

Study on Supply Chain Coordination via Option Contract

Azamat Rajapov¹, Jamshid Valiyev², Sanjar Rajapov³

¹ School of Transportation and Logistics, Southwest Jiaotong University, Chengdu, China

² School of Mechanical Engineering, Southwest Jiaotong University, Chengdu, China

³ School of Computer & Science, Southwest Jiaotong University, Chengdu, China

Abstract: Due to poor performance of supply chain we have studied supply chain contract, which is based on the basic contract model. On the basis, four kinds of typical contract models are analyzed and summarized, In order to make supply chain more effective we have designed coordination mechanism, increase retailer profit, increase supplier profit, coordinate the supply chain occur an important effect in practice, we have run basic portfolio contract model that make the supply chain coordination comes to realize to truth, in decentralized supply chain design option contract in order to increase profit of both members also in the numerical part we illustrated normal probability function and normal cumulative function using Matlab software and summarized the paper with conclusion part.

Keywords: Coordination Mechanism, Supply Chain Coordination, Supply Chain Contract, Option Contract

I. INTRODUCTION

The contract is mainly used in the field of economy and law, and supply chain contract is a kind of economic contract theory in supply chain. In this form, the research is mainly on the theory of multi - stage inventory.

Harris Ford [1] is aware of the first time in 1915 to put forward the concept of inventory, Clark and Scarf [2] together in 1960 will be extended to the case of multi - stage inventory, a relatively independent and identical distribution of demand is established by dynamic programming. The optimal order quantity and trading strategy of a product, which is extended to the lower reaches of the retailer, can be regarded as the supply chain. Since then, with the Clark and Scarf inventory model as the core, the scholars on the multi stage inventory in different directions, a lot of research has been carried out and Federgruen[3] have been carried out in detail. The core problem of the research on the multi - stage inventory is to make the upper and lower reaches through the optimization of the inventory time and the number of stocks. While the interests of the industry increase, but the upper and lower reaches of the enterprise tend to their own interests. So the scholars began to look at the study of the entire supply and sales system coordination and hope that through the arrangement and agreement between the supplier and the retailer to make the individual and the whole to achieve the best in order to achieve coordination. These arrangements and the agreement mainly include: the allocation of decision-making power, inventory number and cost optimization, pricing strategy, information sharing and coordination between the supplier and the retailer. Because the cooperation between the supplier and the retailer is generally general the contract arrangement is realized, so the scholars begin to apply the contract theory of law and economics to the supply chain. Period through the corresponding contract terms to achieve the above arrangements and conventions.

Pasternack [4] the concept of supply chain contract was first proposed in the paper in 1985. Supply chain contract has carried out a lot of researches and supply chain contract research has made great progress in many directions. Root According to the present situation of supply chain contract, the supply chain contract can be divided into four main types: wholesale-price contract, Buy-Back Contract, Revenue Sharing Contract, Quantity Flexibility Contract, in which the wholesale price contract and the revenue sharing contract is the earliest research is also the most common type of contract, while the revenue sharing contract and the number of elastic contract is divided don't study the core content in the supply chain: member's income and product quantity. Of course, in addition to the above four kinds of contract model, there is a quantity discount contract and feedback and rebate contract, etc... However, these contracts model can be evolved from the above four

kinds of contracts, or by one of the two or several of the contract. For example: the number of contract can be derived from the quantity flexibility contract and the pre contract can be evolved by the buyback contract or by the combination of the wholesale price contract and the number of flexible contracts, in the wholesale price contract to increase the incentive and punishment mechanism, in this paper we evolved into a quantity discount contract and reward and punishment contract. Obviously, from the content and model of the study of the four typical contract models are more representative. However, the coordination mechanism and the interaction between the contract parameters are often able to get through the contract model more specifically, so from the perspective of the research approach, according to the different contract model to explain it is more detailed and nuanced. So this paper is based on the research of supply chain contract, which is based on the basic contract model. On the basis, four kinds of typical contract model are summarized and finishing, to establish a more uniform structure and coherence, and the function and coordination mechanism are analyzed, and the method to determine the optimal contract parameters is given.

II. SUPPLY CHAIN CONTRACT BASIC MODEL

2.1 basic hypothesis

Supply chain contract research is generally composed of a supplier (manufacturer) and a retailer consisting of two level supply chains, as shown in figure 1. The retailer faces a random market demand, products are seasonal, and the ordering cycle longer. According to the LF game (Leader-Follower Game) the interaction between the theoretical study of supplier and retailer, supplier is a leader, the retailer is a follower, the supplier is given a set of contract parameters, and the retailer determines its optimal product. Order quantity at the same time, the product market is open, the market price, demand distribution and inventory cost of the products are related to the market. Such information is symmetric. Therefore, as a leader, the supplier can obtain all the necessary information to infer the retailer's property. Order quantity, and make the best decision. Suppliers and retailers are risk-neutral and fully rational, based on expectations.

