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Design of Truth Telling Quantity Discount Contract under Information Asymmetry

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Abstract: Supply chains are often in an environment where the demand is affected by the retailer's sales effort and the supplier has no accurate information about the retailer's cost. In this situation, the retailer's action of distorting his cost information could damage the efficiency of the supply chain. In order to reduce the resulted impairment, the problem of how to coordinate the retailer's action using quantity discount contract is studied based on principal-agent theory. The way of how to determine the parameters of the contract is provided. The contract offers more preferential wholesale price to the retailer with lower cost, so that the retailer has the incentive to reveal his private cost information truthfully and the efficiency of the supply chain is improved. Numerical example shows how the parameters in the quantity discount contract change with the retailer's cost. The impact of the contracts upon the supply chain member's expected profit is also demonstrated. The results support the conclusion drew from the theoretical analysis.

Keywords: information asymmetry1, quantity discount2, sales effort3, adverse selection4, principal-agent theory5

1. INTRODUCTION

Lots of cases in the reality have fully proven that the importance of information in supply chain management (SCM) [1]. Nevertheless, information asymmetry is a widespread phenomenon in supply chain, and no enterprise can get complete information in suppler chain actually, which brings two difficulties to enterprises in business decision making: one is lack of information; the other is hard to distinguish the authenticity of information. This leads to the failure of the transaction among all participators, or poor transaction effect even they can conclude the transaction.

The academia perceives this problem. To eliminate the negative effect of information asymmetry, some scholars studies the incentive mechanism of how to strengthen the information sharing in supply chain [2]-[7]. These research findings can broaden the information source of enterprises effectively, and help them solve the predicament of lack of information. However, these researches are based on a key assumption that is the sharing information is authentic while it comes from the superiority of information owner, without considering the possibility that the superiority of information owner misstate information. Certainly, even the obtained information is inaccurate, it still helps the inferior of information owners diminishes the uncertainty of information, and brings them certain benefit. Nevertheless, it causes the supply chain system can't achieve the optimal state. Hence, it is not enough that if the incentive mechanism can only ensure all participators to 'tell' (that is willing to share information), and can't ensure they 'tell truth' (that is willing to share the authentic private information).

Actually, the possibility that the superiority of information owners misstate information is greater than the inferior because they can obtain benefit usually while they do so [8]. Other scholars try to solve these issues about 'misstated information' by using the principal-agent theory. The superiority of information owner is called principal, and the other side is called agent. Corbett studies the contract design problems in the model of 'order quantity/reorder point' under information asymmetry [9]. Corbett and Groote solve the optimal quantity discount

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policy under the situation that the retailer's cost information is asymmetric [10]. Corbett, Zhou and Tang respectively investigate the single wholesale price contract, two-part linear contract and two-part nonlinear contract under the complete information and asymmetric information about retailer's cost [11]. Based on different assumption, Ha does similar discussion about contract design problem in supply chain with asymmetric information about retailer's cost, and finds the optimal policy that vendor prohibits retailers with high cost participate in supply chain [12]. Özer and Wei consider the capacity decision problems in supply chain under asymmetric forecast information, and suggest two contracts ensuring reliable forecast information sharing [13]. Hansheng Suo and Yihui Jin reveal the optimal buy back strategy for vendor, and conclude that it is impossible to design a contract which makes supply chain achieves cooperative situation with complete information if contract designer doesn't understand the retailer's cost structure [14]. The research of Burnetas, Gilbert and Smith demonstrates how vendor utilizes the quantity discount to coordinate the inventory decision of the downstream buyers who own more demand information [15]. The main purpose of these researches is to design contract properly, so that the agents in supply chain are not only willing to 'tell', but also 'tell truth', and then improve the efficiency of the supply chain.

All the above researches on 'misstated information' don't consider the situation that demand is affected by the level of sales effort. Sales effort refers to a series of actions used to stimulate demand by retailers, e.g. hiring more sales people, strengthening the training of sales people, increasing advertising investment, etc. Considering the cost of all these actions, besides the order quantity, retailer's sales effort should be coordinated in contract designing. Currently, all researches about coordinating both order quantity and sales effort don't take it into account that the retailer's cost information is asymmetric [16]-[18].

