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The Impact of Overconfidence on Supply Chain Incentive Contract under Double-sided Moral Hazard

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Abstract. This paper analyses the impact of retailer overconfidence psychology on incentive contract for a manufacturer-retailer supply chain, where product quality is affected by the manufacturer and the retailer's behaviors. There exists double-sided moral hazard in the supply chain. Using principal-agent model, this paper builds incentive contracts under symmetric and asymmetric information situations respectively. The results show that under information symmetry retailer overconfidence has no effect on optimal sharing rate, effort levels and the manufacturer's expected profit, and under information asymmetry, higher retailer overconfidence increases the manufacturer's expected profit and reduces agent cost.

Keywords: incentive contract; double-sided moral hazard; overconfidence; supply chain

1. Introduction

Product quality is another important factor affecting consumers' purchasing decision, apart from price. The quality of products in the market is affected by quality choosing behaviors of all supply chain partners [1]. Different aims of supply chain partners and the conflict of their interest make the efficacy of supply chain reduced. How to coordinate behaviors of supply chain partners has been a hot topic.

This research considers a manufacturer-retailer supply chain, where the manufacturer sells semi-manufactured products to the retailer, who sells final products in the market after processing the semi-manufactured products. The quality of final products is affected by quality of semi-manufactured products, and the retailer's behavior in processing the semi-manufactured products. The retailer and the manufacturer cannot observe each other's behaviors and both of them can take opportunistic behaviors. Therefore, there exists double-sided moral hazard in the supply chain. The aim of this paper is to design incentive contract to mitigate double moral hazard between the manufacturer and the retailer, considering the influence of the agent's overconfidence.

Much research on double-sided moral hazard has been conducted. For example, [2] analyzes the characteristics of optimal contracts under double-sided moral hazard. Reference [3] builds a general principal-agent model under double moral hazard, allowing entrepreneurs and employees to monitor each other. Reference [1] designs warranty contract in supply chain under double moral hazard. Reference [4] studies linear revenue-sharing contracts in supply chain under double-sided moral hazard. The above contract models under double-sided moral hazard have not considered the effects of irrational behaviors and psychological factors of economic actors.

Overconfidence is a kind of psychology widely existing in economic actors, and much research indicates the propensity of individuals to overestimate their abilities and their contribution to success [5]. Overconfident individuals generally hold optimistic attitude towards uncertainty and risks, affecting contract design. References [6-9] demonstrate the persistence of overconfidence in managers and entrepreneurs. Reference [10]

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examines the effect of overconfidence on employment contract with experimental method. Reference [11] studies the influence of agent overconfidence on compensation contracts. References [12-13] explore how overconfidence affects incentive contracts when both the principal and the agent hold the same and different levels of overconfidence respectively.

In this paper, we focus on the case of agent overconfidence: the retailer holds overly optimistic beliefs, relative to the manufacturer, regarding the success probability of the project, and investigate the impact of agent overconfidence on incentive contract under double-sided moral hazard situation.

2. Model Description

In a supply chain consisting of a manufacturer (denoted by 'she') and a retailer (denoted by 'he'), the quality of semi-manufactured products provided by the manufacturer for the retailer, q_s, is determined by the manufacturer's quality management ability, A_m, and her effort paid in making the semi-manufactured products, e_m. To simplify the model, we suppose $q_s=A_m e_m$. (Subscripts s and m denote semi-manufactured and manufacturer respectively.)

The retailer processes the semi-manufactured products and then sells finished products in the market. Other than the quality of semi-manufactured products, the quality of finished products is also affected by the effort the retailer pays in processing semi-manufactured products, e_r and his quality management ability, A_r (subscript r denotes the retailer). That is to say, the manufacturer's quality choosing action and quality management ability (called manufacturer factors) and the retailer's (called retailer factors) jointly determine the quality of final products, q_f (subscript f denotes final products). Therefore, q_f is expressed as $q_f=\theta A_m e_m+(1-\theta) A_r e_r$, where θ and $1-\theta$ ($0\leq\theta\leq1$) respectively represent the importance of manufacturer factors and retailer factors in affecting the quality of final product, q_f.

This paper supposes the price of final product is constant and only focuses on the influence of product quality on market demand. The market demand for final products, D is given by $D=kq_f+\Phi+\xi=k[\theta A_m e_m+(1-\theta) A_r e_r]+\Phi+\xi$, where Φ is a constant that is big enough to ensure D nonnegative, and k is the influence coefficient of the quality of final product on demand. ξ is a stochastic variable and obeys standard normal distribution, $\xi\sim N(0, \sigma^2)$.

We suppose the manufacture is risk neutral and the retailer is risk averse and overconfident, and so the retailer's absolute risk aversion coefficient is smaller than rational retailers'. Suppose the relationship of the overconfident retailer's absolute risk aversion coefficient ρ_r, and rational retailers' absolute risk aversion coefficient ρ, is expressed as $\rho_r=(1-\lambda)\rho$, where λ ($0<\lambda<1$) denotes the retailer's overconfidence degree. A bigger λ implies that the retailer is more overconfident.