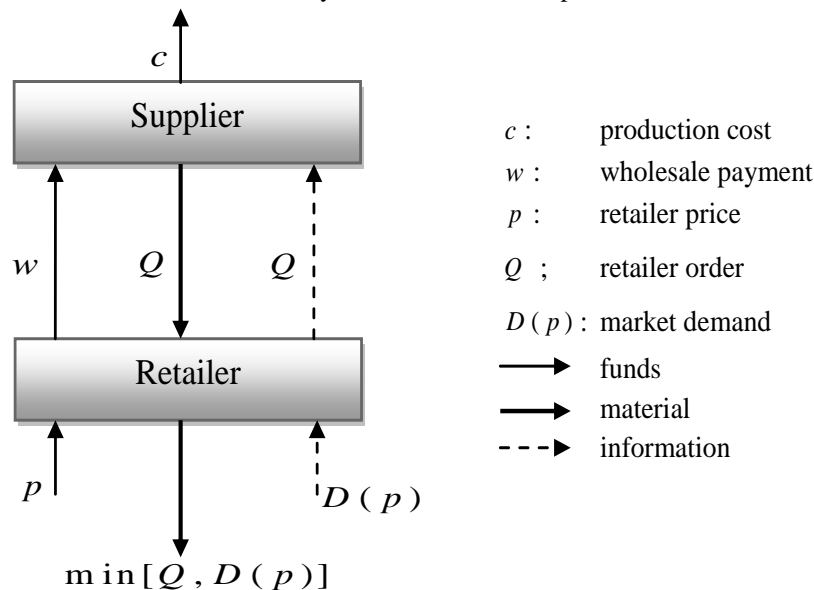


Figure 1. The basic supply chain model between a supplier and a retailer

The market demand for products assuming $D \geq 0$, the cumulative distribution function (CDF) and the probability density function (PDF) are $F(x)$, $f(x)$ and $F(0) = 0$, $\bar{F}(x) = 1 - F(x)$,

$$\mu = E(x) = \int_0^{\infty} xf(x)dx, D \text{ is market demand the production cost of the supplier is } c, \text{ the retailer is single,}$$

sales cost of a single product is c_r , the supplier takes the product to the retailer and the retail price of the product by the wholesale price w . For, the retailer's product order quantity is q , the unit product inventory cost

is c_h , the unit product's stock loss (for example: The loss of credibility, customer loss etc.) c_u , after the season, retailers will stock products handled by price v per unit. In order to guarantee the supply chain of limited profit, set $v < c$. $S(q)$, said retailers' expectations of sales, when the order of q , the actual demand of $x < q$, the retailer's production Product sales of $s(q) = x$; when the actual demand for $x \geq q$, $s(q) = q$ sales, therefore, as a function of sales: $s(q) = \min(q, x)$, t - transportation cost from retailer to the supplier, not included purchased cost.

If $S(q)$ is used to represent the retailer's expected sales, the meaning is $S(q) = E[s(q)]$, the use of mathematical statistics knowledge can be deduced as follows:

$$S(q) = \int_0^{\infty} (q \wedge x) f(x) dx = \int_0^q \int_0^x dy f(x) dx = \int_0^q \int_y^{\infty} f(x) dx dy = \int_0^q \bar{F}(x) dx$$

Where is

The retailer's expected inventory is: $I(q) = E(q - x)^+ = q - S(q)$

The retailer's expected shortage of goods: $L(q) = E(x - q)^+ = \mu - S(q)$

2.2 Basic Model

Supply chain coordination is to achieve the supply chain as a whole decision-making is the best, in the supply chain as a whole to increase the overall revenue from suppliers and retailers. To this end, we first discuss the situation of centralized decision - oriented supply chain. In the centralized supply chain, supply chain production of q products, and directly to the retail price r sold to consumers, the objective is to determine an optimal order quantity to maximize the overall profit of the supply chain. According to the above assumptions can be retail the expected profit of retailer:

$$\pi_r = rS(q) + vI(q) - c_h I(q) - c_u L(q) - wq$$

Supplier's expected profit:

$$\pi_s = (w - c - t)q$$

It expects overall profits of the supply chain as follows:

$$\pi_I = \pi_r + \pi_s$$

$$\pi_I = rS(q) + vI(q) - c_h I(q) - c_u L(q) - (c - t)q = (r + c_h + c_u - v)S(q) - (c - t + c_h - v)q - c_u \mu$$

According to Leibniz rule, known π_I , is a concave function, π_I partial derivative of q was:

$$\frac{\partial \pi_I}{\partial q} = (r + c_h + c_u - v)S'(q^*) + v - c_h - c - t = (r + c_h + c_u - v)\bar{F}(q^*) + v - c_h - c - t$$