This paper uses the principal-agent theory to study the designing problem of quantity discount contract under the situation that is vendor doesn't understand retailer's cost and the demand is affected by retailer's sales effort. Assuming the contract is offered by vendor who is at a disadvantage. In this case, retailer may ask for more preferential contract terms such as lower wholesale price through misstating high cost and narrow margin, so that damage the efficiency of the supply chain. This paper tries to figure out the problems of how to determine the parameters of the quantity discount contract to avoid retailer misstate their cost, and set proper order quantity and sales effort to improve the efficiency of the supply chain.

2. BASIC Model

2.1 Symbols and assumptions

This paper studies a two-tier decentralized decision supply chain system including a single vendor and a single retailer. Vendor offers contract to retailer in a selling cycle, while retailer orders a certain quantity of products and put a certain sales effort to promote it in market to maximize its effectiveness. In order to explain conveniently, authors stipulate the symbols of the model as follow:

p : The retail price of commodity in market determined by market;

q : The quantity of commodity ordered by retailer from vendor;

c : The production cost of commodity of vendor per unit;

ε : Retailer's sales effort, and $\varepsilon \ge 1$;

C_E : The cost function of retailer's sales effort, and satisfies: $C_E(1) = 0$, $C'_E(\varepsilon) > 0$, and $C''_E(\varepsilon) > 0$;

θ : The inventory holding cost spent by retailer on commodity per unit (except wholesale price);

s : The residual value of unsold commodity per unit;

T : The transfer payment from retailer to vendor;

π_s : Vendor's expected profit;

π_r : Retailer's expected profit;

Π : The expected profit of supply chain system;

The '$*$' and 'SB' marked on the upper right corner of symbols represent the optimal situation and suboptimal situation respectively in this paper.

D is a continuous random variable, and its distribution function and probability density function are H and h . D_ε is the market demand of product affected by sales effort, $D_\varepsilon = \varepsilon D$, and its distribution function is F while its probability density function is f .

In addition, the other assumptions are as follow:

① $D > 0$, $H(0) = 0$, H is differentiable and strict increasing;

② Let $F(y|\varepsilon)$ be the distribution of demand with specified ε , and the demand is stochastically increasing with effort, namely, $\dfrac{\partial F(y|\varepsilon)}{\partial \varepsilon} < 0$;

③ The total cost spent on commodity per unit in supply chain is more than its residual value (so the commodity hoarded in supply chain must be sold, otherwise it couldn't make profit), but less than the retail price of commodity (so it must obtain profit when the commodity in supply chain are sold), namely, $s < c + \theta < p$;

④ Both vendor and retailer are risk-neutral;

⑤ Either party must fulfill the contract once is it signed.

2.2 Comparison benchmark: the optimal contract under complete information

According to the regulation of quantity discount contract, the wholesale price of commodity given by vendor is w . Hence, the transfer payment given from retailer to vendor is:

$$T = wq \tag{1}$$

The expected net profit function of retailer is:

$$\pi_{r\,net} = (p - w - \theta)q - (p - s)\int_0^q F(y|\varepsilon)dy - C_E(\varepsilon) \tag{2}$$

The expected net profit function of vendor is:

$$\pi_{s\,net} = (w - c)q \tag{3}$$

The expected gross profit and expected net profit of supply chain in a selling season are as follow respectively:

$$\Pi_{gross}(q, \varepsilon, \theta) = pq - (p - s)\int_0^q F(y|\varepsilon)dy \tag{4}$$

$$\Pi_{net}(q, \varepsilon, \theta) = (p - c - \theta)q - (p - s)\int_0^q F(y|\varepsilon)dy - C_E(\varepsilon) \tag{5}$$

Assuming $\Pi_{net}(q, \varepsilon, \theta)$ is unimodal and can reach the maximum with limited ε (if $q - \int_0^q F(y|\varepsilon)dy$ increases quickly enough with ε and $C_E(\varepsilon)$ is insufficiently convex, then the infinite sales effort may be the optimal, but it is not accord with reality).

