

Edge Intelligence-enabled Supply Chain Financial Model Based on B2B E-business Platforms System

Abstract: Based on the analysis of the existing traditional supply chain financial model, this paper (1) constructs the supply chain financial model based on B2B platforms, (2) combines the operation mechanism of the model and the quantitative analysis thinking of the traditional supply chain financing, and (3) uses the mathematical model to construct and evaluate the cost-benefit model of dealers, manufacturers and B2B e-business platforms in the perspective of the supply chain finance for B2B platforms. In order to further explore the operation strategy of supply chain member enterprises under this mode, we focus on (a) the selection of financing objects of B2B platforms, (b) the optimization of financing cost rate formulated by B2B platforms, (c) the loan amount of financing enterprises, and (d) the optimization of product order quantity. Finally, through numerical analysis, we can directly reflect the changing trend of the relevant parameters of B2B platforms' supply chain financial model, such as strategy making, optimization decision-making, incentive measures, etc., and provide guidance and suggestions for the development of B2B platforms, the reduction of financing costs, and the cooperation mechanism between supply chain and commercial banks.

Key words: B2B e-business; supply chain finance; numerical model; commercial bank

1 Introduction

With the deepening of world economic globalization, supply chain is getting more important in market competition. At present, most existing literature simply describes the model from the qualitative point of view [1]. Therefore, from the perspective of e-business informatization, this paper (i) quantitatively explores the cost-benefit model of supply chain financing based on B2B platforms, when dealers are faced with financial constraints, and (ii) analyzes the optimal decision-making of main members in the chain with B2B platforms as the leading role, which greatly enriches the online supply based on B2B platforms in the Internet environment. The quantitative study of response chain finance is of great guiding significance, and also enriches the theory of e-business supply chain finance [2]. This paper studies the supply chain financing based on B2B platforms to maximize the profit of supply chain. From the perspective of whether the self-owned funds of B2B platforms can meet the financing needs, this paper focuses on the optimization of financing cost rate set by B2B platforms, and provides

theoretical guidance for e-business enterprises to make relevant strategy selection. To promote the research of enterprise synergy in supply chain. From the perspective of the overall development of the supply chain, this paper explores the strategy when dealers on B2B platforms choose the supply chain financial model [3]. The B2B platforms will promote the mutual supervision of enterprises in the supply chain, which is more conducive to the control of financing risks, the reduction of financing costs, and the protection of supply chain interests, so as to provide theoretical guidance for the collaborative development of enterprises in the e-business supply chain [4]. The online supply chain financing of B2B platforms can directly obtain funds for projects that need to be financed among the vulnerable enterprises. That is to say, direct financing is realized, which is conducive to the overall operation of the supply chain. At the same time, B2B e-business, on the basis of its own personal lending, also maintains the attribute of the intermediary [5]. Through the transaction data and the credit analysis of small and medium-sized enterprises (SMEs) in the supply chain, risk control is established on the whole transaction system. The cost of violations has been greatly increased. B2B e-business not only responds to the relevant national policies, but also reduces the credit risk for themselves and banks [6].

Compared with the traditional supply chain financial model, the online supply chain financial model under the e-commerce environment has achieved four major changes. The first change is in the credit evaluation mechanism, that is, from the traditional financial credit evaluation mechanism to the complementary mechanism of e-commerce credit and financial credit. The second one is the change of risk guarantee mechanism, that is, from the unilateral recovery mechanism of banks to that between enterprises. The third one happens in the transformation of credit cycle mechanism, i.e. the whole process of supply chain financing has changed from the traditional repayment credit mechanism to the benign credit integration mechanism of the whole supply chain. The fourth one is the transformation of punishment mechanism, that is, from the traditional financial punishment mechanism to the Internet joint punishment mechanism, which has greatly increased the punishment intensity to reduce the

existence of bad credit. These four mechanism changes optimize the financing environment. They make the financing application simple, and provide concise financing guidelines and rich financing resources for SMEs.

The research objective of this paper is to explore the mode construction, strategy formulation, optimization decision-making, incentive measures and other contents of supply chain finance in B2B platforms. When developing supply chain financial services on B2B e-commerce platforms, this research also analyzes and evaluates the business model of financing, so as to contributing in the development of B2B Platforms, reducing financing costs, and providing technical guidance for the cooperation mechanism between members in supply chain and commercial banks.

The paper contributes in three areas: (1) The innovation of financing mode. Traditional supply chain financing is the financing mode guaranteed by core enterprises. Here we study the financing mode of B2B platforms for lending and guarantee. In the Internet era, the financing mode of SMEs in the e-commerce supply chain is an innovative and new financing mode. (2) The pertinence of the research object. This paper takes the supply chain financing strategy based on B2B platforms as the research object. Most scholars study the traditional supply chain financing strategy, as well as the preliminary qualitative analysis of online supply chain financial model based on B2B platforms. While this paper considers the combination of qualitative and quantitative research on the strategy formulation, optimization decision-making, incentive measures and other contents of the supply chain financial mode of B2B platforms in the Internet era. (3) Game decision making with multi factors. This paper (a) studies the game and cooperation mechanism among B2B platforms, manufacturers, dealers and financial institutions, (b) integrates the guarantee credit and transaction data into the supply chain finance, (c) uses the appropriate cost-benefit model to solve the optimal strategy of each subject in the supply chain, and (d) explores the effort level of B2B platforms and the incentive level of the bank, which need to be studied in more perspectives and in-depth.

The paper is organized as follows. Section 2 introduces related work in literature. Section 3 presents the proposed model. Section 4 discusses the proposed financing strategy. Section 5 unfolds the performance analysis. Section 6 shows the numerical results. Section 7 draws the conclusion.

2 Related work

The traditional supply chain financial model is based on the credit level of the core enterprises in the supply chain [7]. Financial institutions measure whether they provide financing services for disadvantaged SMEs from the perspective of the whole supply chain. In order to improve the overall competitiveness of the supply chain, key members in the supply chain financial model cooperate and complement each other. Based on the analysis of the cooperation and operation mode among enterprises in traditional supply chain finance in the literature, this section describes the basic operation mode of traditional supply chain finance [8]. For the analysis of capital flow in the chain of this model, the loan capital of commercial banks is the only source of financing for small and medium-sized financing enterprises with capital shortage (Figure 1).