Order $\frac{\partial \pi_I}{\partial q} = 0$, we can get the optimal order quantity of the supply chain function is:

$$F(q^*) = \frac{r + c_u - c - t}{r + c_h + c_u - v}$$

Therefore, the optimal order quantity as follows:

$$q^* = F^{-1} \left(\frac{r + c_u - c - t}{r + c_h + c_u - v} \right)$$

Suppose the retailer's optimal order quantity is q_r^* , and $q_r^* = \arg \max \pi_r$. On this basis, supply chain collaboration contract the research focused on two aspects: one is the amount of the retailer's order how to make optimal supply chain efficiency; another term of suppliers and retailers is how to allocate the profits of the supply chain.

According to the above hypothesis and contract model, four kinds of typical supply chain contract models are discussed respectively

- Wholesale-price contract model
- Revenue sharing contract model
- Buy-back contract model
- Quantity elasticity contract model

2.3 Wholesale price contract model

The price only contract is the sign of the supplier and retailer. The wholesale price contract, the retailer according to the market demand and the wholesale price to decide the order quantity, the supplier according to the retailer's order the amount of organization and production, the retailer is not sold out of all the products sold. The supplier's profit run is determined, do not assume the market risk, and the retailer will bear all the market demand risk. Wholesale price contracts in order to say is the most common one kind of contract pattern, also is the most simple one kind of contract pattern, its contract cost is also relatively low. In most of the supply chain management models, the wholesale price is considered to be fixed, and is not negotiable. When the wholesale price contract, the retailer's profit is:

$$\pi_r = rS(q) + vI(q) - c_h I(q) - c_u L(q) - wq = (r + c_h + c_u - v)S(q) - (w + c_h - v)q - c_u \mu$$

The function is a concave function, which is the q for the partial derivative, and the equation is equal to zero, and the optimal order quantity of the retailer can be obtained:

$$q^* = F^{-1} \left(\frac{r + c_u - w}{r + c_h + c_u - v} \right)$$

In order to realize the coordination, must be $q_r^* = q^*$, $w = c - t$, the supplier will not make a profit, clearly contrary to common sense, Therefore, the simple wholesale price contract cannot realize supply chain coordination. Spengler [5] first discovered the problem in 1950, she believes that the main reason for this phenomenon is that suppliers and retailers are taking their own marginal benefit as the goal, but not the test considering the overall marginal benefit of the supply chain; it can produce double marginal benefit, which leads to the supply chain coordination failure. In the wholesale price contract, the wholesale price of the supplier is usually fixed, and therefore, it belongs to "push". The effect of the contract model, cannot really pull, the retailer's order enthusiasm. In order to pull another manifestation of a quantity discount contract (Quantity – Discount Contract) is increasingly valued by people. Quantity discount contract is also a variant of the wholesale price contract. Can be based on the size of the retailer to discount wholesale prices, thereby stimulating the retailer to increase the order quantity. Monahan [6] from the supplier's point of view to consider the economic content of the retailer to provide a quantity discount, to prove a reasonable discount program to increase the order of the retailer purchase quantity and improve the supplier's profit. Rosenblatt and Lee [7-8] studied all the products of the discount problem, they and under the same assumptions, Monahan also discussed the linear discount problem, they think the new profit is not only to the supplier, both buyers and retailers can benefit. Lee and Rosenblatt extended the Monahan model, including the supplier's batch. Banerjee [9] with the viewpoint of central decision maker, joint optimization of the cost of the two sides, the calculation of the joint economic volume, and the final benefit of the two sides of the sale of quantitative description, in order to

