Research on the Construction of Internal Control of Supply Chain in Retail Industry Based on Risk Management Model

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Keywords: Risk Management, Retail, Supply Chain, Internal Control, Internal Control Risk System

Abstract: This paper proposes an internal control system for commercial retail enterprises based on risk management. Based on the mean-preserving transformation and mean-CVaR criterion in probability theory, the author first studies the impact of demand variability reduction and risk preference on the supply chain system. This paper then builds a centralized system of supply chains and demonstrates that promotional efforts and reduced demand variability can increase the profitability of centralized systems. Finally, this paper establishes a decentralized supply chain system under the risk preference of retailers. System simulations demonstrate that a combined contract of revenue sharing and quantity discount can coordinate a supply chain where demand depends on promotional efforts and levels of variability.

1. Introduction

Under the financial crisis, Chinese commercial retail enterprises are facing the strong impact of international multinational commercial retail enterprises. Severe challenges urgently require Chinese commercial retail enterprises to improve their competitiveness as soon as possible, improve their operating efficiency and win the global competition. At the same time, with the changes in consumer demand and the intensification of competition in the commercial market, new commercial formats such as convenience stores, supermarkets, specialty stores, and warehouse shopping malls have developed rapidly, prompting the continuous expansion of the scale of Chinese commercial industry. At the same time, in general, it lacks the characteristics of relying on systems to manage enterprises, especially a considerable number of commercial retail enterprises have not established and improved internal control systems, so that the internal management of the enterprises is still at a low level, which sometimes brings losses to the enterprises. This paper discusses the current status of internal control of commercial retail enterprises, and proposes methods and countermeasures for establishing the internal control system of commercial retail enterprises based on risk management[1]. This paper establishes a centralized system of supply chains and demonstrates that promotional efforts and reduced demand variability can increase the profitability of centralized systems. Finally, this paper establishes a decentralized supply chain system under the risk preference of retailers.

2. Literature Review

2.1. Risk Management Implications

No matter what type of enterprise it is, it will inevitably encounter many risks. Risks will not only bring losses to the enterprise, but also bring many opportunities for the enterprise to obtain economic benefits. Therefore, enterprise managers should not just simply deny risks, but need to have a certain awareness of risks. At the same time, use scientific and systematic methods to manage risks well, and bring high economic benefits to enterprises with the help of risks. It can be seen that risk management is particularly critical for enterprises[2]. Risk management refers to the

  DOI: 10.25236/ichess.2023.027

management process to minimize the possible impact of risks in an environment where risks are definitely present in the enterprise, which covers the measurement, evaluation and response plans of risks. Good risk management is actually a series of prioritized processes, first solving and dealing with the things that will cause the most losses, and then deferring and dealing with those less risky matters.

2.2. The Meaning of Internal Control

In contemporary human society, human social activities can be divided into two types: understanding and transforming the world. In the activities of understanding and transforming the world, there will be deviations from the purpose of the activities, and this part of the gap can be divided into errors caused by lack of understanding of the world. In the process of activities, due to insufficient effort, there will be efficiency differences and impure activities, resulting in fraud. Therefore, the internal control system is a system formulated to strictly control these types of problems within a controllable range[3]. The essential characteristics of internal control are different from external control, because external control relies on external power to achieve control effects, while internal control is a control with initiative and internal demand.

2.3. The Connection between the Two

Management risk and internal control execution objects are the same. Both are systems used by managers to motivate and restrain all employees of the enterprise in order to effectively improve the competitiveness of the enterprise. This kind of system must actively cooperate with the enterprise from top to bottom, not just the responsibility of the internal control execution department or the risk prevention department. Therefore, all employees of the enterprise must actively cooperate and participate, so risk management and internal control are closely linked at this level.

The objectives of risk management and internal control are the same. Risk management and internal control mechanisms are both set up by managers to promote the sustainable development of the enterprise and protect the interests of the enterprise from external and internal damage. Therefore, at this level, risk management and internal control objectives are the same.

Risk management is the main direction of the development of internal control. This can be found from the enterprise risk management framework. The theoretical framework of risk management is set on the internal control framework, which is the development and supplement of the entire framework. In order to promote a more diversified and efficient development of an enterprise, it is necessary to implement internal control. However, in an ever-changing global economic environment, businesses are about to face more complex risks. Therefore, the internal control based on risk management is the best choice for the future development of the enterprise.