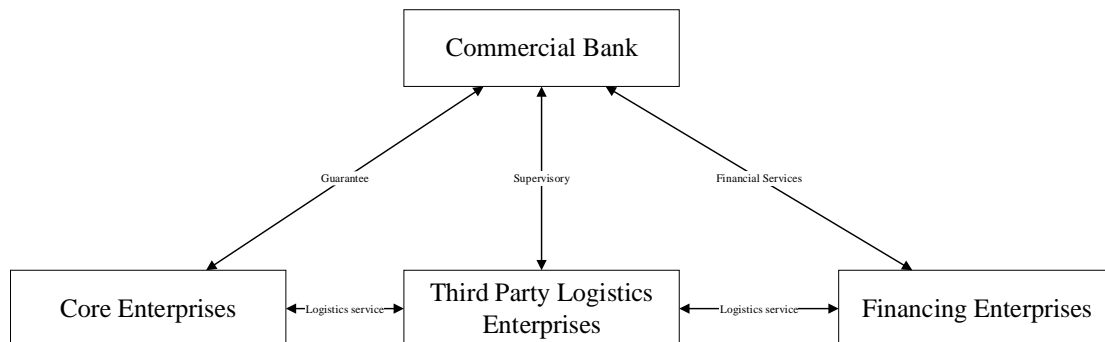


Fig. 1 Traditional Supply Chain Finance Model

However, the core enterprise has a large scale and strong strength, which is in a strong position to control the capital flow and logistics of the whole supply chain. In practice, focal enterprises often take goods on credit from suppliers, while dealers need advance fund to order and sell. The financial pressure on upstream and downstream SMEs needs

to be alleviated [9]. Speeding up the capital turnover of suppliers can reduce their inventory and shorten the production cycle, while speeding up the capital turnover of dealers can expand the scope of sales and relieve the pressure of enterprises [10]. However, focal enterprises strictly control funds and goods for suppliers or distributors, which is likely to cause a shortage of funds in the supply chain. At the same time, it is difficult to assess and monitor the financial situation of SMEs, which affects the lending efficiency of commercial banks [11].

3 The proposed model

Based on the existing operation mode of traditional supply chain finance, this paper studies the online development of supply chain finance in B2B e-business environment, and puts forward and constructs the supply chain finance mode based on B2B e-business platforms. At the same time, it analyzes and evaluates the innovative characteristics of the new model and the challenges in its development.

With rapid development in information technology, loads of transaction information has been recorded on the e-business platforms, which greatly increases the credibility of credit evaluation on the e-business platforms with the scale of data. Under the combination of supply chain finance and e-commerce, e-business supply chain financing mode came into being. In this mode, e-business platforms have replaced the traditional large-scale enterprises and become a new core enterprise, playing a decisive role in the operation of the supply chain. B2B based supply chain finance has evolved from traditional supply chain finance, as shown in Figure 2.

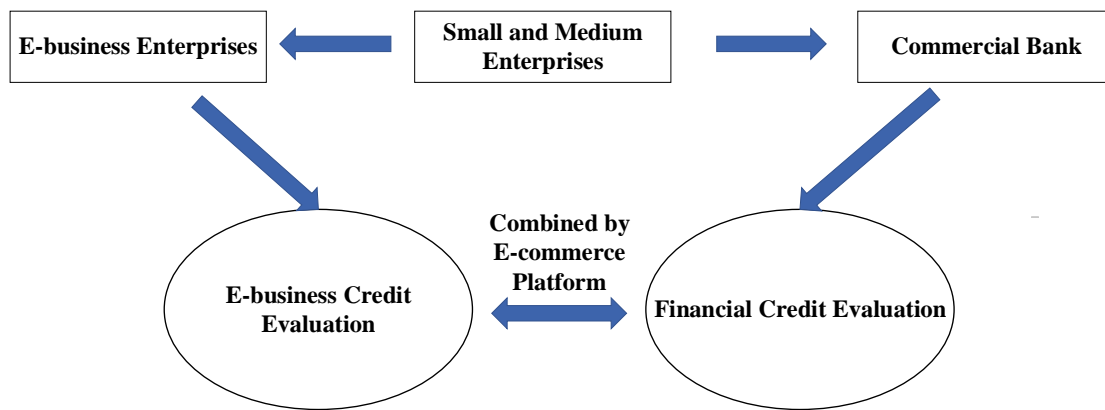


Fig.2 E-business supply chain financial operation mechanism

Based on the model evolution analysis in Figure 2, there are three main ways to develop the online evolution of traditional supply chain financial model. The first one is the electronic evolution of traditional supply chain finance. The online supply chain financial services launched by commercial banks are regarded as the bank-led online supply chain financial model. The second is the bank's further expansion of the supply chain financial model. The scope of financial services is the online supply chain financial services launched in cooperation with B2B e-business platforms to solve the trade financing problem of e-business. The lending capital comes from the bank is defined as the bank supply chain financial model based on B2B e-business platforms. The third is the "three flows" of B2B e-business platforms through the effective integration of supply chain, namely logistics information flow and capital flow. In the supply chain financial model, B2B platforms directly lend to single or multiple SMEs in the upstream and downstream of B2B platforms to build a collaborative E-business supply chain model. This mode can complete the new financing trend of transaction payment and logistics tracking online, which is also the main research object of this paper.

B2B e-business enterprises provide financing services for the upstream and downstream enterprises of the platforms. They use their own information advantages to monitor and manage the transaction information, logistics information, capital flow information of SMEs on platforms. They can effectively reduce the credit risk by

predicting the market risk of supply chain transactions. In the online supply chain financial model, not only financial credit is considered, but also the e-business credit of SMEs managed by B2B platforms is increased. B2B platforms can use new measures such as information monitoring, data analysis and network pursuit to monitor credit risk, which is also conducive to alleviate the financing difficulties of SMEs.

Based on the above analysis, the existing traditional supply chain finance operation mode is immigrated to the e-business environment. This paper constructs the online supply chain finance mode based on B2B platforms. Large enterprises represent large-scale and high reputation enterprises in the supply chain, most of which are large-scale manufacturers. In this operation mode, their transaction volume, logistics data and capital flow are also the lending basis of B2B platforms. They play key roles in the traditional supply chain financial mode. The logistics enterprise is a B2B platforms self-supporting logistics or contract logistics enterprise, which aims to implement the online platforms transaction to the field circulation activities of offline products. Financing enterprises are mostly SMEs affected by capital constraints, that is to say, they play the role of financing demand in online supply chain financing mode. B2B e-business is the core of the online supply chain financial model based on B2B platforms. It creates favorable conditions for the financing of SMEs by using the information data held by platforms.