optimal discount policy. Jeuland and Shugan[10] discussed the pricing strategy in the channel coordination, they think the number quantity discounts can be coordinated with the channel members of the operational performance, but also to share new interests, however, they also recognize that, there is a legal barrier to the realization of coordination, in particular, the relevant parameters of the discount, the need to understand all of the this information. Weng [11] extends the conclusion of Jeuland and Shugan to extend the entire supply from the supplier's perspective. Should be the chain to investigate the quantity discount strategy, through the analysis of the relationship between the supplier and the retailer, he believes that by providing a quantity discount can coordinate the supply chain in the relationship between the supplier and the retailer, and can realize the supply chain overall profit maximization. Weng[11] also analyzes the pricing strategy, the purpose is to coordinate the relationship between manufacturers and distributors through price. He compares the system manufacturers and distributors independently pricing and jointly determine the operating performance of the system and the production and order situation, explain how to cooperate increase system profit, and increase the number of how to depend on the change of system parameters. Weng[11] also discussed a similar problem, only the assumption that the cost and the target has changed, he assumed the two production cost function, the distributor of the service constrained by the level of service, the optimal strategy and the formation of the optimal strategy are obtained by the system's optimal strategy and the optimal strategy. Transaction price, In addition, Cachon[12] and Ferguson[13], who proposed the concept of the two order, that is, to provide two suppliers wholesale price, one is the wholesale price in advance, the other is according to the market demand to take the emergency order. His wholesale price, the wholesale price is higher than the wholesale price in advance. In the model of the two orders, the retailer can be the first. First with a lower wholesale price to book a product, if after a period of observation, the market demand is greater than the order when purchasing quantity, the retailer can use the higher wholesale price from the supplier to obtain the badly needed product, thus reducing the lack of loss of goods. They found that using the two order strategy, suppliers and distributors can benefit from it. We can see from the above wholesale price contract, due to the simple wholesale price contract cannot achieve supply chain collaboration, therefore, almost no one advocates the use of wholesale price contracts to improve the overall efficiency of the supply chain. About pure the research literature on the wholesale price contract is also less, and most of the literature has incorporated the wholesale price contract into other cooperative contracts. However, due to the relatively small contract price of the wholesale price contract, and there is no return cost, therefore, the product value is small, the high cost of the return of the case, a simple wholesale Price contracts may be more effective than other collaborative strategies, while wholesale price contracts are still low, due to their simplicity and low implementation costs. And it has been widely used in practice.

2.4 Revenue-sharing contract model

The so-called revenue sharing contract is the supplier to the retailer with a lower wholesale price, and gets a part retailer's sales revenue. At present, the domestic commonly used franchise mode is the typical case of the revenue sharing contract. If the supplier has the share of sales revenue for the share of ϕ , retailers $(1 - \phi)$ profits for retailers:

$$\begin{aligned} \pi_r &= (1 - \phi)[rS(q) + vI(q)] - wq - c_h I(q) - c_u L(q) = \\ &= [(1 - \phi)(r - v) + c_h + c_u]S(q) - [w + c_h - (1 - \phi)v]q - c_u \mu \end{aligned}$$

The optimal order quantity of the retailer is:

$$q^* = F^{-1} \left(\frac{(1 - \phi)r + c_u - w}{(1 - \phi)(r - v) + c_h + c_u} \right)$$

$$q_r^* = q^*$$

$$w = (1 - \phi)(c - t) + \phi c_u - \frac{\phi(c_h + c_u)(r + c_u - c - t)}{r + c_h + c_u - v}$$

To (2.11) into (2.9) and finishing available:

$$\pi_r = \frac{(1 - \phi)(r - v) + c_h + c_u}{r + c_h + c_u - v} \pi_I - \frac{\phi(r - v)}{r + c_h + c_u - v} c_u \mu$$

The vendor's profit:

$$\pi_s = \pi_I - \pi_r = \frac{\phi(r - v)}{r + c_h + c_u - v} \pi_I + \frac{\phi(r - v)}{r + c_h + c_u - v} c_u \mu = \lambda(\pi_I + c_u \mu)$$

$$\text{Among them } \xi = \frac{\phi(p - v)}{r + c_h + c_u - v}$$

Obviously $0 < \xi < 1$, so the revenue sharing contract can achieve coordination of supply chain. Retailers and suppliers according to the public share the benefits of the supply chain at different ratios and by determine the optimal wholesale price w . Rental revenue sharing contract in foreign countries industry has been successfully applied. Mortimer [14] the application of revenue sharing contract in the video rental industry carried out empirical research from the perspective of economics found that the revenue sharing contract about the overall profit of the supply chain has increased by seven percentage points. However, Cachon and Lariviere[15] think there are two factors that can cause the failure of the revenue sharing contract, one is the implementation of the revenue sharing contract management costs are too high; two is the implementation of the revenue sharing contract may reduce the marketing enthusiasm of the retailer. At the same time, they find that the demand is random and the price is under the premise of the correlation, the revenue sharing contract can still achieve the supply chain collaboration. Dana and Spier [16] application of benefit sharing contract in the perfect competition market. Pasternack[17] for some of the products using revenue sharing, At the same time, the research of the combination contract of the wholesale price contract is carried out, and the profits of the supplier and the retailer are found, the application of the revenue sharing contract in two cases is analyzed: First, the demand is random, the downstream business in the actual demand to determine the price and inventory; two is the need to predict and decreased with the passage of time, the price is variable. Giannoccaro and Pontrandolfo[18] the analysis of the three levels of supply chain (manufacturer, a distributor and a retailer) the supply chain cooperation strategy is adopted to adjust the supply chain contract parameters, Can improve supply chain efficiency, increase the interests of all members of the supply chain. Li [19], in his doctoral dissertation, the concept of profit sharing contract is proposed. He made the following assumptions about the profit sharing contract:

- (1) Wholesale price of w is: $w = k(r - c_s - c_r) + c_s$, here $0 \leq w \leq 1$, which is the market price: r, c_s, c_r for production cost.
- (2) For the products that are not sold, the supplier agrees to pay the retailer's return price $b = kp$ According to the above two hypotheses, that the retailer's profit model, $\pi_r = (1 - k)\pi_I$, the supplier's profit model. $\pi_s = k\pi_I$, The total profit of the supply chain. So k is regarded as the distribution factor to share the profit of supply chain. Profit there is two different points between the share contract and the revenue sharing contract between Cachon and Lariviere [15]:

2.5 Buy-back contract model

Repurchase contract, also known as return policy, is currently the most widely used in a collaborative mechanism. The so-called repurchase contract is the supply of a reasonable price b ($b > v$) from the retailer to buy back the product sales not to sell the product, so as to stimulate the retailer to increase the amount of order, expand the sales of products. Buy back contract fashion products, such as books, magazines, newspapers, audio and video products, computer software, are used for the more stringent requirements of time. And hardware, greeting cards, and medical products, etc... The profit of the retailer in the buy-back contract is:

$$\pi_r = rS(q) + bI(q) - c_h I(q) - c_u L(q) - wq = (r + c_h + c_u - b)S(q) - (w + c_h - b)q - c_u \mu$$

Retailers can obtain the optimal order quantity:

$$q^* = F^{-1} \left(\frac{r + c_u - w}{r + c_h + c_u - r} \right)$$

$$q_r^* = q^*$$

$$w = c - t + \frac{(b - v)(r + c_u - c - t)}{r + c_h + c_u - v}$$

The formula above, finishing available:

$$\pi_r = \frac{r + c_h + c_u - b}{r + c_h + c_u - v} \pi_l - \frac{b - v}{r + c_h + c_u - v} c_u \mu$$

The vendor's profit:

$$\pi_s = \pi_l - \pi_r = \frac{b - v}{r + c_h + c_u - v} \pi_l + \frac{b - v}{r + c_h + c_u - v} c_u \mu = \lambda (\pi_l + c_u \mu)$$

$$\text{Among them } \xi = \frac{b - v}{r + c_h + c_u - v}$$

As $0 < \xi < 1$, so the purchase contract can achieve supply chain coordination. According to the formula above, the supplier through choose to buy back the size of r to determine their own share of the entire supply chain profit, and according to the type to ensure that the optimal wholesale price of w , $\{b, w\}$ is defined as the optimal decision parameters. Comparison above, when $b - v = \phi(r - v)$, using revenue sharing contract and buy-back contract with the same coordination effect. For the study of the repurchase contract is more, Jeuland and Shugan[10] as early as 1983, it was found that the repurchase strategy can be to achieve coordination between the supplier and the retailer, unfortunately, they did not establish the corresponding model of the contract. Pasternaek[17] is the first scholar to study in the market to buy back the contract, he studied by the single supplier, single retailer sales channel sales of a single product situation, focus on the common sales channels of the repurchase contract, analysis of the side The impact of the international benefits of the potential operation of the void, under the assumption that the repurchase price is less than the wholesale price the total profit of the sales channel is similar to that of the vertical integrated supply chain. He thought a return full was a complete buy back, a compromise of the repurchase strategy can promote the supply of chain collaboration, and can improve collaboration efficiency through Pareto optimization. Kandel[20] pair of Pasternack based on the establishment of a price sensitive random demand model, and in the repurchase The same conclusion is deduced from the assumption that the price is related to the cost. The buy-back contract is because they are worried that the retail chamber of Commerce will sell the rest of the product after the sales season. And the damage to the supplier's product brand, which is particularly common in the high-end brand sales process, and some supply In order to re coordinate the inventory between retailers. Tagaras and Cohen [21], Anupindi, Bassok, and Zemel [22] are also studied. Then Padmanabhan and Png[23] are studied in order to control the supplier. In the case of the sale of the transition between the competition and the use of the repurchase strategy, found that the supplier's gains and therefore have been increased. But In the case of the demand is fixed, the repurchase strategy will lead to the retailer's order quantity is not rational. In addition, Taylor [24] Market demand and retailer 's efforts to buy back contracts were studied, and the results were found through the research on the related situation of the market demand. The coordination of supply chain can be realized. The similar research is also included in the Taylor, Padmanabhan, Taylor, Lee and Wang etc... Padmanabhan and Png and Kandell [20] et al., it is commonly used to consider the repurchase strategy from the perspective of market risk. Demand uncertainty and market risk. Tsay [25] has a risk sensitivity in the supplier and the retailer under the premise of discussing the risk sensitivity of the impact of the repurchase strategy, they study found that the neglect of suppliers and vendors sensitivity to risk can cause serious damage.