According to the equation (5), it is known that the optimal order quantity and the level of sales effort of the whole supply chain can be solved by the following equation:

$$\begin{cases} -(p-s)\int_0^q \frac{\partial F(y\mid\varepsilon)}{\partial\varepsilon}dy - C_E'(\varepsilon) = 0 \\ p-c-\theta-(p-s)F(q\mid\varepsilon) = 0 \end{cases} \tag{6}$$

In order to simplify discussion, let $C_E(\varepsilon) = a(\varepsilon-1)^2$, $D \sim U[0, D_{\max}]$, and it is found that:

$$\varepsilon^*(\theta) = 1 + \frac{D_{\max}}{4a}\frac{(p-c-\theta)^2}{p-s} \tag{7}$$

$$q^*(\theta) = (1 + \frac{D_{\max}}{4a}\frac{(p-c-\theta)^2}{p-s})D_{\max}\frac{p-c-\theta}{p-s} \tag{8}$$

Vendor only needs to allocate a portion of expected net profit of supply chain which equals to $\pi_{r\,\min}$ to retailer, and then it could satisfy his participation constraint and coordinate with supply chain, so that the following equation is tenable:

$$\pi_{r\,net}(q^*(\theta), \varepsilon^*(\theta), \theta) = \pi_{r\,\min} \tag{9}$$

Therefore, it is easy to determine the wholesale price of the optimal quantity discount contract, which is:

$$w^*(\theta) = p - \theta - \frac{(p-s)q^*(\theta)}{2\varepsilon^*(\theta)D_{\max}} - \frac{a(\varepsilon^*(\theta)-1)^2 + \pi_{r\,\min}}{q^*(\theta)} \tag{10}$$

3. The SUBOPTIMAL CONTRACT RESULTING IN 'TELL TRUTH' UNDER THE ADVERSE SELECTION

3.1 The derivation of the incentive compatibility constraint

This paper assumes vendor could observe retailer's sales effort and compensate the corresponding cost to retailer, without considering the information asymmetry about retailer's sales effort. In some cases, this assumption is tenable. For example, vendor easily understands how much effort retailer uses to advertise on media, or how many shelves retailer arranges for products and so on. The following discussion is about how to design the quantity discount contract when vendor doesn't know retailer's cost θ. Assuming retailer knows his accurate cost, but vendor doesn't know it. However, vendor knows the distribution of retailer's cost Θ, which is the continuous distribution in the intervals of $[\underline{\theta}, \overline{\theta}]$, and the distribution function is $G(\theta)$ while the density function is $g(\theta)$, in addition, the monotone hazard rate condition is tenable, namely, $\frac{\partial}{\partial\theta}\left(\frac{G(\theta)}{g(\theta)}\right) \geq 0$. For the reason of simplification, authors assume $\Theta \sim U[\underline{\theta}, \overline{\theta}]$.

In this case, if adopting the primary optimal contract, the wholesale price obtained by retailer is $w^*(\tilde{\theta})$ where the order quantity placed by retailer is $q^*(\tilde{\theta})$ and its sales effort is $\varepsilon^*(\tilde{\theta})$, when retailer reports its cost is $\tilde{\theta}$. The actual expected net profit of supply chain system is $\Pi_{net}(q^*(\tilde{\theta}), \varepsilon^*(\tilde{\theta}), \theta)$ (that is $\Pi_{net}(q^*(\tilde{\theta}), \varepsilon^*(\tilde{\theta}), \tilde{\theta}) + (\tilde{\theta} - \theta)q^*(\tilde{\theta})$). It is easily calculated that the expected net profit obtained by retailer is

$\pi_{r\,net}(q^*(\hat{\theta}),\theta) = \pi_{r\min} + (\hat{\theta} - \theta)q^*(\hat{\theta})$ based on the equation (10). Obviously, retailer whose actual cost is θ can obtain higher profit through reports a higher false cost $\hat{\theta} > \theta$. To design a contract which makes retailer reports his real cost, the key factor is to get the incentive compatibility constraint to make agent's profit obtained by 'tell truth' is greater than or equal to the profit obtained by misstating cost.

$\psi(\theta)$ is defined as the payment to retailer, including two parts: the compensation to retailer's cost and the portion divided from the net profit of supply chain system to retailer, and under the complete information, $\psi(\theta) = \pi_{r\min} + \theta q(\theta) + C_E(\varepsilon(\theta))$, but ,under the adverse selection, $\psi(\theta) = \pi_{r\min} + U(\theta) + \theta q(\theta) + C_E(\varepsilon(\theta))$. In the equation of $\psi(\theta)$, $U(\theta)$ is the information rent delivered from vendor to retailer initiatively to let retailer 'tell truth'. If and only if $U(\theta) \ge 0$ is tenable, the expected net profit obtained by retailer is $\pi_{r\min}$ at least, and that can ensure retailer is like to cooperate with supply chain. Therefore, the condition $U(\theta) \ge 0$ is the participation constraint condition to retailer.