4 The proposed financing strategy

This paper first constructs the cost-benefit model of supply chain finance based on B2B, and then explores B2B platforms' decision-making on the optimal financing cost rate, the optimal ordering decision of dealers, and the optimal pricing decision of manufacturers. Combined with the regulation and control performance of B2B platforms in supply chain, this paper analyzes (1) the selection of financing objects, (2) the optimization of financing cost rate of B2B platforms, (3) the loan amount of financing enterprises, and (4) the optimization of product order quantity by B2B

platforms with small loan license. It also presents the conclusion of theoretical analysis through numerical simulation analysis of MATLAB software.

4.1 Description of model symbols and assumptions

When building the cost-benefit model in this paper, the parameter descriptions and model assumptions involved are shown in Table 1 below.

Table 1 Description of relevant symbol parameters

Variables and parameters	Detailed description
c	Purchase price of raw materials per unit purchased by manufacturer
w	Wholesale price per unit of product when the distributor purchases the product
p	Retail price per unit of product in the market
q	Distributor's order quantity
x	Product market demand, its probability density function is $f(x)$, cumulative distribution function
r	Risk free interest rate
r_b	Interest rate of loans from dealers to commercial banks
r_m	Financing cost ratio of B2B e-business using its credit to loan to commercial banks
r_e	Financing cost ratio of financing enterprises formulated by B2B platforms
x_m	Lending capital of B2B e-business enterprises

Description of model assumptions:

- (1) It is assumed that market demand x meets $h(x) = f(x) / \bar{F}(x); \bar{F}(x) = 1 - F(x)$.
- (2) It is assumed that the market demand function $F(x)$ is a continuous and differentiable distribution function, which increases strictly when demand x increases, that is, strictly increasing function.
- (3) If the dealer has been short of funds, and has no funds to order at the beginning, and cannot complete the transaction, then the dealer's capital shortage is wq .
- (4) It is assumed that all nodes of the supply chain are completely information symmetric.

(5) It is assumed that the transaction subjects of capital market are risk neutral.

4.2 Construction of financing cost and income model of the online supply chain

Dealers affected by capital constraints can choose different financing modes, such as traditional supply finance and supply chain finance based on B2B e-business. When dealers choose different ways of supply chain financing, the corresponding main income will also change. Based on the analysis of the financing cost and income of the traditional offline supply chain, this paper constructs the financing cost and income model of the online supply chain based on the B2B platforms, and draws the overall income of the financing enterprise dealers and the supply chain with MATLAB software, so as to evaluate the financial service of the supply chain based on the B2B platforms quantitatively.

1. Traditional supply chain financing cost-benefit model

When dealers choose traditional supply chain financing, based on the guarantee of large manufacturers, commercial banks, as the only capital suppliers, directly credit financing enterprises. At this time, the income of the main enterprise is as follows:

$$\text{Dealer Revenue: } \prod_R^S(x) = [p \cdot \min(x, q) - wq(1 + r_b)]^+ \quad (1)$$

$$\text{Manufacturer's Revenue: } \prod_M^S(x) = (w - c) \cdot q \quad (2)$$

$$\text{Bank Revenue: } \prod_B^S(x) = \min[p \cdot \min(x, q), wq(1 + r_b) - wq] \quad (3)$$

$$\text{Overall supply chain Revenue: } \prod_T^S(x) = p \cdot \min(x, q) - cq \quad (4)$$

2. Supply chain financing cost-benefit model based on B2B platforms

Based on its core dominant position, B2B e-business enterprises not only provide guarantee for SMEs, but also provide financing for SMEs with shortage of funds in the upstream and downstream of platforms through their own funds and commercial bank credit funds. As a SME with less bargaining power in the supply chain, the financial strength of dealers is weak. The financial constraints will directly affect the ordering

transactions between dealers and manufacturers. According to the previous assumption, the market demand of the products sold by the distributors is random. The manufacturers production is based the orders of the distributors, without considering the flow of B2B e-business platforms (i.e. their own capacity). This part combines the operation mode of supply chain finance based on B2B platforms and the analyses the idea of traditional supply chain financing cost-benefit model. To explore the cost-benefit situation of online supply chain financing, the main enterprises of supply chain and the whole supply chain adopt to B2B platforms according to dealers.

This paper proposes that when B2B e-business's own lending capital can meet the financing needs of dealers, it is the first source of funds to lend with B2B platforms' own funds. If B2B e-business's own lending capital can't meet the financing needs of SMEs with capital shortage, B2B e-business platforms will use its own credit to obtain financing from commercial banks for the part in shortage, which is the financing of commercial banks. Credit funds are the second source of funds. When the dealers affected by capital constraints choose the supply chain financing based on B2B platforms, the income of the main enterprise and the whole supply chain is analyzed from the following two capital source modes:

(1) When $wq \leq x_m$, the loan capital of B2B e-business platforms can meet the dealers' capital demand, that is, all the funds needed by dealers are supplied by the loan capital of B2B e-business platforms itself. The income of each entity is as follows:

$$\text{Dealer Revenue: } \prod_R^{E1} x = [p \cdot \min(x, q) - wq(1 + r_e)]^+ \quad (5)$$

$$\text{Manufacturer's Revenue: } \prod_M^{E1} (x) = (w - c) \cdot q \quad (6)$$

$$\text{Bank Revenue: } \prod_E^{E1} (x) = \min[p \cdot \min(x, q), wq(1 + r_e)] - wq + (x_m - wq) \cdot r \quad (7)$$

$$\text{Overall supply chain Revenue: } \prod_T^{E1} (x) = p \cdot \min(x, q) - cq + (x_m - wq) \cdot r \quad (8)$$

(2) When $wq > x_m$, the B2B e-business platforms' own loan capital is not enough to meet the dealer's capital demand, and the insufficient part will be borrowed from the B2B e-business platforms to the commercial bank to meet the dealer's demand. The

income of each entity is as follows:

$$\text{Dealer Revenue: } \prod_R^{E2} x = [p \cdot \min(x, q) - wq(1 + r_e)]^+ \quad (9)$$

$$\text{Manufacturer's Revenue: } \prod_M^{E2} (x) = (w - c) \cdot q \quad (10)$$

$$\text{B2B platforms Revenue: } \prod_E^{E2} (x) = \min[p \cdot \min(x, q), wq(1 + r_e)] - wq + (wq - x_m) \cdot r_m \quad (11)$$

$$\text{Overall supply chain Revenue: } \prod_T^{E2} (x) = p \cdot \min(x, q) - cq - (wq - x_m) \cdot r_m \quad (12)$$

The management meaning of the overall income of the supply chain: the overall income of the supply chain is the sum of the income of the operating entities in the closed-loop chain, i.e. the income of dealers, the income of manufacturers and the income of B2B platforms. At this time, although the initial source of some financing funds is the bank, banks only have transaction credit with B2B platforms in the supply chain financing mode. There is no direct impact in the whole closed-loop supply chain, so this paper does not consider the relevant impact of banks when analyzing the overall income of the supply chain.