2.6 Quantity elasticity contract model

The quantity flexibility contract means that the retailer orders a part of the product before the sales season. After the market demand is determined by business, the final purchase can be determined in the quantity of the product supplied by the supplier. The amount of relative to the purchase price of the repurchase contract to adjust the price adjustment, the number of flexible contract is concerned about the adjustment of the number of products ordered, play in the electronic and computer industry, the number of contracts has been widely used, such as Microsystems Sun, Nippon Otis, Solectron, IBM, HP, Compaq and other large companies. Under the assumption that the situation of the retailer to predict the market demand for q her lowest commitment to buy the amount of $(1 - \beta)q$, suppliers The production capacity of $q_s = (1 + \alpha)q$, which is less than or equal to 0 and less than or equal to $0 \leq \beta \leq 1, \alpha \geq 0$. Then: The retailer's expectations of the purchase volume and the desired volume of sales are:

$$N(q, \alpha, \beta) = \int_0^{q(1-\beta)} q(1-\beta)f(x)dx + \int_{q(1-\beta)}^{q(1+\alpha)} xf(x)dx + \int_{q(1+\alpha)}^{\infty} q(1+\alpha)f(x)dx$$

$$S(q(1+\alpha)) = \int_0^{q(1+\alpha)} \bar{F}(x)dx, \quad S(q(1-\beta)) = \int_0^{q(1-\beta)} \bar{F}(x)dx$$

Retailer's expected profit:

$$\pi_r = rS(q(1+\alpha)) + vI(q(1-\beta)) - c_h I(q(1-\beta)) - c_u L(q(1+\alpha)) - wN(q, \alpha, \beta)$$

$$\frac{\partial \pi_r}{\partial q} = 0$$

$$(1+\alpha)(r-w+c_u)\bar{F}((1+\alpha)q^*) - (1-\beta)(w-v+c_h)F((1-\beta)q^*) = 0$$

$$\eta = \frac{(1+\alpha)}{(1-\beta)}, \quad q_s^* = (1+\alpha)q^*$$

$$F\left(\frac{q_s^*}{\eta}\right) = \eta \frac{(r-w+c_u)}{(w-v+c_h)} [1 - F(q_s^*)]$$

$$q_s^* = q^* = F^{-1}\left(\frac{r+c_u-c-t}{r+c_h+c_u-v}\right)$$

$$w = v - c_h + \frac{c-t-v+c_h}{\frac{1}{\eta} F\left(\left(\frac{1}{\eta} F^{-1}\left(\frac{r+c_u-c-t}{r+c_h+c_u-v}\right)\right)\right) + \frac{c-t-v+c_h}{r+c_h+c_u-v}}$$

η can be viewed as an elastic metric for quantitative elasticity. According to the formula, consider two extremes The situation, if the infinite elasticity ($\eta = \infty, \alpha = \infty, \beta = 1$), while retailers out of stock loss is zero ($c_u = 0$), Wholesale price $w = r$, retailers will therefore profit to zero; if the minimum degree of elasticity ($\eta = 1, \alpha = 0, \beta = 0$), then retailers are risk preferences, the number of flexible contracts is also corresponding to the transformation of the wholesale price contract, the optimal wholesale price is $w = c - t$, the retailer will take all the market risk and grab all the proceeds, while the supplier's profit is zero. Above Two cases are unable to achieve supply chain coordination, only when the call is located between η the two cases, in order to make the $w \in (c, r)$, the contract parameters $\{\alpha, \beta, w\}$, achieve the supply chain coordination. Signorelli and Heskett [26] use as a typical example of a Harvard Business School case to illustrate the retailer can not only increase the profit of the retailer, but also increase the profit of the manufacturer. Eppen and Iyer [27] backup agreements model is established based on the number of elastic contracts. Prior to the start of

