Consider the level of the retailer's sales effort research on pledge rate decision-making

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Abstract. In the market competition environment of oversupply, this paper considers the impact of retailers' sales effort level on the market demand, and studies the relationship between the pledge rate decision and the expected income of financial institutions under the mode of dynamic inventory pledge financing. Financial institutions and retailers of market demand changes are complete information, with financial institutions own risk appetite, financing enterprise exogenous default probability, collateral loss, sales effort level set constraints, with financial institutions inventory pledge financing final expected returns for the target function to establish pledge rate decision model, respectively, retailer different sales effort level of pledge rate decision. Research shows that when the commodity price is certain, the retailer sales effort level will affect the financial institutions expected income, when the higher sales effort level, financial institutions expect more, the best rate of pledge value is larger, namely, financial institutions tend to provide higher loan ratio to financing enterprises.

Keywords: Inventory pledge, Pledge rate, Sales effort level, Expected return.

1 Introduction

As a business model of supply chain finance, inventory pledge financing provides a better solution for small and medium-sized enterprises to solve their financing problems. Pledge rate decision as a financial institution in the inventory pledge financing business key decisions, so the study of pledge rate decision has important theoretical significance and practical significance.

Scholars have made many studies on the decision issue of pledge rate. Chiu, Choi and Tang [1] under the premise of demand depends on price, the demand function for product and additive form, build two supply chain model under the demand function, and extend the repurchase contract, under the repurchase contract, the supplier only repurchase over the sales target of the remaining products, the results show that in the price multiplication and price addition two demand function, the repurchase contract can realize the coordination of supply chain. Hou, Zeng and Zhao [2] considering the pledge goods market demand is uncertain circumstances, study the random fluctuation of demand for supply chain coordination and the influence of repurchase contract, the

T. Ramayah et al. (eds.), *Proceedings of the 2024 International Conference on Applied Economics, Management Science and Social Development (AEMSS 2024)*,
Advances in Economics, Business and Management Research 284,
https://doi.org/10.2991/978-2-38476-257-6_5

results show that demand fluctuation is the key factor affecting the repurchase contract, and with the fluctuation of demand, the supply chain participant income will be significantly affected. Yan, Sun, Zhang and other companies consider the provision of partial credit guarantee by suppliers, small and medium-sized enterprises choose financing channels and the formulation of financing strategies under the corresponding financing mode. The study found that when suppliers provide partial guarantee, financial institutions are more willing to provide loans to retailers [3]. Buzacott and Zhang [3] study the impact of corporate profitability on the returns of financial institutions under the condition of financial constraints, and analyzed the relationship between loans and pledge rate of financial institutions. Panos and Qiu [4] study the decision of purchasers under the conditions of bank inventory pledge financing and supplier credit loan under the condition of optimal return on investment. Scholars have studied the relationship between the level of sales effort and the market demand,the retailer can influence the demand through her sales effort[5,6].

2 Problem Description

Financing enterprises to initiate loan applications from financial institutions, After the comprehensive assessment of chattel pledge and financing enterprises conducted by financial institutions, the multi-period inventory pledge financing contract is signed, The financial institution will assess the value of the pledged goods at the end of each pledge period, Make it always no less than the loan principal and interest and, At the beginning of each pledge cycle, Financial institutions shall judge the value of the pledge and the size of the principal and interest of the loan, When the value of the pledge is not lower than the sum of the principal and interest of the loan, Business continues, Enter into the next pledge cycle, Otherwise, the financing enterprises need to close their positions, That is, the supplementary goods to pay the deposit, To meet the value of the pledged goods not less than the principal and interest of the loan, If the financing enterprise does not choose to supplement the goods or pay the deposit, That is, the financing bond enterprises choose to default, At this point the liquidation process, Financial institutions will process the pledged goods to repay the principal and interest of the loan. If choose to continue, after the next pledge cycle.