3. Retail Supply Chain Structure and Risk Model

The retail supply chain is the product of the coordinated development of industrial clusters and supply chains. Clusters without a supply chain will compete viciously with each other due to the tendency of enterprises within the organization to produce undifferentiated products; without the support of the competitive advantages of industrial clusters, the supply chain system in which SMEs participate is likely to become an inefficient organization. Enterprises in the retail supply chain not only cooperate with each other within the single-chain supply chain, but also have a dynamic competition and cooperation relationship between cross-chains[4]. As a new and efficient organization system, it not only includes the enterprise group associated with the entire product chain of "raw material supply of upstream enterprises - production and manufacturing of key components of core enterprises - sales and services of downstream enterprises", but also includes some supply chain related enterprises[5]. These institutions and organizations merge with the upstream and downstream enterprise groups to form a network value chain system with strong vitality. The structure of the cluster supply chain is shown in Figure 1. Its composition and structure are shown in Figure 2.

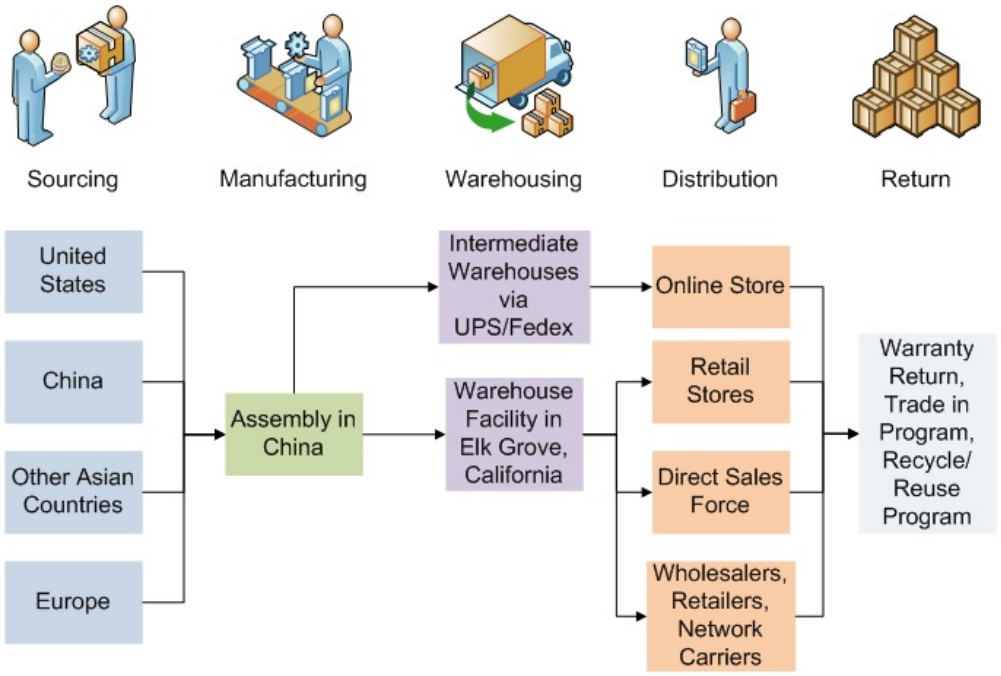

Figure 1 Retail supply chain structure.