the sales season, retailers ordered the total amount of y products according to historical data, and the price of c prepaid. $(1 - \rho)y$ the deposit of y products, after the start of the selling season, retailers and then to the price of c to buy ρy products, if the market demand, Below the original order quantity, the retailer is required to pay compensation for the excess of the product, through the compensation agreement can simultaneously to improve the supply chain coordination. Model their basic idea is that when the retailer initially provides an order q , the supplier will agree to produce $(1 + \mu)q$. Products, at the same time, vendors to buy at least $(1 - d)q$ products. After a period of observation, the retailer may in $((1 - d)q)$ and $(1 + \mu)q$ any number of products ordered q . They unanimously believe that by providing a number of flexible contracts approximately, the profit of the supply chain can be effectively improved. Subsequently, Tsay and Lovejoy[28] are extended to a number of flexible contracts In the case of multi demand stage, multi inventory location, delayed delivery and demand update, we find that the single phase is due to random demand. And the expected return can be improved in many stages. Bassok and Anupindi[29] are more realistic than Tsay and Lovejoy, and they have a deeper analysis. The effect of elastic quantity contract in multi period supply chain on the order flexibility. Schuster-Barnes, et al. The demand has a correlation with the two periodic elastic quantity contract problem, they assume that after the first phase of the demand is observed to buy the second phase of the sale of some of the privileges, and demonstrates the privilege to improve the supply chain collaboration The importance of benefit. Anupindi and Bassok [29] assumed that retailers to suppliers purchase a total of at least a certain amount in limited time. Products, the purchase of a certain number of other products, the same price, and then buy the product price will be higher. The research of this paper the purpose is to make the total cost of the retailer is minimal, the demand is divided into static demand and stochastic demand, the optimal strategy here should be modified late elastic quantitative strategies. In order to describe the flexibility that the buyer needs to study the buyer's price the uncertainty of the lattice, with the drift of the geometric Brown motion model to describe the price. They aim to evaluate the number and time of with regard to the value of flexibility in deciding on the structure of the cost of the contract, the design of the risk sharing price, the price of the answer The dynamic characteristics of the lattice fluctuations are more appropriate in the circumstances. This agreement by the parameters (r, c) said that in the sales season, the buyer agreed to purchase the total amount of y The unit product, and immediately to the price of c to buy $(1 - \rho)y$ number of products, in the observation of two weeks after the sale of data, the use of Bias method predicts and revised the seasonal demand, the buyer can add the order of the original price c , the number of orders in the 0 and ρy Between retailer's rapid delivery. For the ρy in the number of products not to buy, per unit product penalty for b . Pass points It can be concluded that the contract with the supplementary agreement is better to improve the double party interests. Recently, the Wu[30] has been analyzed using the Bayesian updating method. Quantitative contract model, through the comprehensive analysis of the elasticity of the mountains w , the transfer payment c and Bias update number n , he concluded that for, the more flexible the order quantity, it is always better to the retailer, but the supplier only in the interest of the small. Bassok and Anupindi[29] research hypothesis premise for the retailer's initial forecast and in the phase of the modified market field demand forecast, the article analyzes the forecast and purchase behavior. The paper addresses the modeling problem as follows: (1) In the first phase of the estimated purchase amount: (2) the actual purchase amount per phase. The author finds that the problem is very complicated, which is determined by numerical method. Cachon and Lafivieret and Lariviere the interaction between the amount of elasticity and the forecast is studied, and they think that retailers in the supply chain can be more than the suppliers. Well forecast demand, and suppliers are encouraged to try to encourage vendors to improve their level of demand forecasting.

III. NUMERICAL STUDY

In order to discuss the model and illustrate the conclusion more clearly, this section through numerical example analysis the supply chain decision results in both decentralized and centralized system are calculated and also get the better understanding supply chain coordination model. In this section we use following parameters: $\mu = 100, \mu_1 = 130, \mu_2 = 145, \sigma = 20, \sigma_1 = 30, \sigma_2 = 45$, wholesale price of

the selling product is $w = 600$ Yuan/kg, the production cost for the supplier $c = 360$ Yuan/kg. For the retailer selling price per unit for the market $p = 800$ Yuan/kg and for the retailer salvaging price per unit $S = 200$ Yuan/kg and salvaging price for the supplier $h = 300$ Yuan/kg. Random variable x is on the market that we get the range of random variable from 100 to 200 to make easy numerical calculation. In order to better understanding we get different variables: Fig.2 shows that normal probability function with $\mu, \sigma, \sigma 1, \sigma 2$. Fig.3 shows that when same σ (sigma) and different μ (mu).

