supply chain also feeds back product supply information, production progress information, and logistics status information to the omni - channel marketing department, helping the marketing department better arrange promotional activities and customer services. Through information sharing and collaborative decision - making, omni - channel marketing and agile supply chain can achieve seamless docking, improving the enterprise's market response speed and operational efficiency. For example, when the omni - channel marketing department finds that the market demand for a certain product suddenly increases, it timely

3.4.2 Optimal Allocation of Resources

The coordinated development of omni-channel marketing and agile supply chain helps to achieve the optimal allocation of internal resources within an enterprise. In terms of marketing resources, enterprises can reasonably arrange marketing activities and promotional resources according to the product supply information and inventory status provided by the agile supply chain, avoiding the waste of marketing resources caused by product shortages or overstocking. In terms of supply chain resources, enterprises can optimize the production and distribution resources of the supply chain based on the market demand information fed back by omni-channel marketing, improving resource utilization efficiency. For example, enterprises can rationally allocate production resources according to the sales data of different channels, giving priority to the production of products with strong market demand; at the same time, they can optimize the logistics distribution routes according to the sales situation in different regions to reduce logistics costs.

3.4.3 Customer Value Creation

The ultimate goal of the synergy between omni-channel marketing and agile supply chain is to create greater value for customers. Through omni-channel marketing, enterprises can provide customers with personalized and convenient shopping experiences; through the agile supply chain, enterprises can ensure the timely supply and high-quality delivery of products. The synergistic effect of the two enables customers to enjoy better products and services during the shopping process,

improving customer satisfaction and loyalty. For example, after consumers place an order to purchase goods on the omni-channel marketing platform, the agile supply chain can respond quickly, and deliver the goods to consumers in a timely manner through efficient logistics distribution while ensuring the quality and integrity of the goods. After having a satisfactory shopping experience, consumers are more likely to choose the products and services of this enterprise, thus creating more value for the enterprise.

4. Empirical Analysis of the Synergy between Omni-channel Marketing and Agile Supply Chain Enabled by Digital Finance

4.1 Research Hypotheses

Based on the above theoretical analysis, the following research hypotheses are proposed:

H1: Digital finance has a significant positive impact on the coordinated development of omni-channel marketing and agile supply chain.

H2: Digital finance promotes the coordinated development of omni-channel marketing and agile supply chain through accurate marketing support.

H3: Digital finance promotes the coordinated development of omni-channel marketing and agile supply chain through innovative marketing models.

H4: Digital finance promotes the coordinated development of omni-channel marketing and agile supply chain by optimizing capital flow management.

H5: The information sharing and collaborative decision-making between omni-channel marketing and agile supply chain play a mediating role in the relationship between digital finance and their coordinated development.

H6: The optimal allocation of resources between omni-channel marketing and agile supply chain plays a mediating role in the relationship between digital finance and their coordinated development.

4.2 Variable Selection and Data Sources

4.2.1 Variable Selection

Explanatory variable: The development level of digital finance (DF) is measured by the proportion of the digital finance market size to GDP. This indicator comprehensively reflects the overall scale of digital finance business in a region or country and its importance in the economic system. The digital finance market size covers the total transaction volume of multiple fields such as mobile payment, online lending, and digital currency. By taking the ratio to GDP, it can eliminate the influence of economic scale differences and more accurately reflect the development degree of digital finance.

Explained variable: The synergy degree between omni-channel marketing and agile supply chain (CS). A comprehensive indicator system is constructed to measure the synergy degree, covering dimensions such as the degree of information sharing, the efficiency of collaborative decision-making, the degree of resource allocation optimization, and the level of customer value creation. For example, the degree of information sharing is measured by the timeliness and accuracy of information transmission among upstream and downstream enterprises in the supply chain; the efficiency of collaborative decision-making examines the time interval and decision-making quality for making decisions in response to market changes; the degree of resource allocation optimization can be evaluated from aspects such as inventory turnover rate and the input-output ratio of marketing resources; the level of customer value creation is reflected by indicators such as customer satisfaction and repurchase rate. By conducting a weighted average of the indicators of these dimensions, the synergy degree between omni-channel marketing and agile supply chain is obtained.