To sum up, when dealers adopt the supply chain financing mode based on B2B platforms, the total income of the supply chain is as follows:

$$\prod_T^E (x) = \begin{cases} p \cdot \min(x, q) - cq + (x_m - wq) \cdot r & wq \leq x_m \\ p \cdot \min(x, q) - cp + (x_m - wq) \cdot r_m & wq > x_m \end{cases} \quad (13)$$

4.3 Evaluation of supply chain financing model based on B2B platforms

The purpose of this paper is to evaluate the cost-benefit model of online supply chain financing based on B2B platforms, and to study the significance of supply chain financial services based on B2B platforms.

First of all, it makes a comparative analysis of the financing interest rate involved in this paper. Based on the fact that commercial banks can determine their own credit interest rate within a certain range, the ability of commercial banks to obtain the upstream and downstream financing enterprise information of the platforms is weaker than that of B2B platforms. Therefore, when it lends to small-scale vulnerable enterprises, even with the guarantee of traditional manufacturers, banks will still charge higher financing interest rate in order to reduce their own risk. The credit rating of B2B e-business enterprises is higher than that of weak SMEs. Based on the analysis of a large number of information data recorded on its platforms, it can effectively control its own and bank's risks, so obviously the financing interest rate r_b given by commercial banks to dealers is higher than the financing cost rate r_m given by banks to B2B platforms, that is to say $r_m < r_b$.

Secondly, under the assumption that x and q are in the same condition under the two financing modes, that is, x and q are the same, to explore the overall income of the supply chain, proposition 1 can be obtained.

Proposition 1: when the self-loan funds of B2B platforms can meet the needs of financing enterprises, $q \leq \frac{x_m}{w}$, the overall income of supply chain from the B2B platforms is higher than the traditional supply chain financing income.

Proof: first of all, from the perspective of whether the dealers of financing enterprises are bankrupted and whether they can repay, this paper discusses the cost-benefit of the whole supply chain when the dealers adopt two different financing methods. When the dealers adopt traditional supply chain finance and B2B based supply chain finance, the differences of the overall benefits of the supply chain are as follows:

$$\Delta\Pi(x) = \begin{cases} (x_m - wq) \cdot r & wq \leq x_m \\ (x_m - wq) \cdot r_m & wq > x_m \end{cases} \quad (14)$$

According to $r < r_m < r_e < r_b$, no matter whether the dealer goes bankrupt or not, $q \leq \frac{x_m}{w}$, when the dealer adopts B2B based supply chain financing, the overall benefit of supply chain is higher than that of traditional supply chain financing.

It can be seen from the above that proposition 1 is proved. However, when the self-owned funds of B2B platforms cannot meet the financing needs, due to the addition of B2B platforms in the supply chain operation, platforms still need to obtain credit funds from the bank. The increase of the operation subject leads to the increase of the supply chain operation cost, so the overall income of the supply chain has a small decline. However, this small increase can reduce the credit risk of B2B platforms and banks, and improve the overall competitiveness of the supply chain, which is worth operating.

Then, combining with the actual data of H company's supply chain, the two financing modes are analyzed by numerical simulation. Now set: $c = 7$, $w = 8$, $p = 10$, $r = 0.03$, $r_b = 0.08$, $r_m = 0.05$, $r_e = 0.06$, $x_m = 40000$, $q_1 = 2000$, $q_2 = 10000$. Matlab is used to calculate the overall profits of the supply chain of the two financing modes when the B2B platforms's own loan funds can meet the dealers' financing needs, as shown in Figure 3.

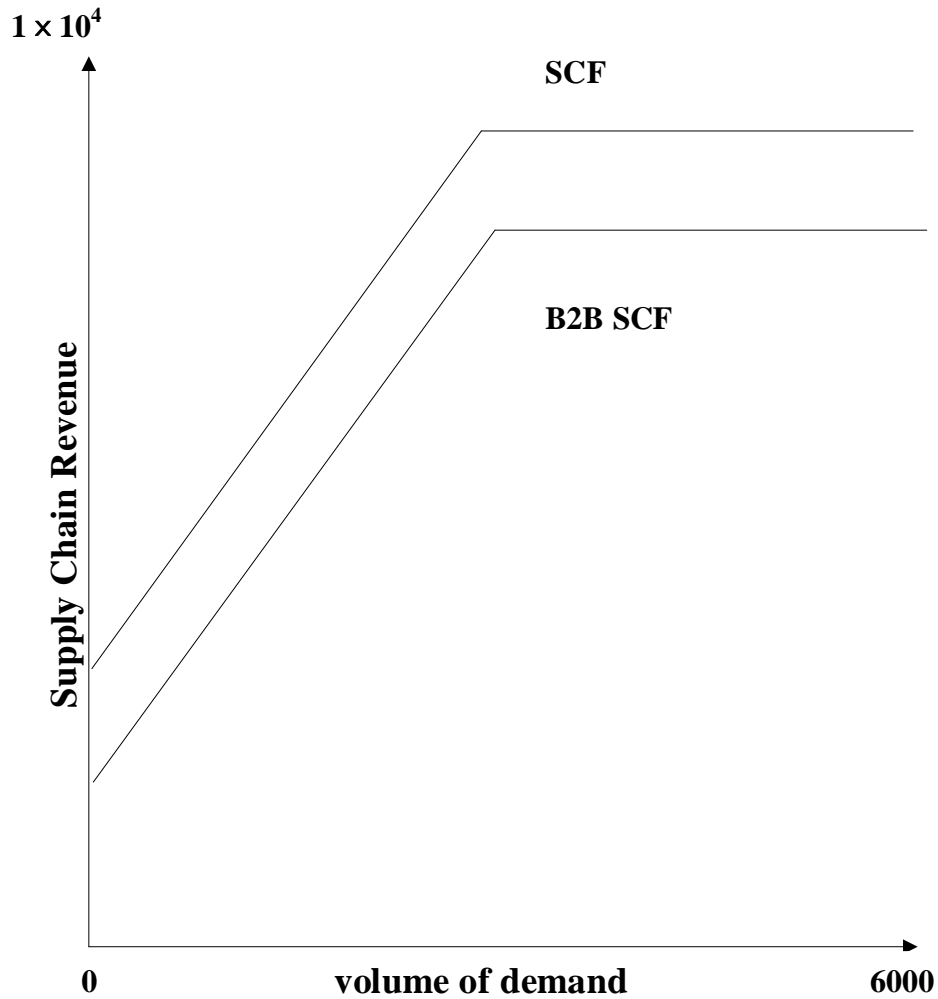


Fig.3 Supply chain income under two financing modes

Obviously, when the market demand for goods is small, the overall revenue of supply chain finance based on B2B platforms is very similar to that of traditional supply chain finance, which is mainly because when the dealers make a wrong prediction of the demand for goods, the commodities of the dealers will have overstocked inventory. It will make the supply chain unable to make normal capital turnover, thus affecting the profits of the whole supply chain. That is to say, the overall revenue of supply chain finance based on B2B platforms is very close to that of traditional supply chain finance in the B2B supply chain financial model. B2B platforms also needs to bear the risk of sales of dealers. When the market demand for goods is large, the model can also effectively use the supply chain capital flow, so as to improve the overall income of the supply chain, and further demonstrates proposition 1. In practical operation, B2B