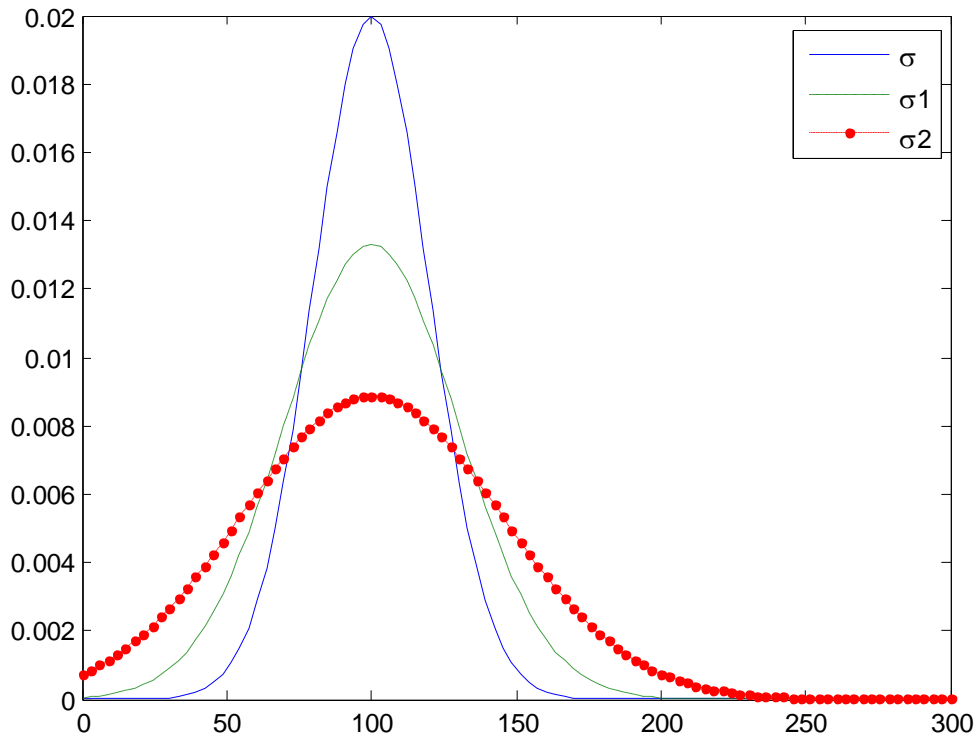


Figure 2. Normal probability density function (*normpdf*) with different σ

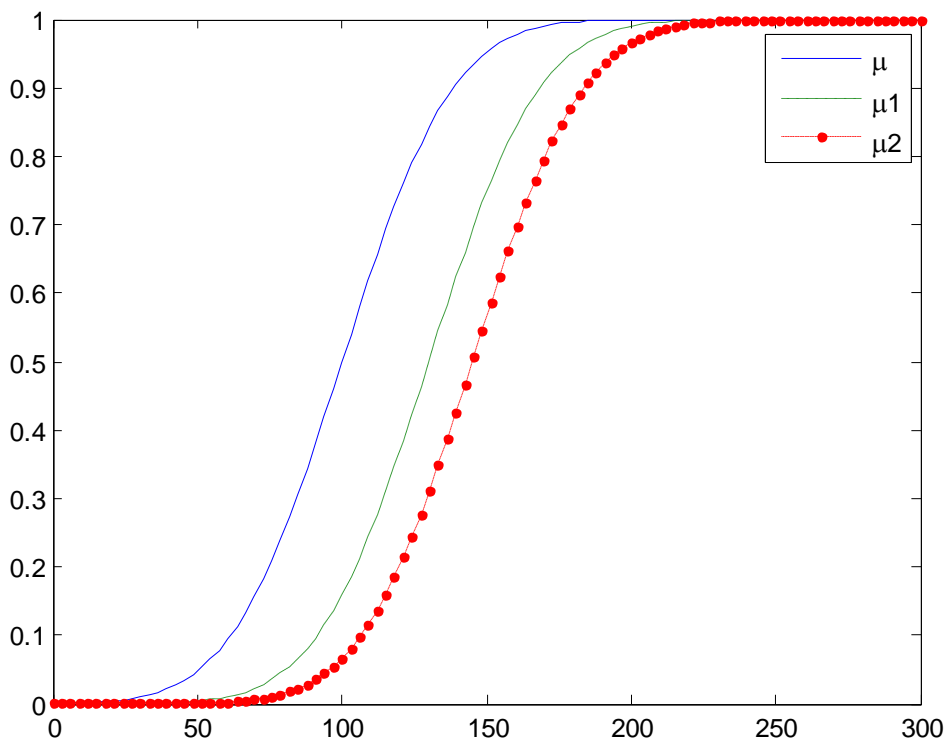


Figure 3. Normal cumulative density function (*normcdf*) with different μ

IV. CONCLUSION

In this paper, the model of supply chain contract is the typical model of supply chain contract, the origin of supply chain contract, the coordination of the basic contract model and coordination mechanism, the typical contract model the methods of the type of expansion and the coordination of the emphasis on the determination of the optimal contract parameters were studied. Through the survey we have found that the supply chain contract is not only through the quantity and price of two parameters to achieve the supply chain coordination, but also there is a strong correlation between the contract, can achieve the same coordination effect through mutual combination, The wholesale price contract is widely used because of its low cost and transaction process, but it cannot be realized. Supply chain coordination, so it is often used in combination with other contracts to achieve supply chain coordination. Wholesale price contract, the purchase contract and revenue sharing contract are mainly realized through price parameters, and the quantity of the supply chain is coordinated. In this paper, we will further explore options contracts on the basis of the above research. Information structure characteristics and the role of different organization structure in the supply chain process and the role of the mechanism, is not difficult to see, the text the typical contract in the present study is similar to the study of the best performance in the supply chain. They exist in the supply chain information and organizational structure characteristics and differences, these differences are not the difficulty of modeling and optimization of the subsequent coordination mechanism is more difficult, which is the value of this paper.

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