Mediating variables:

Accurate marketing effect (PM): It is measured by indicators such as the customer response rate of marketing activities and the accuracy rate of precise targeting of target customers. The customer

response rate reflects the degree of consumers' participation in marketing activities, and the accuracy rate of precise targeting reflects the accuracy of enterprises' positioning of target customers based on the data provided by digital finance. The two comprehensively reflect the actual effect of accurate marketing.

Innovation degree of marketing models (MI): It is measured by the proportion of sales revenue brought by new marketing models to the total sales revenue and the market expansion speed of new marketing models. The higher the proportion of sales revenue of new marketing models and the faster the market expansion speed, the higher the innovation degree of marketing models.

Optimization degree of capital flow (CF): It is measured by indicators such as the reduction rate of financing costs of supply chain enterprises and the improvement rate of capital turnover speed. The reduction rate of financing costs reflects the decline in the cost of enterprises obtaining funds with the help of digital finance, and the improvement rate of capital turnover speed reflects the improvement of the capital circulation efficiency in the supply chain. The two jointly reflect the optimization degree of capital flow.

Control variables: Enterprise size (Size) is measured by the total assets or operating income of the enterprise, because the enterprise size may affect its capabilities and decisions in digital finance application, marketing resource investment, and supply chain management. Industry type (Industry). There are differences in market competition degree, product characteristics, and supply chain complexity among different industries, which will have an impact on the synergy between omni-channel marketing and agile supply chain. The industry types are classified and controlled. Market competition degree (Comp) is measured by industry concentration indicators (such as the CR4 or HHI index). The more intense the market competition, the more motivated enterprises are to use digital finance to enhance the synergy level between omni-channel marketing and agile supply chain.

4.2.2 Data Sources

The data mainly come from three aspects. First, authoritative financial databases, such as the Wind database and the CEIC database, are used to obtain macroeconomic data such as the digital finance market size and GDP, as well as market competition data such as industry concentration [6]. Second, data are collected through questionnaires to enterprises. Enterprises of different industries and sizes are selected as the survey objects, and the questionnaire content covers the enterprises' omni-channel marketing practices, agile supply chain management situations, the degree of digital finance application, accurate marketing effects, innovation situations of marketing models, the optimization degree of capital flow, and basic enterprise information [7]. To ensure the quality of the questionnaire data, pre-investigations and expert consultations are carried out in the questionnaire design stage, and the questionnaire content is repeatedly revised and improved; when the questionnaires are distributed, a combination of stratified sampling and random sampling methods is adopted to improve the representativeness of the samples; after the questionnaires are collected, the data are strictly screened and cleaned, and invalid questionnaires are excluded. Third, enterprise annual reports and publicly disclosed information are used to supplement data related to enterprise size, industry type, and part of marketing and supply chain, so as to enrich the data sources and improve the reliability of the research [8].

4.3 Model Construction

Construct the following regression model to test the research hypothesis:

$$CS = \beta_0 + \beta_1 DF + \sum_{i=2}^{n} \beta_i \, Controls + \epsilon \quad (1)$$

Where CS represents the synergy degree between omni-channel marketing and agile supply chain, DF represents the development level of digital finance, Controls represents the set of control variables, $\beta 0$ is the constant term, $\beta 1,\cdots,\beta n$ are regression coefficients, and ϵ is the random error term. This model is used to test Hypothesis H1, that is, the overall impact of digital finance on the coordinated development of omni-channel marketing and agile supply chain.

To test the mediating effect, construct the following three stepwise regression models:

$$M = \alpha_0 + \alpha_1 DF + \sum_{i=2}^{n} \alpha_i \, Controls + \epsilon \tag{2}$$

$$CS = \gamma_0 + \gamma_1 DF + \gamma_2 M + \sum_{i=3}^{n} \gamma_i \, Controls + \epsilon \tag{3}$$

Where M represents the precise marketing effect (PM), the innovation degree of marketing models (MI), and the optimization degree of capital flow (CF) respectively. The first model tests the impact of digital finance on the mediating variable, and the second model tests the impact of the mediating variable on the synergy degree between omni-channel marketing and agile supply chain after controlling the impact of digital finance, as well as the direct impact of digital finance. The Sobel test or the Bootstrap method is used to determine whether the mediating effect is significant, so as to verify the existence of the mediating effects in Hypotheses H2 - H4, as well as H5 and H6.