3 The pledge rate decision model considering the level of sales effort

3.1 Description of the model symbol

In order to facilitate the establishment of an inventory pledge rate decision model considering the level of retailer sales effort, the parameters are set and explained as follows.

n: Number of segments of the dynamic pledge cycles1,2..... i. p: Unit price of commodity sales. g: Commodity processing price. q: Number of collateral. λ: Inventory pledge ratio of financial institutions($0<\lambda<1$). R: Financing and loan interest rate. t:

A certain batch cycle during the dynamic pledge period, t=T/n. V(t): Number of collateral at time t of the pledge cycle. a: market demand. Q: The main default rate of financing enterprises. Pm: The default probability of the financing enterprise at the end of the pledge period, m is 1,2,3..... i. Πm: The expected return of the financing enterprise after the default in the pledge cycle, m is 1,2,3..... i. Z: Total expected return at the end of the pledge period. w: Commodity loss rate, as a constant, w> 0, wt <1. k: The cost-sensitive coefficient of sales effort is related to the financing enterprise itself. L, B: Financial institutions adopt the lower risk control mode (L, B) to manage the risk of pledge business. L indicates the maximum loss of financing amount that financial institutions can bear, and B indicates the risk tolerance of financial institutions.

3.2 Mathematical model establishment

Inventory pledge rate decision model considering the level of retailer sales effort.

$$\max Z=P_1\prod_1 + P_2\prod_2 + P_3\prod_3 \ldots\ldots + P_n\prod_n \tag{1}$$

$$\text{s.t.}\begin{cases} 0 < \lambda \le 1 \\ e^{-wT} \ge \lambda(1+RT) \\ F\left[\frac{\lambda pq(1+RT-L)-g\sum_{i=1}^{n} P_i V(it)}{(p-g)\sum_{i=1}^{n} P_i}\right] \le B \\ 0 \le s \le \sqrt{\frac{2[pq-\lambda pqRT)]}{k}} \end{cases} \tag{2}$$

The constraints of the pledge rate decision model are shown in Equation (2). Pledge rate decision model illustration considering retailer level of sales effort. The objective function is shown in equation (1):$Z = P_1\prod_1 + P_2\prod_2 + P_3\prod_3 \ldots\ldots + P_n\prod_n$. Break up the above formula, and calculate the probability of default of the financing enterprise and the expected return expression of the financial institution at the time of default under each pledge cycle respectively. The default probability in the first pledge cycle is equal to the probability of the main default rate Q multiplied by the probability distribution function under the critical demand. The calculation formula is follows:$P_1 = QF(a_1)$. The expected income of financial institutions under the first pledge cycle is:$\prod_1 = p\int_0^{a_1} af(a)\,da + g\int_0^{a_1}(V(t)-a)f(a)\,da - \lambda qp(1+Rt)$.

Similarly, the default probability and expected return function of the financing enterprise at the end of the nth cycle is: $P_n = 1 - P_1 - P_2 - P_3 - \ldots - P_{n-1}$, $\prod_n = \lambda qpRT - QF(a_n)\lambda qp(1+RT) + Q(p-g)\int_0^{a_n} af(a)\,da + QF(a_n)gV(T)$.

3.3 Description of the model constraints:

In the process of inventory pledge financing business, there is a natural loss of the pledged goods, so the risk brought by the commodity loss will be considered first. Based on the research of previous scholars on the commodity loss, the relationship between the commodity surplus and the loss rate is obtained according to the literature research: $V(t) = q_0 e^{-wt}$. For financial institutions, the value of the surplus goods

should be greater than the principal and interest of the loan:$e^{-wt} \geq \lambda(1+RT)$. Financial institutions adopt the lower risk avoidance model [L, B], L is the financial risk tolerance, that is, the proportion of the loss amount, and B the probability of the loss L as the proportion of the amount.$F[\frac{\lambda pq(1+RT-L)-g\sum_{i=1}^{n} P_i V(it)}{(p-g)\sum_{i=1}^{n} P_i}] \leq B$. The effect function of sales effort behavior on market demand is as follows and the sales effort cost function is as follows: Demand function under the influence of sales effort:$a = a_0 + \theta s$. The s is sales effort level. $s \geq 0$.θ is the market demand sensitive coefficient under sales efforts. θ Related to financing enterprises. Sales effort cost function:$h(s) = ks^2/2$. The k is the cost-sensitive coefficient of sales effort and is related to financing enterprises. The sales effort level constraints are:$0 \leq s \leq \sqrt{\frac{2[pq-\lambda pqRT)]}{k}}$.