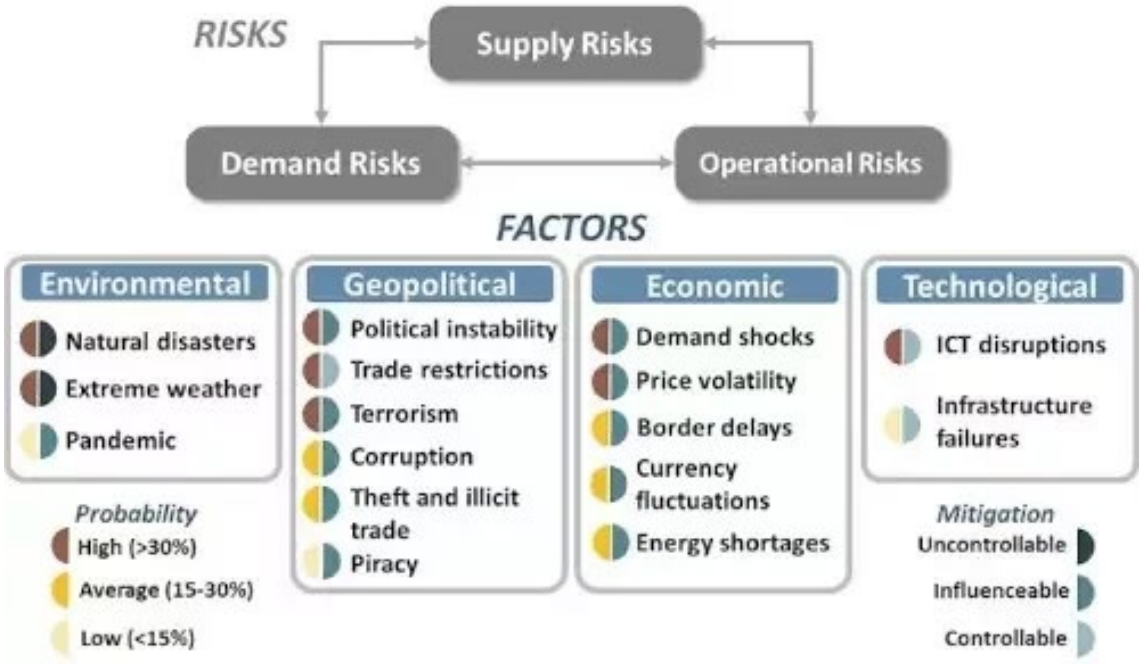

Figure 2 The composition of the retail supply chain risk system.

On the basis of defining and analyzing the connotation and composition structure of the retail supply chain risk system, the author will analyze the internal and external environment of the retail supply chain and the endogenous risks caused by the particularity of the retail supply chain structure. From the perspective of research, the control mechanism of the supply chain risk system is studied (Figure 3).

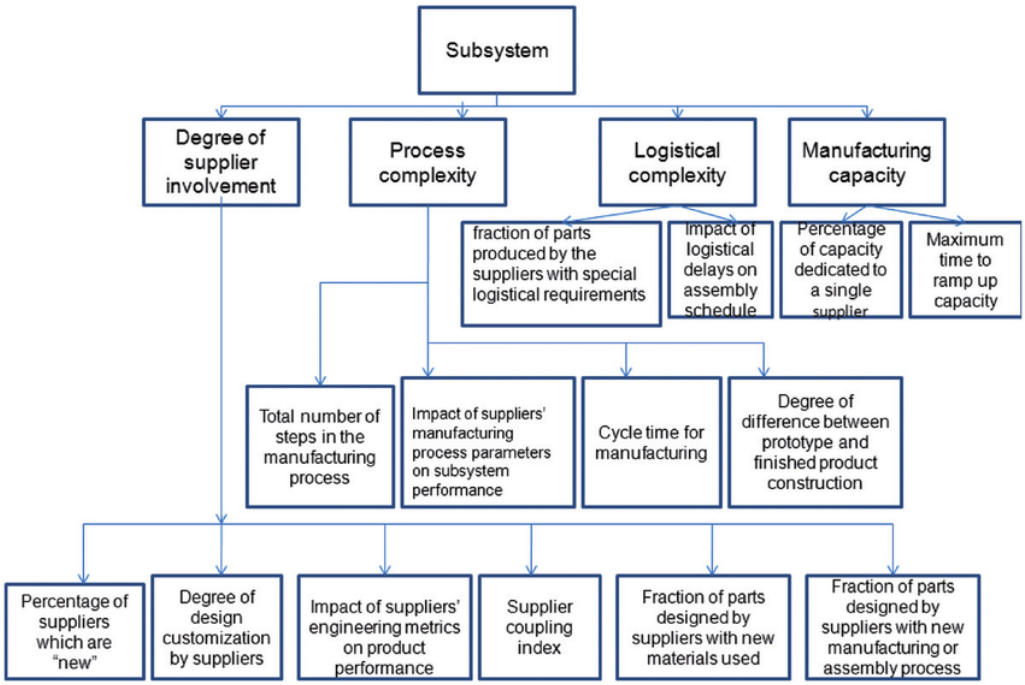

Figure 3 The composition of risk subsystems in the retail supply chain.

4. Model Design of Risk Control System for Retail Supply Chain

The research requirements in this section rely on a centralized system model of the supply chain under promotional efforts and variability. Considering the centralized supply chain system, supply chain integrators facing uncertain demand usually influence demand through effective promotions such as advertising, giving discount coupons, providing customers with pre-sales and after-sales services, and improving the shopping experience of products[6]. The demand function $D(e,\alpha)$ thus depends on the level of promotion effort e and the level of demand variability α, which is given by:

$$D(e,\alpha)=\beta(e)[\alpha X+(1-\alpha)\mu],0<\alpha\le 1 \tag{1}$$

Among them, the demand function $D(e,\alpha)$ in formula (1) has two characteristics: one is that the demand function $D(e,\alpha)$ is a monotonically increasing concave function of the promotion effort level e, namely $\beta'(e)>0$ and $\beta''(e)\le 0$. Efforts have a marginal diminishing effect on improving market demand, where $e\ge \underline{e}$ meets $\underline{e}$, that is, doing promotional efforts has a positive impact on product market demand. The second is that the demand function $D(e,\alpha)$ decreases with the decrease of demand variability. The variability is represented by the convex sequence ($\le_{cx}$) in probability theory, and α represents the level of variability of demand, that is,

$$D(e,\alpha_1)\le_{cx} D(e,\alpha_2) \tag{2}$$

Holds for all $0<\alpha_1<\alpha_2$. Notation (1) The bracket part on the right side of the equal sign is X_α, namely $X_\alpha=\alpha X+(1-\alpha)\mu$, where X_α is called the mean-preserving transformation, which satisfies: 1) The mean values of X_α and X are equal, that is, the smaller $E[X\alpha]=E[X];2)\alpha$ is, the smaller the variability of X_α is, That is, $X_{\alpha_1}\le_{cx} X_{\alpha_2}$ holds for all $0<\alpha_1<\alpha_2$. Among them, X is a continuous non-negative random variable defined on [0, l], 1> 0, its cumulative distribution function and probability density function are $F(\cdot)$ and $f(\cdot)$, respectively, and the mean is $E(X)=\mu$. When the cumulative distribution function $F(\cdot)$ of X increases strictly monotonically, its inverse distribution function is $F^{-1}(\cdot)$.

When $\beta(e)=1,\alpha=1$,demand function $D(e,\alpha)$ degenerates to traditional random demand without reducing demand variability and without promotion efforts; When $\beta(e)=e,\alpha=1$, demand function $D(e,\alpha)$ is the same as Taylor's demand function; When $\beta(e)=1,0<\alpha\le 1$ demand The function $D(e,\alpha)$ is the same as the demand function of Gerchak and Mossman; When $\alpha\beta(e)=\tilde{\beta}(e),\beta(e)(1-\alpha)\mu=\xi(e)$ is the demand function $D(e,\alpha)$, it is the demand function of Yu Haibo.

Considering a single-cycle single-class product with no inventory at the start of the promotional cycle, the supply chain integrator decides to order the product in quantity y and ordering cost as c, excluding fixed ordering costs[7]. When the realization of the demand is less than the order quantity y, after the promotion period ends, the supply chain integrator will process the remaining products with the unit residual value v, $0<v<c$; Out of stock penalty. Products are available immediately after the order is placed, and the delivery lead time is 0. The market retail price is $p, p>c$. When products are put on the market, effective promotions such as advertising and discount coupons are used to increase market demand. $g(e)$ is the promotion cost at a given level of promotion effort, which is an increasing convex function with respect to e, i.e., satisfying $g'(e)>0, g\ (e)>0$ and $g(1)=0, g'(1)>0$. The goal of the supply chain centralization system is to determine the order quantity y and the level of promotion effort e to maximize the expected profit, namely

$$\begin{aligned}&\max_{y\ge 0,e\ge \underline{e}} \pi^{C}(y,e)=\\&E[p\min(y,D(e,\alpha))+\\&v(y-D(e,\alpha))_{+}-cy-g(e)]\end{aligned}\tag{3}$$

The first item in formula (3) represents the sales revenue, the second item represents the sales surplus, the third item represents the ordering cost, and the fourth item represents the promotion cost. In order to simplify the optimization problem of the centralized system of the supply chain, remember

$$\Lambda(y,D)=\rho y-(y-D)_{+}\tag{4}$$

Among them, D is a continuous non-negative random variable, its cumulative distribution function and probability density function are $F_D(\cdot)$ and $f_D(\cdot)$, respectively, and the mean value is $E[D]=\mu_D$. When the cumulative distribution function $F_D(\cdot)$ of D increases strictly monotonically, its inverse distribution function is $F_0^{-1}(\cdot),\rho=(p-c)/(p-v)$. For the function $\Lambda(y,D)$ of formula (4), denote the function $M_D(y)=E[\Lambda(y,D)], y_D^*$ as the maximum point of the function $M_D(y)$, and denote the maximum value of the function $M_D(y)$ as $M_D^*(y_D^*)$. The following Lemma 1 and Lemma 2 give a characterization of the optimization of the function $M_D(y)$ problem.