platforms, as a lender of funds, provides funds for dealers, which needs to bear most of the loan risk and supply chain management risk of supply chain financing business operation. Then, when B2B platforms participates in supply chain financing, it should have a comprehensive grasp of the product market demand of the loan object in the supply chain, so as to reduce the business risk that B2B platforms needs to bear. MATLAB is used to calculate the two modes of financing enterprise dealers' income results, as shown in Figure 4.

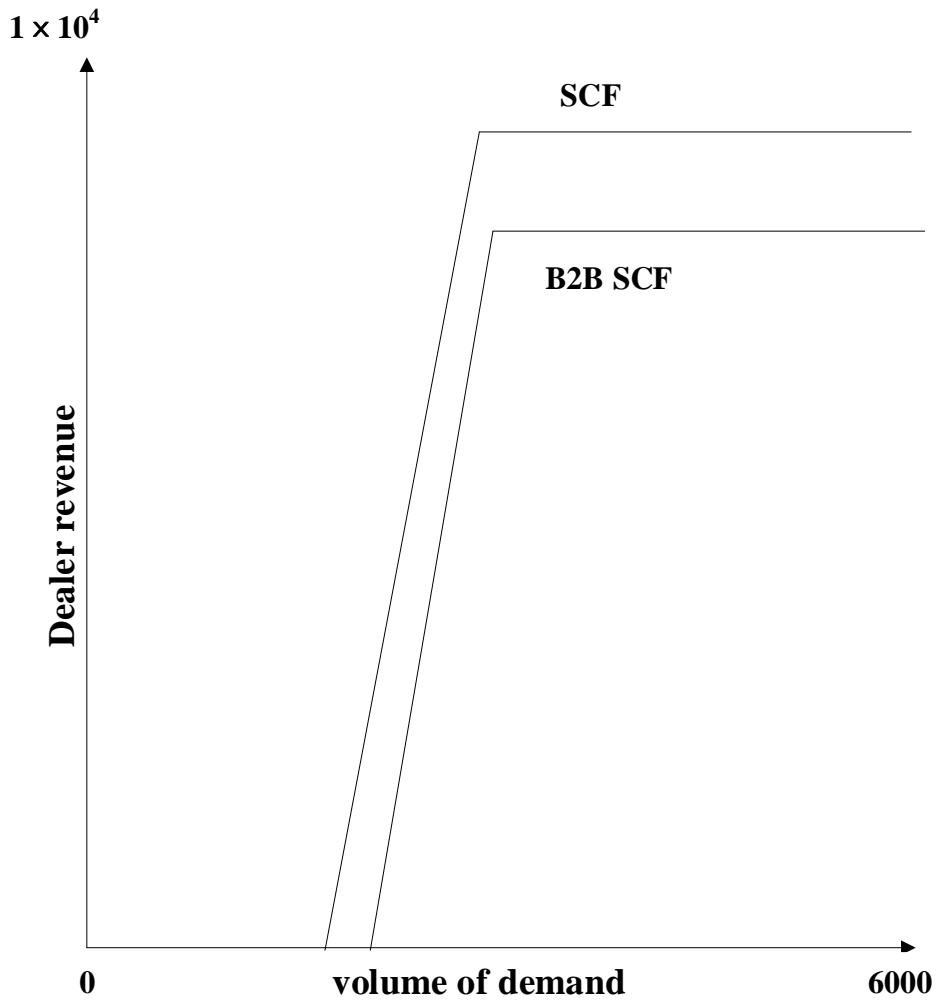


Fig.4 Dealer revenue under two financing modes

Whether or not the B2B platforms' own lending funds can meet the financing needs of dealers, as long as the product demand increases to a certain amount, the income growth of the capital constrained dealers who choose the supply chain financing based on the B2B platforms. The result will become more and more significant, and Proposition 2

can be obtained at the same time.

Proposition 2: no matter whether the B2B platforms' own lending funds can meet the financing needs, that is, whether the B2B platforms need to obtain credit loans from commercial banks or not, the income that the financing enterprise dealers choose the supply chain financing mode based on the B2B platforms is higher than that of the traditional supply chain financing mode.

As B2B e-business can better understand the operation of dealers through its own platform information advantages, it not only effectively supervises and assists dealers, but also reduces the cost of information asymmetry. At the same time, Proposition 2 is proved intuitively by the numerical simulation results of dealer income under the two modes.

To sum up, compared with the traditional single supply chain financial model, it is effective for dealers to choose the supply chain financial model based on B2B platforms when facing financial constraints. In the practice of supply chain finance mode based on B2B platforms, dealers should actively cooperate with B2B platforms online, learn to use the supply chain finance mode based on B2B platforms to alleviate the financial difficulties of enterprises, so as to expand the vision of enterprises and promote their own development.

5 Performance Analysis

In the construction of financing operation mode, it has been pointed out that the self-loan funds of B2B platforms are insufficient for a large number of SMEs constrained by funds. It is obvious that the operation funds of supply chain financing based on B2B platforms mostly come from B2B platforms and banks at the same time. When $wq > x_m$, that is to say, when B2B platforms need to obtain credit funds from commercial banks to meet the financing needs of dealers, the financing strategy in the

supply chain financial model is to rely on B2B platforms. This paper focuses on the financing cost rate of decision variable B2B platforms r_e , the optimal order quantity of dealers q^* , and the optimal pricing of manufacturers w^* . We do not consider the flow of B2B platforms (i.e. the size of its own capability) and the information processing costs when B2B platforms cooperate with banks. Moreover, as the economy vigorously promotes the "Internet +", the electric business enterprises do not charge the registration fees of platforms members for the operation of their own platforms.