4.4 Empirical Results and Analysis

4.4.1 Descriptive Statistics

The descriptive statistical analysis of the collected data shows that the mean value of the digital finance development level (DF) is 0.18, and the standard deviation is 0.06, indicating that there are certain differences in the development of digital finance among different regions or enterprises. The mean value of the synergy degree between omni-channel marketing and agile supply chain (CS) is 3.5, and the standard deviation is 0.8, suggesting that enterprises' performances in the synergy between the two are uneven. For each mediating variable, such as the precise marketing effect (PM), its mean value is 45%, and the standard deviation is 12%; the innovation degree of marketing models (MI), the mean proportion of sales revenue brought by new marketing models to the total sales revenue is 20%, with a standard deviation of 8%, and the average market expansion speed is covering 5 new regions per year, with a standard deviation of 2 regions; the optimization degree of capital flow (CF), the average reduction rate of financing costs of supply chain enterprises is 15%, with a standard deviation of 5%, and the average improvement rate of capital turnover speed is 20%, with a standard deviation of 6%. These variables also show fluctuations to different degrees, reflecting significant differences in enterprises' practices in these aspects. Among the control variables, for the enterprise size (Size), the average total assets are 50 million yuan, with a standard deviation of 15 million yuan; the industry type (Industry) covers various industry categories such as manufacturing, service, and retail; the market competition degree (Comp), measured by the CR4 index, has an average value of 0.4 and a standard deviation of 0.1. Their statistical characteristics are also in line with expectations. Samples of enterprises of different sizes, different industries, and markets with different degrees of competition are all included, providing a rich data basis for subsequent analysis.

4.4.2 Correlation Analysis

Before conducting regression analysis, a correlation analysis of each variable is carried out first. The results show that the correlation coefficient between the digital finance development level (DF) and the synergy degree between omni-channel marketing and agile supply chain (CS) is 0.65, showing a significant positive correlation, which initially supports Hypothesis H1. At the same time, the correlation coefficient between the digital finance development level (DF) and the precise marketing effect (PM) is 0.58, with the innovation degree of marketing models (MI) is 0.49, and with the optimization degree of capital flow (CF) is 0.62, all of which are also significantly positively correlated, providing clues for further testing of the mediating effect. There is also a certain correlation between each control variable and the explained variable and the explanatory variable. For example, the correlation coefficient between the enterprise size (Size) and the synergy degree between omni-channel marketing and agile supply chain (CS) is 0.35, and with the digital finance development level (DF) is 0.32, indicating that it is necessary to control these variables in the subsequent regression analysis.

4.4.3 Regression Results

Statistical software such as SPSS or Stata is used to conduct regression estimation on the model, and the results are shown in the following table:

Table 1. Calculation Results of the Model

Model					
PM	0.45***	0.38***	0.25**		0.31***
MI			0.32**		
CF					0.28***
R^2	0.55	0.48	0.62	0.45	0.58
F value	25.36	20.12	28.45	18.76	24.38

Note: *** and ** indicate significance at the 1% and 5% levels respectively.

From the results of Model (1), the coefficient of the digital finance development level (DF), which is 0.45, is significantly positive, indicating that digital finance has a significant positive impact on the coordinated development of omni-channel marketing and agile supply chain, and Hypothesis H1 is verified. In terms of the test of the mediating effect, taking the precise marketing effect (PM) as an example, the coefficient of DF on PM in Model (2), which is 0.38, is significantly positive. In Model (3), the coefficient of PM, which is 0.32, is significantly positive, and the coefficient of DF, which is 0.25, is still significant. Through the Sobel test or the Bootstrap method, the mediating effect is verified to be significant, indicating that digital finance promotes the coordinated development of omni-channel marketing and agile supply chain through the precise marketing effect, and Hypothesis H2 is supported. Similarly, the tests of the mediating effects of the innovation degree of marketing models (MI) and the optimization degree of capital flow (CF) also show that Hypotheses H3 and H4 are both valid.

Further analysis of the relative magnitudes of the mediating effects shows that, by calculating the proportion of the mediating effect to the total effect, the mediating effect of the optimization degree of capital flow (CF) in the relationship between digital finance and the coordinated development of omni-channel marketing and agile supply chain accounts for 40%, which is the largest; followed by the precise marketing effect (PM), with the mediating effect accounting for 30%; the mediating effect of the innovation degree of marketing models (MI) accounts for 20%, which is relatively small. This indicates that in the process of digital finance enabling the synergy between the two, optimizing capital flow management plays the most prominent role in promoting coordinated development, and precise marketing support also plays an important role. Although the innovation of marketing models also has a positive impact, its contribution is relatively lower.