If retailer reports his cost is $\hat{\theta}$ but his actual cost is θ, he will be required to place an order of $q(\hat{\theta})$ and set his sales effort level as $\varepsilon(\hat{\theta})$, and his net profit is $\psi(\hat{\theta}) - \theta q(\hat{\theta}) - C_E(\varepsilon(\hat{\theta}))$. So the first-order condition of the optimal selection of retailer with cost of $\hat{\theta}$ is $\psi'(\hat{\theta}) - \theta q'(\hat{\theta}) - C_E'(\varepsilon(\hat{\theta}))\varepsilon'(\hat{\theta}) = 0$. In order to let revealing real cost information become the optimal selection to retailer, for arbitrary θ, it must have the equation of $\psi'(\theta) - \theta q'(\theta) - C_E'(\varepsilon(\theta))\varepsilon'(\theta) = 0$ .It is equivalent to $\psi(\theta) - \theta q(\theta) - C_E(\varepsilon(\theta)) \ge \psi(\hat{\theta}) - \theta q(\hat{\theta}) - C_E(\varepsilon(\hat{\theta}))$, so that it is the incentive compatibility constraint to retailer. The incentive compatibility constraint can be shown as $U'(\theta) = -q(\theta)$, because $U'(\theta) = \psi'(\theta) - q(\theta) - \theta q'(\theta) - C_E'(\varepsilon(\theta))\varepsilon'(\theta)$.

The second-order condition of retailer's decision problem must be tenable where $\hat{\theta} = \theta$, namely, it must have $\psi''(\theta) - \theta q''(\theta) - C_E''(\varepsilon(\theta))(\varepsilon'(\theta))^2 - C_E'(\varepsilon(\theta))\varepsilon''(\theta) \le 0$. The derivation of the first-order condition $\psi'(\theta) - \theta q'(\theta) - C_E'(\varepsilon(\theta))\varepsilon'(\theta) = 0$ is $\psi''(\theta) - q'(\theta) - \theta q''(\theta) - C_E''(\varepsilon(\theta))(\varepsilon'(\theta))^2 - C_E'(\varepsilon(\theta))\varepsilon''(\theta) = 0$, so the second=order condition can be written as $q'(\theta) \le 0$.

3.2 Determining the parameters of the suboptimal quantity discount contract

After the incentive compatibility and participation constraint are obtained, the difficult faced by vendor is to set proper value of $U(\theta)$ to let retailer with cost θ 'tell truth', meanwhile, don't need to pay too much. The allocation of the gross profit of supply chain carries out as following steps: firstly, the value of $cq(\theta) + \pi_{s\min}$ is divided from expected gross profit to pay vendor's cost and his reserved profit; and then the value of $\theta q(\theta) + C_E(\varepsilon(\theta)) + \pi_{r\min} + U(\theta)$ is divided to pay retailer's cost (including inventory holding cost and the cost of sales effort), retailer's reserved cost and information rent; finally, the residual of expected gross profit (this residual of the expected gross profit is only solved according to the random demand D)is assigned to vendor. This is denoted as:

$$\rho(q(\theta), \varepsilon(\theta), \theta) = (p - c - \theta)q(\theta) - (p - s)\int_0^{q(\theta)} F(y \mid \varepsilon(\theta))dy - C_E(\varepsilon(\theta)) - (U(\theta) + \pi_{r\min} + \pi_{s\min}) \quad (11)$$

The retailer's cost Θ is a random variable to vendor, so the residual of the expected gross profit to vendor is the function of a two dimensions random variable $<D, \Theta>$. Combined with the incentive compatibility and participation constraint in the preceding section, the optimization problem of vendor can be described as follow:

$$\text{P:} \quad \max_{\{U,\,q,\,\varepsilon\}} E\,\rho = \int_{\underline{\theta}}^{\overline{\theta}} \rho(q(\theta), \varepsilon(\theta), \theta) g(\theta) d\theta$$

$$\text{s.t.} \quad \text{IC} \quad U'(\theta) = -q(\theta)$$

$$q'(\theta) \le 0$$

$$\text{IR} \quad U(\theta) \ge 0$$

The IC in P ensures every retailer with different kind of cost reveal his cost information truthfully. IR can be simplified as $U(\overline{\theta}) \ge 0$ and compacted, namely, $U(\overline{\theta}) = 0$. According to the integral of $U'(\theta) = -q(\theta)$, and use the condition $U(\overline{\theta}) = 0$, it is found that: $U(\theta) = \int_{\theta}^{\overline{\theta}} q^{SB}(z)dz$.

