

Profit Distribution of Internet Supply Chain Finance Guaranteed By Core Companies

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Abstract: This paper researches the profit distribution of core companies and suppliers in the Internet supply chain finance. From the perspective of fair pricing, paper builds a rotating bargaining game model for repricing, and works out the profit distribution including optimal prices and expected returns. Finally, paper takes Ant Financial Services' agricultural supply chain finance as an example to test the rationality of the model. And compared to traditional supply chain finance, we find that the profit of the core company and the supplier has increased.

1. Introduction

With the maturity and advancement of "Internet +" technology, supply chain finance is actively exploring in the direction of the Internet. Kaplan and Sawhney (2000) propose the concept of E-hub and introduce that electronic center can provide financing services for buyers and sellers in the supply chain aggregation model. Yuan Changjin (2014) define the Internet supply chain finance: commercial banks that have both the identity of fund providers and e-commerce platform operators or e-commerce companies with loan licenses provide comprehensive financial services to small and medium-sized enterprises on the e-commerce platform. But there are few researches on the profit distribution in Internet supply chain finance, most of them are theoretical researches of its development model, participants, risk assessment, and strategic recommendations.

Yan (2008) found that both manufacturers and retailers benefit from the dual channel profit sharing strategy by using the bargaining game model. Hu and Zheng (2013) find agricultural supply chain finance can not only improve the overall income level, but also ensure that the income of all participants can be increased. This article builds a game model of bargaining between core companies and suppliers to determine the profit distribution in Internet supply chain finance.

2. Internet supply chain finance guaranteed by core companies

2.1 Development in China

For a long time, the expensive and difficult financing has been restricting the development of China's SMEs. Therefore, supply chain finance develops rapidly in China. In 2018, the size of China's supply chain finance market increased to 16.51 trillion yuan, and the percentage of upstream financing business relying on core companies is 24%.

Internet supply chain finance, as an innovative business of supply chain finance, relying on its big data advantages to enable cargo flow, business flow, information flow, and capital flow to achieve "four flows in one." E-commerce platforms and banks have achieved remarkable results in just a few years. As of 2017, Ant Financial Services' "Wangnong Loan" served 1.669 million small and micro enterprises and farmers, covering 231 cities and 557 counties in China. The supply chain financial product "Jingbao Bei" by JD.com in 2013 can quickly provide loans to suppliers. The amount of financing in the first month exceeded 300 million yuan, and more than 1 billion was completed one year later.

2.2 Financing mode

On the one hand, the e-commerce platforms provide new sales channels for core companies, leading to increased demand for their products. Core companies will acquire more suppliers' products to expand production. On the other hand, the platforms provide more loans for suppliers, as is shown in fig.1. By relying on the guarantee of core companies and the transaction records on the e-commerce platform. Core companies have made certain contributions in this process, which has greatly improved the revenue of suppliers. Therefore, the distribution of profits between core companies and suppliers will change. Core companies will ask suppliers to reduce the price on the grounds of purchasing more suppliers' products and providing loans to suppliers to increase credit.

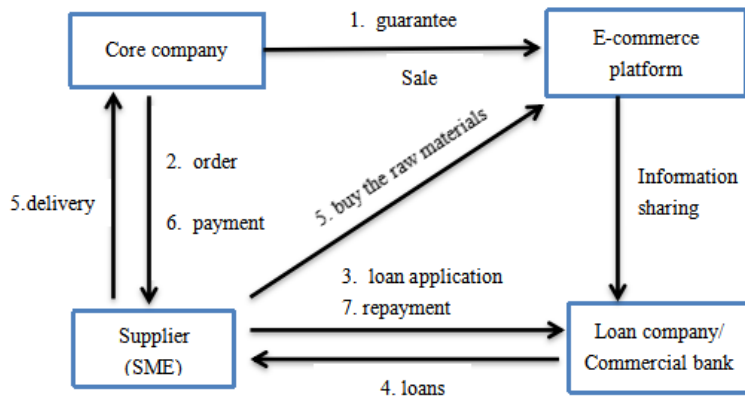


Fig. 1 Financing mode

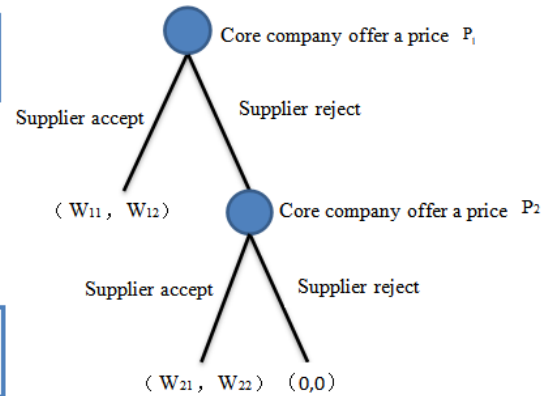


Fig. 2 Two-stage game tree

3. Profit Distribution Game Model

3.1 Assumptions

Assumption 1: The amount of loans that supplier receives in traditional supply chain finance is L_0 , annual interest rate is I_0 , core company purchases Q_0 tons of products from suppliers each year;