5.2.1 Decision on the optimal financing cost rate of B2B platforms

In this paper, the B2B platforms is risk neutral for investment. The expected return when it uses its own funds to participate in supply chain financing should be equal to the expected return when it uses this part of funds for other projects. This paper explores the financing cost rate of decision variable B2B platforms r_e . As a capital provider of B2B e-business platforms, the expected value of its lending income should be equal to the expected value of risk-free investment income. Then, the supply chain financing cost rate formulated by the B2B platforms should meet the following requirements:

$$\int_0^{\mu} p \cdot xf(x)dx + \int_{\mu}^{\infty} p \cdot \mu f(x)dx - wq(1+r_m) + x_m(r_m - r) = 0 \quad (15)$$

$$\mu \bar{F}(\mu) = \mu / (1+r_e) + [x_m(r - r_m) + wq \cdot r_m] / p - \int_0^{\mu} xf(x)dx \quad (16)$$

According to the variables in the above formula, the financing amount of dealers wq , amount of self-loan funds of B2B platforms x_m , bank's credit rate to B2B platforms r_m , as well as the risk-free interest rate r will affect the B2B platforms on dealers' financing cost rate r_e . According to this, we can get proposition 3 to explore the financing cost rate decision of B2B platforms.

B2B e-business platforms uses its own assets and the unified credit fund obtained from

the bank to provide financing services for dealers. The bank's credit interest rate and risk-free interest rate for B2B platforms are the market competitive interest rate of B2B platforms' financing cost rate. Therefore, when it increases, the cost of B2B platforms participating in supply chain financing operation mode will also increase, so the financing cost rate set by B2B platforms for financing enterprises will also increase.

When the self-loan capital of B2B e-business platforms is not enough to meet the financing demand, B2B platforms will use the unified credit capital of commercial banks to meet the demand. Combined with the cost-benefit model of supply chain financing based on B2B platforms adopted by dealers, this paper explores the optimal order quantity of decision variables dealers q^* .

Affected by the shortage of funds, the dealers of vulnerable enterprises obtain the funds of ordering goods from the B2B platforms, but they also pay the financing interest to the B2B platforms while paying the loan principal within the specified period of completion of sales. On the other hand, it also increases the dealer's operating cost, so the bank's credit rate to B2B platforms will directly affect the dealer's optimal order quantity decision.

The research mode of this paper is that the dealer orders the goods from the manufacturer. When the self-loan funds of B2B e-business platforms are not enough to meet the financing needs, B2B platforms will use the unified credit funds of commercial banks to meet the needs. Combined with the manufacturer's use of the cost-benefit model of supply chain financing based on B2B platforms, it explores the decision variable manufacturer's optimal pricing w^* .

5.2.2 Numerical analysis

Through numerical simulation and analysis, the conclusions of decision-making are further demonstrated. B2B e-business platforms as fund providers can assess the market

environment to establish the optimal financing interest rate, so as to maximize its own profits. Now set x obeys uniform distribution on $[800000]$, and $p = 10, w = 8$.

First, the relationship between market competitive interest rate r and r_m financing cost rate r_e determined by B2B platforms is discussed. At the same time $x_m = 10000, q = 10000$, it explores the impact of the bank's credit interest rate r_m and risk-free interest rate r to the B2B platforms's financing cost rate r_e

$$\int_0^\mu \frac{x}{800} dx + \int_\mu^{16000} \frac{\mu}{800} dx - 80000(1 + r_m) + 70000(r_m - r) = 0 \quad (17)$$

The results of MATLAB software analysis are shown in figure 5.

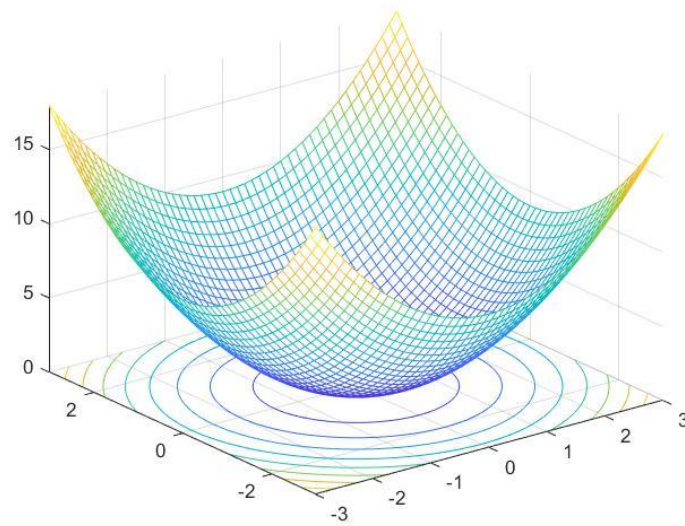


Fig.5 Market competition interest rate impact

The risk-free interest rate r and the interest rate that B2B platforms obtains credit funds from banks r_m are directly proportional to the financing cost rate r_e set by B2B platforms. That is to say, this paper assumes that B2B platforms is risk neutral for investment, so the financing cost rate r_e set by B2B platforms will increase with the increase of risk-free investment interest rate r and bank's credit interest rate r_m for

B2B e-business. Thus, proposition 1 is proved.

When the risk-free interest rate r rises, it will increase the opportunity cost for B2B platforms to enter the supply chain financial mode, and at the same time, it will reduce the willingness of the platforms to join, which leads to the increase of the financing cost rate r_e formulated by B2B platforms; while when the bank's credit rate r_m for B2B e-business increases, the lending cost of B2B platforms will increase correspondingly, which leads to the increase of the financing cost rate r_e formulated by B2B platforms To meet its capital cost. Then in the practice of supply chain finance mode based on B2B platforms, B2B platforms needs to measure the setting environment of market competition interest rate to formulate the financing cost rate of the platforms, so as to realize the maximization of its own income.

Secondly, it discusses the relationship between the dealer order quantity q and the bank's credit interest rate r_m for B2B e-business.

When $x_m = 10000, r = 0.03, r_e = 0.04$, the optimal order quantity of dealers q^* is explored to make an effective order decision so as to improve the efficiency.

$$\Pi_R^E(x) = -\frac{q^2}{1600} + (2 - 8r_m)q + (300 - 10000r_m) \quad (18)$$

By substituting $r_m = 0.045, r_m = 0.05, r_m = 0.055$ in respectively, we can get:

$$\Pi_{R1}^E(x) = -\frac{q^2}{1600} + 1.64q - 150 \quad (19)$$

$$\Pi_{R2}^E(x) = -\frac{q^2}{1600} + 1.64q - 200 \quad (20)$$

$$\Pi_{R3}^E(x) = -\frac{q^2}{1600} + 1.56q - 250 \quad (21)$$

Matlab is used to get the change of dealer order quantity q when the bank sets three

different financing cost rates r_m for B2B e-business, as shown in Figure 6.