Refer to the method in [19], the equation about $q(\theta)$ is:

$$(p - c - \theta - (p - s)F(q(\theta) \mid \varepsilon(\theta)))g(\theta) - G(\theta) = 0 \tag{12}$$

And then solve the first-order condition about $\varepsilon(\theta)$, it is found that:

$$\frac{(p-s)(q(\theta))^2}{2D_{\max}(\varepsilon(\theta))^2} - 2a(\varepsilon(\theta) - 1) = 0 \tag{13}$$

Combing the assumption condition with the simultaneous equations (12) and (13), it is found that:

$$\varepsilon^{SB}(\theta) = 1 + \frac{D_{\max}(p - c + \underline{\theta} - 2\theta)^2}{4a(p-s)} \tag{14}$$

$$q^{SB}(\theta) = D_{\max}(1 + \frac{D_{\max}(p - c + \underline{\theta} - 2\theta)^2}{4a(p-s)})(\frac{p - c + \underline{\theta} - 2\theta}{p - s}) \tag{15}$$

The following is to determine the wholesale price of the suboptimal quantity discount contract. Let:

$$\pi_{r\,net}(q^{SB}(\theta), \varepsilon^{SB}(\theta), \theta) = U(\theta) + \pi_{r\min} \tag{16}$$

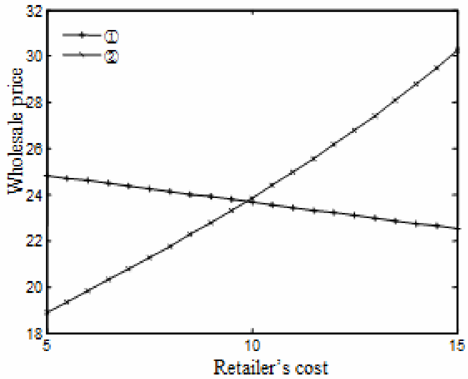
And then it is obtained:

$$w^{SB}(\theta) = p - \theta - \frac{(p-s)q^{SB}(\theta)}{2\varepsilon^{SB}(\theta)D_{\max}} - \frac{a(\varepsilon^{SB}(\theta) - 1)^2 + \int_{\theta}^{\overline{\theta}} q^{SB}(z)dz + \pi_{r\min}}{q^{SB}(\theta)} \tag{17}$$

4. NUMERICAL ANALYSIS

This section reveals the rule of how parameters in contract change with the retailer's cost by means of numerical analysis, and the influence of the optimal and suboptimal contract upon the expected profit of vendor, retailer and the whole supply chain system under different situation, and point out the corresponding meaning of management. Let $\Theta \sim U[\underline{\theta}, \overline{\theta}]$, the parameters in model are p=70, s=5, c=10, $\underline{\theta} = 5$, $\overline{\theta} = 15$, $\pi_{s\min} = \pi_{r\min} = 10^3$, $D_{\max} = 10^4$ and a=10^4.

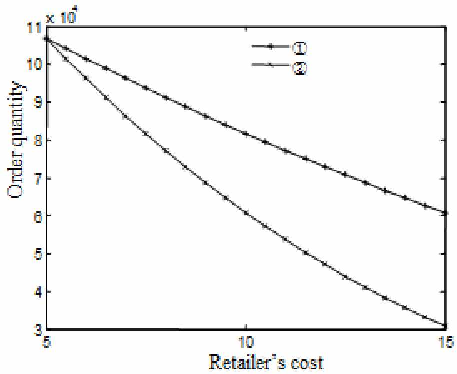
The figure 1 demonstrates the relationship of wholesale price changed with retailer's cost in the optimal and suboptimal contract. It is noticed that the monotonicity of the wholesale price's function curves in both contracts show completely opposite. Vendor only needs to let the wholesale price be the value that retailer can only obtain reserved value under complete information. Therefore, it means that the profit space gained from the retailer with low cost has great potential, for this reason, vendor would set a higher wholesale price to gain this part of profit. On the contrary, to those retailers' with high cost, vendor would like to set a lower wholesale price to ensure they gain reserved profit. Consequently, the wholesale price in the optimal contract decrease with the increasing of the retailer's cost. Retailer with low cost misstates a higher cost to obtain lower wholesale price and decreases his order quantity and sales effort when the reverse selection exists. But the suboptimal contract is quiet different, its wholesale price increases with the increasing of retailer's cost, which means vendor delivers actively a part of profit (that is information rent) to retailer with low cost to let retailer 'tell truth', and reveal his cost information truthfully and recover his order quantity and sales effort. The retailer's cost is lower, the incentive intensity needed by retailer is greater, and retailer gets more information rent.