3.4 Mathematical model solution

Considering the pledge rate decision model of retailer sales effort behavior, the process of solving the pledge rate decision model is as follows:

First, substitute the given parameter into the equation (1) and (2) constraint. Through this process, the value range of the pledge rate can be determined. Second, substitute the value range of these parameters and the pledge rate into the expected return target function. Through this step, you can calculate what the expected return is under different pledge rates. third. By substituting different levels of sales effort into the model and repeating the above steps, the optimal pledge ratio and the maximum expected return at different sales effort levels are obtained.

4 Example analysis

Set the parameters for the pledge rate decision model in Table 1

Table 1. Parameter setting of the pledge rate decision model

p	q	g	k	T	t	Q	R	L	B	w	θ
100	1000	50	1000	3	1	0.6	0.055	0.1	0.02	0.005	100

Decision analysis of pledge rate under different levels of sales effort. In analyzing how the sales efforts affect the market demand, the optimal pledge rate and the maximum expected profit corresponding to the different sales effort levels must be calculated separately, and the sales effort levels are set as follows: s=0.3, s=0.5, s=0.7, s=1. The sales effort behavior of retailers is one of the key factors affecting the expected profit of financial institutions. As sales efforts improve, retailers are able to obtain greater market demand and increase sales, and financial institutions expect profits to increase. This phenomenon is particularly pronounced under the same pledge rate. For financial institutions, retailers can achieve higher returns at the same cost of capital through increasing sales efforts. Therefore, for financial institutions, the level of sales effort of retailers is also an important factor in their pledge rate decisions. As retailers'

sales efforts improve, financial institutions also tend to provide more financing, that is, to set larger pledge rates.Fig.1 shows the trend of the calculation results.

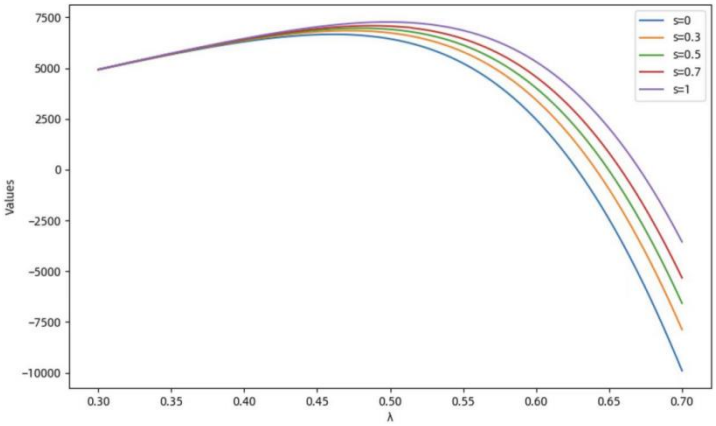

Fig. 1. Financial institutions expected profit change trend chart

Table 2 shows some of the calculation results. It is convenient to more intuitively compare the best pledge rate of financial institutions and the maximum expected return of the value under different sales effort levels in the following table.

Table 2. Some financial institutions expect profits

λ	Z(s=0)	Z(s=0.3)	Z(s=0.5)	Z(s=0.7)	Z(s=1)
0.461	**6663.42**	6829.56	6925.68	7011.28	7122.01
0.472	6647.37	**6844.19**	6958.53	7060.69	7193.40
0.480	6614.18	6836.05	**6965.35**	7081.15	7232.02
0.487	6568.68	6814.52	6958.16	**7087.08**	7255.48
0.498	6462.97	6750.53	6919.28	7071.23	**7270.55**
0.507	6342.16	6667.82	6859.58	7032.74	7260.64

5 Conclusion

Based on the dynamic inventory pledge financing model, considering the market demand with the retailer sales effort level, studied the relationship between the sales effort behavior and the pledge rate decision, the results show that retailer's sales efforts behavior help improve the pledge rate of financial institutions, namely provide higher loan ratio, financial institutions can also get more loan income, financing enterprises can also get more loan funds. It provides theoretical reference for financial institutions.

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