When the bank's credit rate to B2B e-business r_m increases from 0.045 to 0.055 units, the dealer's optimal order quantity q decreases from 925.3 to 721.8 units. That is, when the lending cost of B2B e-business increases, the dealer's optimal order quantity will decrease accordingly. As the cost of B2B e-business to obtain financing from the bank rises, the financing cost rate r_e set by B2B platforms will inevitably rise because of the rising operation cost of B2B e-business. It increases the financing cost of dealers, so the expected financing amount of dealers will also be reduced, and the number of orders will be reduced.

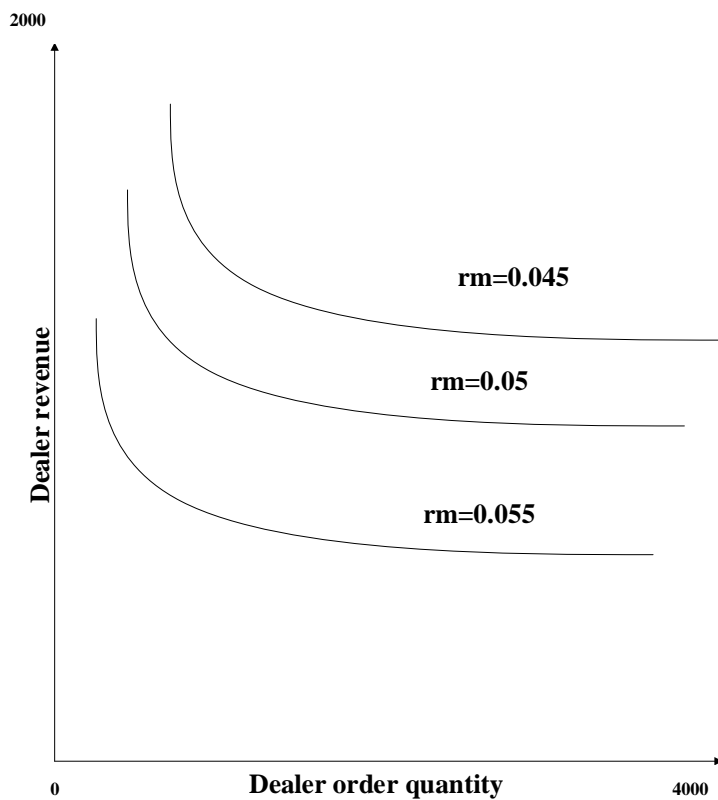


Fig.6 Relationship between q and r_m

Finally, the relationship between the optimal order quantity of dealers q and the self-loan capital of B2B platforms x_m is discussed.

When $r = 0.03, r_e = 0.04, r_m = 0.05$, it explores the influence of B2B platforms' own

lending capital on the dealer's ordering strategy. By substituting the data into the cost-benefit function model of dealers, we can get:

$$\Pi_R^E(x) = -\frac{q^2}{1600} + 1.6q + 0.02x_m \quad (22)$$

By substituting $x_m = 10000, x_m = 20000, x_m = 30000$ in respectively, we can get:

$$\Pi_{R1}^E(x) = -\frac{q^2}{1600} + 1.6q + 200 \quad (23)$$

$$\Pi_{R2}^E(x) = -\frac{q^2}{1600} + 1.6q + 400 \quad (24)$$

$$\Pi_{R3}^E(x) = -\frac{q^2}{1600} + 1.6q + 600 \quad (25)$$

We can draw the change of the dealer's order quantity q in three different B2B self-loan capitals x_m with MATLAB, as shown in figure 7.

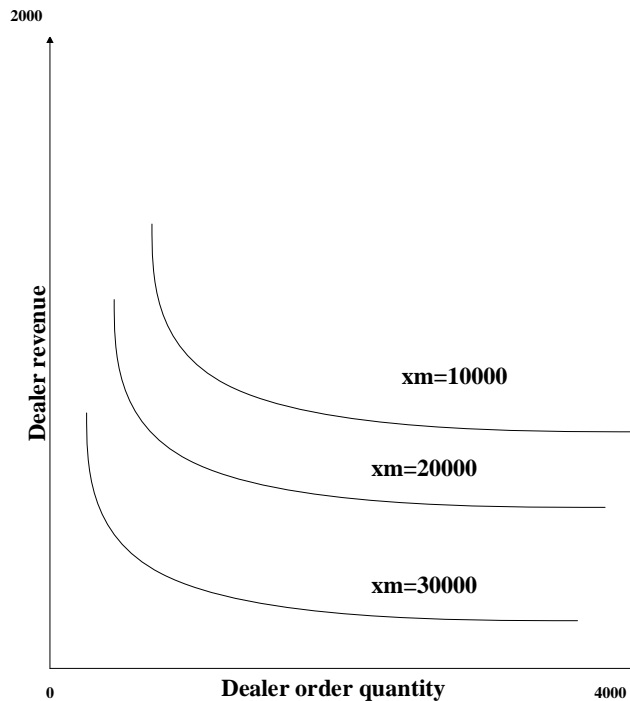


Fig.7 Relationship between x_m and q

Obviously, when the self-loan capital of B2B platforms x_m increases from 10000 to

30000 units, the optimal order quantity of dealers is constant at 1280 units. The income of dealers is increased from 1224 to 1624 units. The increase of B2B platforms' own lending capital means that the supply chain finance based on B2B has more low-cost lending capital, which reduces the financing cost rate set by B2B platforms. So the financing cost of dealers reduces and the benefit increases.

In the practice of supply chain finance mode based on B2B platforms, the increase of bank's credit interest rate for B2B e-business r_m will increase the lending cost of B2B platforms, while the increase of B2B platforms' own lending capital x_m will reduce the lending cost of B2B platforms. Then, when making an order decision, dealers should fully consider the lending cost of the B2B platforms. If the cost rises, they should appropriately reduce the order quantity to make up for the capital cost of the B2B platforms as a capital lender. At the same time, we also need to have a more comprehensive grasp of the market supply and demand, order on demand, in order to maximize our own revenue.