① -wholesale price in the optimal contract
②-wholesale price in the suboptimal contract

Figure 1. The relationship of wholesale price changed with retailer's cost

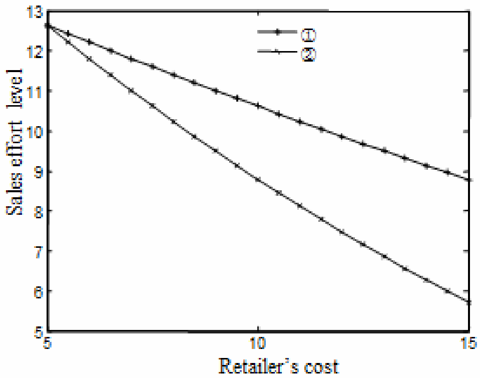
The figure 2 shows the relationship of retailer's order quantity changed with its cost in the optimal and suboptimal contracts. Both order quantity in the optimal and suboptimal contract decrease with the increasing of retailer's cost. The order quantity of other types of retailers in the suboptimal contract is lower than in the optimal contract, except the retailer with the lowest cost. Because the value of information rent is $U(\theta)=\int_{\theta}^{\bar{\theta}} q^{SB}(z)dz$, the order quantity of retailer is larger, more information rent needed to pay by vendor. Vendor could decrease the information rent delivered to retailer through reducing retailer's order, so the suboptimal contract would make a downward distortion to the order quantity of retailer, which presents a tradeoff between the efficiency loss and rent payment faced by vendor.



① -Order quantity in the optimal contract
②-Order quantity in the suboptimal contract

Figure 2. The relationship of order quantity changed with retailer's cost

The figure 3 displays the relationship of retailer's sales effort changed with retailer's cost in the optimal and suboptimal contracts. It can be seen that both sales effort decrease with the increasing of retailer's cost in the optimal and suboptimal contracts. And the sales effort of other types of retailers in the suboptimal contract is lower than in the optimal contract, except the retailer with the lowest cost. It is natural, because the order quantity of the retailer with higher cost is distorted downward, as a result, there is no need for retailer to put too much sales effort.



① -sales effort in the optimal contract
②-sales effort in the suboptimal contract

Figure 3. The relationship of sales effort changed with retailer's cost

The figure 4 reveals the expected residual profit obtained by vendor based on the rule of the suboptimal contract. It can be seen that vendor still obtains positive expected residual profit after fulfill the payment of the cost compensation, reserved profit and information rent to every participator. Hence, the profit space of the supply chain is great enough in this example. The downward distortion of the order quantity and sales effort of retailer would not cause the profit of the supply chain decrease too much to fulfill the above payment, so it is unnecessary to consider the situation that prohibiting the retailer with high cost to participate the supply chain. And the figure 5 shows that while retailer with a cost of θ misstate his cost as $\tilde{\theta}$, his expected profit increase with the increasing of the misstated value (since $\frac{\partial \pi_{r\ net}}{\partial \tilde{\theta}} > 0$), as a result, all retailers with different kinds of cost would report his cost is $\overline{\theta}$.