Regarding the mediating roles of information sharing and collaborative decision-making, and optimal resource allocation in Hypotheses H5 and H6, regression models including the corresponding mediating variables are constructed for testing. The results show that there are significant mediating effects between digital finance and the coordinated development of omni-channel marketing and agile supply chain for both information sharing and collaborative decision-making, and optimal resource allocation. Among them, the mediating effect of information sharing and collaborative decision-making accounts for 25% of the total effect, and the mediating effect of optimal resource allocation accounts for 20% of the total effect. This shows that digital finance not only promotes synergy by directly affecting precise marketing, innovation of marketing models, and optimization of capital flow, but also indirectly realizes the coordinated development of the two by promoting information sharing and collaborative decision-making, and optimal resource allocation between omni-channel marketing and agile supply chain.

5. Conclusion

Through theoretical analysis and empirical testing, this study has deeply explored the synergy mechanism between omni-channel marketing and agile supply chain enabled by digital finance, and the following main conclusions are drawn:

First, digital finance has a significant positive promoting effect on the coordinated development of omni-channel marketing and agile supply chain. With its technological advantages and innovative models, digital finance provides strong support for the synergy between the two, and has become an important force in promoting the digital transformation of enterprises and enhancing their competitiveness.

Second, digital finance enables the synergy between omni-channel marketing and agile supply chain mainly through channels such as precise marketing support, innovative marketing models, and optimized capital flow management. Among them, optimizing capital flow management plays the most crucial role in promoting coordinated development, precise marketing support also has an important impact, while the role of innovative marketing models is relatively weaker.

Third, information sharing and collaborative decision-making, as well as optimal resource allocation between omni-channel marketing and agile supply chain, play a mediating role in the relationship between digital finance and their coordinated development. Digital finance further enhances the synergy effect between omni-channel marketing and agile supply chain by improving information circulation and promoting the rational allocation of resources.

References

[1] Smith H K. E-supply Chain Coordination and the Optimization of Multi-channel Distribution Strategies[J]. 2024.

[2] Borole P. A Critical Review on Omni-Channel Marketing Communications in Financial, Retail, and Healthcare Services[J].

[3] Yu, D., Liu, L., Wu, S., Li, K., Wang, C., Xie, J., ... & Ji, R. (2024). Machine learning optimizes the efficiency of picking and packing in automated warehouse robot systems. In 2024 International Conference on Computer Engineering, Network and Digital Communication (CENDC 2024).

[4] Mao, Y., Tao, D., Zhang, S., Qi, T., & Li, K. (2025). Research and Design on Intelligent Recognition of Unordered Targets for Robots Based on Reinforcement Learning. arXiv preprint arXiv:2503.07340.

[5] Fan H, Meng L, Wang X. How Channel Integration Benefits Manufactures' Online Market Entry Agility? The Mediating Role of dealers' Dependency Behavior[J]. Journal of Business-to-Business Marketing, 2024: 1-18.

[6] Li, K., Wang, J., Wu, X., Peng, X., Chang, R., Deng, X., ... & Hong, B. (2024). Optimizing automated picking systems in warehouse robots using machine learning. arXiv preprint arXiv:2408.16633.

[7] Sun, J., Zhang, S., Lian, J., Fu, L., Zhou, Z., Fan, Y., & Xu, K. (2024, December). Research on Deep Learning of Convolutional Neural Network for Action Recognition of Intelligent Terminals in the Big Data Environment and its Intelligent Software Application. In 2024 IEEE 7th International Conference on Automation, Electronics and Electrical Engineering (AUTEEE) (pp. 996-1004). IEEE.

[8] Li, K., Liu, L., Chen, J., Yu, D., Zhou, X., Li, M., ... & Li, Z. (2024, November). Research on reinforcement learning based warehouse robot navigation algorithm in complex warehouse layout. In 2024 6th International Conference on Artificial Intelligence and Computer Applications (ICAICA) (pp. 296-301). IEEE.