This paper constructs the cost-benefit model of the financing mode, and evaluates the effective significance of the financing service quantitatively. It is concluded that the income obtained by the financing enterprise dealers when they choose the supply chain financing based on the B2B platforms is higher than that when they choose the traditional supply chain financing. When the self-loan capital of the B2B e-business enterprise can meet the needs of the financing enterprise, the supply chain relies on the B2B platforms. The overall income of financing supply chain is also higher than that of traditional supply chain financing. At the same time, it also further explores the supply chain financing strategy based on B2B platforms, focusing on the B2B platforms to make the optimal financing cost rate decision, the optimal ordering decision of dealers and the optimal pricing decision of manufacturers. Using MATLAB software to draw the decision-making of these participants respectively, we get that the financing cost rate of B2B platforms (1) decreases with the increase of its own lending capital,

and (2) increases with the increase of market competition interest rate and financing demand. It has an impact on dealers to determine the optimal order quantity.

When B2B e-business participates in the supply chain financing, it is necessary to select dealers with fast sales and high reputation on platforms to control the risk. Dealers of financing enterprises should constantly adjust the product order quantity according to the loan amount and market demand to prevent bankruptcy risk. These studies provide a theoretical basis for the supply chain finance model based on B2B e-business platforms to supplement the shortcomings and limitations of the current research.

6 Conclusion

According to the operation mode of supply chain finance based on B2B e-business platforms, this paper focuses on the financing strategy of this mode. First of all, this paper constructs the online supply chain financing cost-benefit model based on B2B platforms, and quantitatively evaluates the effective significance of this model. At the same time, according to the cost-benefit model, this paper explores the B2B platforms to make the optimal financing cost rate decision, the optimal ordering decision of dealers, and the optimal pricing decision of manufacturers.

Therefore, according to the above step-by-step analysis, the main conclusions of this paper are as follows:

Firstly, the online supply chain finance based on B2B platforms constructed in this paper can effectively alleviate the financing difficulties of SMEs. This supply chain financing mode has its specific operation process.

Secondly, combined with the numerical simulation of MATLAB software, the quantitative evaluation of supply chain finance based on B2B platforms shows that the income of financing enterprise dealers will be higher than that of traditional supply chain finance when they choose supply chain finance based on B2B platforms.

Thirdly, in the analysis of online supply chain financing strategy based on B2B e-

business platforms, this paper studies the selection of financing objects of B2B platforms, the optimization of financing cost rate of B2B platforms, the loan limit of financing enterprises, and the optimization of product order quantity.

Fourthly, in the numerical analysis of online supply chain financing strategy based on B2B e-business platforms, the paper explores (a) the influence of risk-free interest rates and B2B platforms to bank financing cost rates on B2B leading supply chain financing cost rate, (b) the relationship between dealer order quantity and bank to B2B e-business financing cost rate, and (c) the relationship between dealer optimal order quantity and B2B platforms own loan capital.

References

- [1]. Jian, M., Shin, D. H., & Cohen, J. F. (2017). Trust and risk in consumer acceptance of e-services. *Electronic Commerce Research*, 17(2), 255-288.
- [2]. Orman, L. V. (2017). Information markets over trust networks. *Electronic Commerce Research*, 16(4), 1-23.
- [3]. Vashishth, A., Chakraborty, A., & Antony, J. (2017). Lean six sigma in financial services industry: a systematic review and agenda for future research. *Total Quality Management & Business Excellence*, 30(9), 1-19.
- [4]. Yang, D., & Li, M. (2018). Evolutionary approaches and the construction of technology-driven regulations. *Emerging Markets Finance and Trade*, 54(4), 1-16.
- [5]. Tavengerwei, R. (2018). Using trade facilitation to assist msme in E-business in developing countries. *Journal of International Economic Law*, 21(2), 349-378.
- [6]. Yusuf, A. S., Hussin, A. R. C., & Busalim, A. H. (2018). Influence of e-wom engagement on consumer purchase intention in social commerce. *Journal of Services Marketing*, 32(1), 493-504.
- [7]. Qiang, Z., & Yan, W. (2018). Struggling towards virtuous coevolution: institutional and strategic works of alibaba in building the taobao E-business ecosystem. *Asian Business & Management*, 17(4), 1-35.
- [8]. Hong, X. (2017). To compete or to take over? an economic analysis of new sellers on E-business marketplaces. *Information Systems and e-Business*

Management, 16(3), 1-13.

- [9]. Li, C., Wu, K., Johnson, D. E., & Avey, J. (2017). Going against the grain works: an attributional perspective of perceived ethical leadership. *Journal of Business Ethics*, 141(1), 87-102.
- [10]. Wang, N., & Xie, X. (2017). The impact of race, income, drug abuse and dependence on health insurance coverage among us adults. *European Journal of Health Economics*, 18(5), 537-546.
- [11]. Escobar-Rodríguez, T., & Bonsón-Fernández, R. (2017). Analysing online purchase intention in Spain: fashion E-business. *Information Systems and e-Business Management*, 15(3), 1-24.
- [12]. Sun, W., Zhao, Y., Sun, L. (2019). Big Data Analytics for Venture Capital Application: Towards Innovation Performance Improvement. *International Journal of Information Management*[J]. 2019, 50(1):557-565.
- [13]. Sun, L., Zhao, Y., Sun, W. (2019). Study on supply chain strategy based on cost income model and multi-access edge computing under the background of the Internet of Things. *Neural Computing and Applications*. <https://doi.org/10.1007/s00521-019-04125-9>.
- [14]. Wang, F., Ding, L., Yu, H. et al. (2019). Big data analytics on enterprise credit risk evaluation of e-Business platforms. *Information Systems and e-Business Management*. <https://doi.org/10.1007/s10257-019-00414-x>.
- [15]. Yang, R., Yu L, Zhao, Y., et al. Big data analytics for financial Market volatility forecast based on support vector machine. *International Journal of Information Management*[J]. 2019, 50(1):452-462.
- [16]. Liu, Z et al. Research on Staged Pricing Model and Simulation of Intelligent Urban Transportation. *IEEE Access*[J]. 2019, 7(11): 141404 – 141413.
- [17]. Kabanda, S., & Brown, I. (2017). Interrogating the effect of environmental factors on E-business institutionalization in Tanzania: a test and validation of small and medium enterprise claims. *Information Technology for Development*, 23(1), 59-85.
- [18]. Zhenhua Huang, Xin Xu, Juan Ni, Honghao Zhu, and Cheng Wang.

Multimodal Representation Learning for Recommendation in Internet of Things.
IEEE Internet of Things Journal (2019). DOI: 10.1109/JIOT.2019.2940709.

- [19]. Zhou, T., Zhang, J., 2019. Analysis of commercial truck drivers' potentially dangerous driving behaviors based on 11-month digital tachograph data and multilevel modeling approach. Accident Analysis and Prevention 132, 105256.
<https://doi.org/10.1016/j.aap.2019.105256>