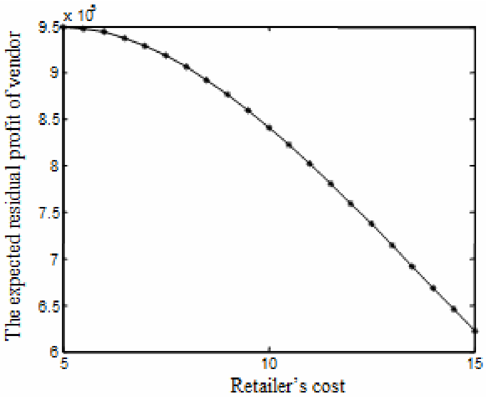


Figure 4. The expected residual profit of vendor

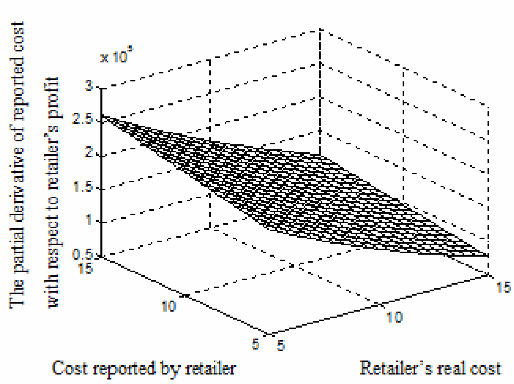


Figure 5. The value of $\frac{\partial \pi_{r\ net}}{\partial \tilde{\theta}}$

The figure 6 displays that under the suboptimal contract, the expected net profit of retailer with different kinds of cost can reach the maximum if and only if they reveal their cost information truthfully (the highest point of every expected net profit curve is pointed by every arrows in figure 6, consequently, they wouldn't misstate information. That presents the suboptimal quantity discount contract designed in this paper is the mechanism which let agent 'tell truth' indeed.

The figure 7 shows the different expected profit obtained by vendor adopting two contracts respectively under the reverse selection. If vendor offers the optimal contract to retailers, then retailer with different kind of cost will declare his cost is $\overline{\theta}$, so that the expected profit of vendor wouldn't change. And if vendor offer the suboptimal contract to retailer, then retailer would report his kind truthfully. Because retailer's cost is higher, the distorted level of his order quantity and sales effort made by the suboptimal contract is more. When retailer's cost is very high, the performance of the suboptimal contract would be worse than the optimal contract. But the suboptimal contract can effectively minimize the negative impact brought by the reverse selection on the whole. The zone A and B in figure 7 present the increase and decrease of the expected profit caused by the suboptimal contract. Obviously, the area of zone A is larger than zone B, so adopting the suboptimal contract is a better supply chain coordination policy to improve the expected profit of

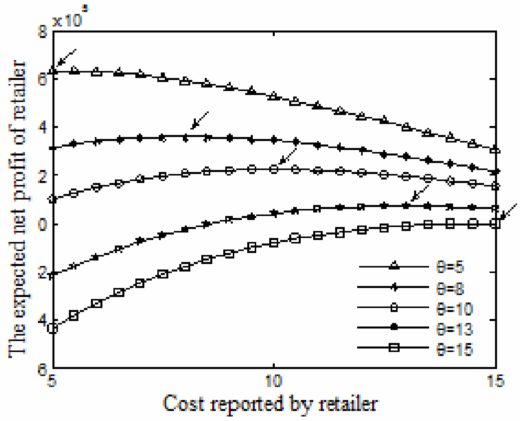
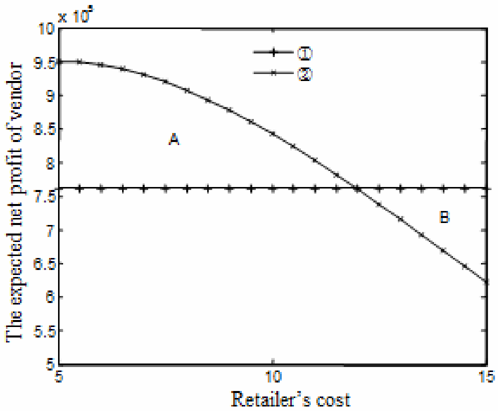


Figure 6. The relationship of sales effort changed with retailer's cost



① -the optimal contract under adverse selection
②-the suboptimal contract under adverse selection

Figure 7. The expected net profit of vendor in two contracts

vendor under information asymmetry.

5. CONCLUSIONS

It is unsure that every member in supply chain shares accurate information even an efficient information and communication channel built among them. Because misstating information could bring benefit to the superiority of information owner in some cases, but damage other. It happens when vendor doesn't understand retailer's cost. To solve this problem, authors found a quantity discount contract that ensures retailer 'tell truth' and reveal his real cost by using principal-agent theory and analyzed the motivation of misstating information of retailer, under the environment that the demand is affected by the sales effort level of retailer. Although, based on the regulation of this contract, vendor pays a certain information rent to retailer, and the order quantity and sales effort level of retailer with higher cost is less than the optimal value. This contract significantly increases the expected profit of vendor on the whole, so it is effective. The result of numeric analysis supports this conclusion as well.

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