Assumption 2: In the Internet supply chain finance, the loan amount that the supplier receives from the platform is L , and the annual interest rate is I , core company purchases Q tons of products from suppliers every year. The market price is P_0 per ton, the new price P per ton through bargaining;

Assumption 3: The unit cost of the supplier is unchanged, and annual investment return rate is R in traditional supply chain finance. The annual cost of core company to support the loan is C . And the above is the private information;

Assumption 4: Discount factors can be understood as the degree of patience, for supplier and core company is δ_1, δ_2 , and $\delta_1 \leq 1, \delta_2 \geq 0$. Due to the effect of the discount factor, the same share will reduce the value in the next period.

Assumption 5: The loan period is one year, and pay interest monthly.

Assumption 6: During the game, the two sides make quotations alternately, and each stage quoted as P_i ($i=1,2,3\dots$). The core company first starts quoting. Considering the "accept as soon as possible" principle of the discount factor, this article only discusses the two-stage bargaining game model. The game tree is shown in Fig. 2

3.2 Solution of game model

The established model is a complete information dynamic game model, which is suitable to be solved by inverse induction. So discuss the second stage of the game first. In the second stage, the supplier makes a quotation. If the core company rejects the quotation, the game ends and the profit of both parties is zero. As long as the quotation meets the profit of the core company is greater than 0, the core company will accept the quotation.

$$\delta_2(P_0 - P_2)Q - \delta_2 C \geq 0 \quad (1)$$

$$P_2 \leq P_0 - C/Q \quad (2)$$

Let $Z = P_0 - C/Q$, assuming Z is uniformly distributed on $[P_1, P_0]$. So the probability that the core company will accept the quotation is P_{2A} , and the probability that it will reject is P_{2R} .

$$P_{2A} = P(P_2 \leq Z) = (P_0 - P_2)/(P_0 - P_1) \quad (3)$$

$$P_{2R} = P(P_2 > Z) = (P_2 - P_1)/(P_0 - P_1) \quad (4)$$

So the total profit of the supplier is W_1 .

$$W_1 = P_{2A} \delta_1 [L(R-I) - (P_0 - P_2)Q] + P_{2R} \delta_1 * 0 = (P_0 - P_2) \delta_1 [L(R-I) - (P_0 - P_2)Q] / (P_0 - P_1) \quad (5)$$

It can be seen that (5) is a unary quadratic function about P_2 . Derivative of P_2 , we can get the best quotation P_2 of supplier in the second stage.

$$P_2 = P_0 - L(R-I)/2Q \quad (6)$$

If $P_2 \leq P_0 - C/Q$, that is $L(R-I) \geq 2C$, the core company will accept the quotation. Its profit is W_{22} , and the supplier's profit is W_{21} .

$$W_{21} = 0.5 \delta_1 L(R-I) \quad (7)$$

$$W_{22} = 0.5 \delta_2 L(R-I) - C \delta_2 \quad (8)$$

Back to the first stage, the core company's quotation is P_1 . If the supplier accepts the quotation, its profit will be W_{11} , and the core company's profit is W_{12} .

$$W_{11} = L(R-I) - (P_0 - P_1)Q \quad (9)$$

$$W_{12} = (P_0 - P_1)Q - C \quad (10)$$

Since the core company know the supplier's selection method and profit in the second stage, as long as the quotation of the core company in the first stage makes the supplier's profit under this quotation greater than the second stage's profit, the supplier will accept the quotation.

$$L(R-I) - (P_0 - P_1)Q \geq 0.5 \delta_1 L(R-I) \quad (11)$$

$$P_1 \geq P_0 - L(R-I)(1 - 0.5 \delta_1)/Q \quad (12)$$

Let $Y = P_0 - L(R-I)(1 - 0.5 \delta_1)/Q$, Y is mainly related to R . Because the core company doesn't fully understand the total profit on investment of the supplier, it will estimate Y uniformly distributed on $[m, P_0]$ (m is the unit cost of the supplier estimated by the core company, $m = P_0/(1+R)$). The probability that the supplier accepts and rejects the core company's quotation is P_{1A} , P_{1R} .