5. System Simulation Analysis

Assuming that X obeys the uniform distribution defined in$[0,10]$, its cumulative distribution function is $F(x)=x/10, x\in 10, x\in[0,10].X$ with mean 5, and its inverse distribution function is

$$p=10,c=2.8,v=2,\alpha=0.5,$$

$F^{-1}(\gamma)=10\gamma,\tilde{T}(\gamma)=5\gamma^2$. Take $\eta=0.5,\underline{\alpha}=5>1,$. When the retailer's promotion effort

$$\beta(e)=e\ge 1,\delta_2=\delta_3=160$$

is not considered, the promotion effort cost is 0, so the promotion effort cost $g(e)=0.5k(e-1)^2, k=2$. Figure 4 below shows the impact of the risk appetite coefficient on the performance of supply chain members.

Based on the combination contract coordination of revenue sharing and quantity discount, when the retailer's risk preference coefficient is smaller, that is, the higher the degree of risk pursuit and the lower the profit distribution coefficient, the higher wholesale price of the manufacturer. This indicates that manufacturers will provide a higher wholesale price in order to ensure their own benefits, while retailers will provide higher revenue sharing coefficient to encourage manufacturers to cooperate with them, share market risks and profits together, and achieve the purpose of coordinating the supply chain[8]. If the profit of the centralized supply chain system is constant, the retailer's optimal expected profit decreases. However, the retailer's optimal expected utility is opposite to the retailer's optimal expected profit with respect to the monotonicity of the risk preference coefficient, because in the process of contract coordination, the revenue sharing coefficient is related to the retailer's risk preference, which realizes the i.e., revision of risk appetite, when retailers face an uncertain market directly, rather than paying attention to the impact of market risk on themselves, risk-seeking retailers pay more attention to the high efficiency brought by market risk.

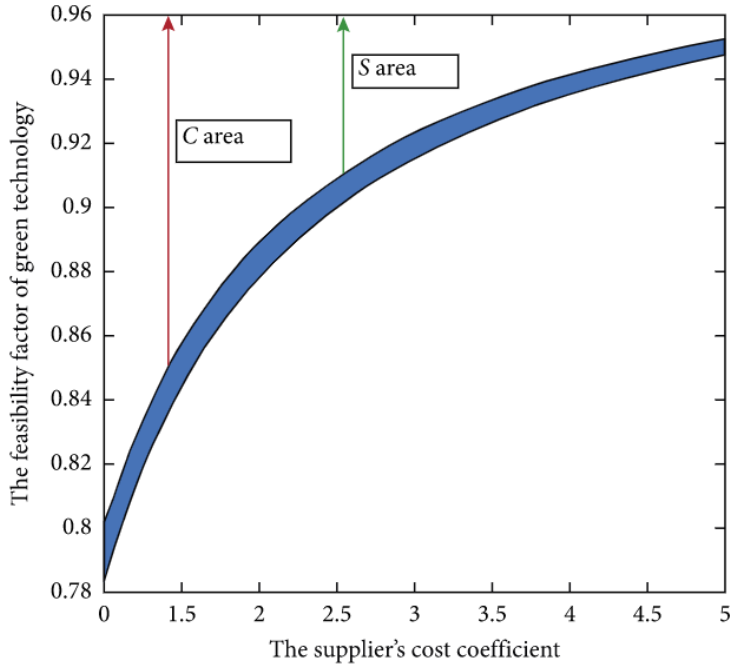

Figure 4 The impact of risk appetite on the performance of supply chain members.

When the retailer's risk preference coefficient is larger, that is, the degree of risk aversion is higher, the income distribution coefficient is smaller, and the manufacturer's wholesale price is lower, indicating that conservative retailers will provide manufacturers with higher wholesale prices in order to obtain lower wholesale prices. Income distribution ratio[9]. When the risk-averse retailer faces an uncertain market, it is conservative when making decisions. Compared with the higher returns obtained, the risk-averse retailer is more conservative. Businesses pay more attention to the impact of market risks on themselves, and the ideal state after coordination is that utility is not affected by risks.

6. Conclusion

It is found that the retail supply chain risk system is a complex system with obvious ambiguity and randomness. Various risk factors from different levels are interrelated, and the mechanism of action is very complex. Only by participating in the cooperation of risk control of the entire retail supply chain can all actors ultimately achieve the goal of reducing or sharing risks and losses. By establishing a centralized system model of supply chain and a decentralized system model of supply chain, this paper gives the optimal solution of supply chain system, discusses the coordination problem of supply chain when demand depends on promotion efforts and variability, and analyzes

the reduction of demand variability and retailers' risk appetite on the performance of supply chain members.

Acknowledgements

This work was financially supported by Achievements of Key Research Base of Humanities and Social Sciences in Shenzhen—Skilled Society Research Center of Shenzhen Institute of Technology.

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