$$P_{1A} = P(P_1 \geq Y) = (P_1 - m)/(P_0 - m) \quad (13)$$

$$P_{1R} = P(P_1 < Y) = (P_0 - P_1)/(P_0 - m) \quad (14)$$

If the supplier rejects the quotation from the core company in the first stage, the probability that the core company will accept the quotation from the supplier in the second stage is P_{1R2A} .

$$P_{1R2A} = P_{1R} P_{2A} = (P_0 - P_1)/(P_0 - m) * (P_0 - P_2)/(P_0 - P_1) = (P_0 - P_2)/(P_0 - m) \quad (15)$$

The total profit of the core company in the entire bargaining game W_2 consists of two parts.

$$W_2 = P_{1A} W_{12} + P_{1R2A} W_{22} = (P_1 - m)/(P_0 - m) [(P_0 - P_1)Q - C] + (P_0 - P_2)/(P_0 - m) [0.5 \delta_2 L(R-I) - C \delta_2] \quad (16)$$

It can be seen that (16) is a unary quadratic function about P_1 . Derivate P_1 on both sides of the equation to get the best quotation from the core company in the first stage.

$$P_1 = [(P_0 + m)Q - C] / 2Q \quad (17)$$

Substituting (17) into (9) (10), we get both profit when the supplier accept the quotation.

$$W_{12} = 0.5Q(P_0 - m) - 0.5C \quad (18)$$

$$W_{11} = L(R - I) - 0.5(m - P_0)Q + 0.5C \quad (19)$$

4. Ant Financial Services' supply chain finance

Zhengbang Group was established in 1996 and is a national core company in agricultural industrialization. And Zhengbang Technology was listed on the Shenzhen Stock Exchange in 2007. After reaching a supply chain finance intention with Ant Financial Services in 2017, Zhengbang Feed selected 500 from more than 2,000 upstream suppliers to provide loan guarantee for these suppliers. This article selects one of the corn suppliers for a case study.

According to the results of questionnaires and interviews, the information of Zhengbang Feed and upstream corn supplier after cooperation with Ant Financial Services is shown in Table 1. Insert the data into the game model, the results are shown in Table 2.

Table.1. The information of Zhengbang Feed and upstream corn supplier

P_0 (yuan)	L(yuan)	L_0 (yuan)	I	I_0	Q(ton)	Q_0 (ton)	R	C(yuan)	δ_1	δ_2
1880	500000	100000	6%	8%	5000	4000	35%	5000	0.7	0.9

Table.2. Game results of Zhengbang feed and the corn supplier

Game stage	Item	Parameter	Results(yuan)
First stage	Quotation from the core company	$P_1 = [(P_0 + m)Q - C] / 2Q$	1635.8
	Equilibrium condition (Otherwise enter the second stage)	$P_1 \geq P_0 - L(R - I)(1 - 0.5\delta_1) / Q$	No
	The core company's profit	$W_{12} = 0.5Q(P_0 - m) - 0.5C$	/
	The supplier's profit	$W_{11} = L(R - I) - 0.5(m - P_0)Q + 0.5C$	/
Second stage	Quotation from the supplier	$P_2 = P_0 - L(R - I) / 2Q$	1865.5
	Equilibrium condition (Otherwise terminate cooperation)	$P_2 \leq P_0 - C / Q$	Yes
	The core company's profit	$W_{22} = 0.5\delta_2 L(R - I) - C\delta_2$	61750
	The supplier's profit	$W_{21} = 0.5\delta_1 L(R - I)$	50750

After two rounds of bargaining, the price of corn is finally determined to be 1865.5 yuan/ton, which is 14.5 yuan/ton lower than the market price. In the Internet supply chain finance, the corn supplier's profit is 50750 yuan, and Zhengbang Feed's profit is 61,750 yuan. This is consistent with the actual situation obtained from the survey. In actual cooperation, the corn supplier gives a concession price of 10-20 yuan per ton based on the market price. This shows that the repricing model established in this article is reasonable and feasible. When not cooperating with Ant Financial Services, the profit obtained from the bank loan of the supplier is $W_S = L_0(R - I_0) = 27000$ yuan. So corn supplier income increased by $50750 - 27000 = 23750$ yuan, Zhengbang feed income increased by 61750 yuan. This shows that the Internet's participation in supply chain finance has increased the profit of the system and the participants.

5. Conclusion

This article simulates the operation mode of Internet supply chain finance, and build a repricing model between core companies and suppliers using the bargaining game. The model works out the

new profit distribution. Finally, using Ant Financial Services' agricultural supply chain finance as an example, the model is verified to be reasonable. And compared to traditional supply chain finance, we find that the profit of the core company and the supplier has increased.

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