We use $c(e_m)$ to denote the cost the manufacturer will suffer if she chooses quality behavior e_m. $c(e_m)$ satisfies $c'(e_m)>0$ and $c''(e_m)>0$ (superscripts ' and " denote first- and second-differential respectively). For simplicity and without loss of generality, we suppose $c(e_m)=\varphi e_m^2/2$, where φ is cost coefficient of the manufacturer's quality choice behavior e_m, or the manufacturer's effort cost coefficient. Likewise, the cost caused by the retailer's choosing quality behavior e_r, $c(e_r)$ satisfies $c'(e_r)>0$ and $c''(e_r)>0$. We suppose $c(e_r)=be_r^2/2$, where b is the retailer's effort cost coefficient.

When the manufacturer produces semi-manufactured products, the basic cost per semi-manufactured product is c, which is caused by basic raw material and labor costs. The total revenue of supply chain alliance is $y=(p-c)D$.

The manufacturer offers the retailer an incentive contract (α, β), in which α is fixed payment regardless of y, and β is the revenue sharing rate, or incentive coefficient ($0\leq\beta\leq1$). If the retailer accepts the contract, the manufacturer will pay the retailer $s=\alpha+\beta y$ from at the end of contractual period.

The sequence of events in this model is given by the following. (1) The manufacturer provides an incentive contract (α, β) for the retailer and the retailer chooses to accept or refuse the contract. (2) If the retailer refuses the contract, he will obtain his reserved utility $\bar{u}$. If the retailer accepts the contract, the manufacturer will take action e_m to make semi-manufactured products, and he will take action e_r to process those semi-manufactured products. Both the manufacturer and the retailer's actions are unobservable. (3) At the end of the period, the manufacturer pays *s* to the retailer.

Based on the above hypotheses, we know the manufacturer is risk neutral, and thus the certainty equivalence of her profit, CE_m, is equal to her expected profit, i.e.

$$CE_m = E(\pi) = (1-\beta)(p-c)[k\theta A_m e_m + k(1-\theta)A_r e_r + \Phi] - \frac{\varphi e_m{}^2}{2} - \alpha \quad . (1)$$

The retailer's expected utility *E(u)* is given by

$$E(u) = \alpha + \beta(p-c)[k\theta A_m e_m + k(1-\theta)A_r e_r + \Phi] - \frac{b e_r{}^2}{2} \, . \quad (2)$$

For the risk-averse retailer, the certainty equivalence of his utility, CE_r equals his expected utility minus risk cost, i.e.

$$CE_r = \alpha + \beta(p-c)[k\theta A_m e_m + k(1-\theta)A_r e_r + \Phi] - \frac{b e_r{}^2}{2} - \frac{(1-\lambda)\rho\beta^2(p-c)^2\sigma^2}{2} \, . \quad (3)$$

3. Optimal Incentive Contract Under Information Symmetry

In the game of the manufacturer and the retailer, the manufacturer has to satisfy two kinds of constraints from the retailer: individual rationality (*IR*) (also called participation constraint) and incentive compatibility constraints (*IC*). Individual rationality constraint is that the profit the retailer gains from the contract is no less than his reservation utility $\bar{u}$. Incentive compatibility constraint implies that the retailer will choose the behavior that maximizes his expected profit.

Under information symmetry, the manufacture and the retailer can observe each other's behaviors and there is no moral hazard in the supply chain, thus *IC* constraint not holding.

3.1 The Building and the Solution of the Model

Under information symmetry, the manufacturer's problem is to set α and β to maximize her expected profit subject to the retailer's participation constraint, which is expressed as maximization problem (P1).

$$\begin{aligned} &\max_{\alpha,\beta,e_m,e_r} (1-\beta)(p-c)[k\theta A_m e_m + k(1-\theta)A_r e_r + \Phi] - \varphi e_m{}^2/2 - \alpha \\ &s.t. \\ &(IR) \quad \alpha + \beta(p-c)[k\theta A_m e_m + k(1-\theta)A_r e_r + \Phi] \\ &\qquad - b e_r{}^2/2 - (1-\lambda)\rho\beta^2(p-c)^2\sigma^2/2 \ge \bar{u} \end{aligned} \quad (P1)$$

Under optimal situation, the manufacture will minimize the payoff to the retailer and thus make the retailer's expected profit equal reservation utility $\bar{u}$. So, by making (*IR*) in (P1) into equality, we can calculate the expression of α, and obtain the equivalent maximization problem (P2) through substituting the expression of α into the objective function of (P1).

$$\begin{aligned} \max_{\alpha,\beta,e_m,e_r} \{&(p-c)[k\theta A_m e_m + k(1-\theta)A_r e_r + \Phi] \\ &- \frac{\varphi e_m{}^2}{2} - \frac{b e_r{}^2}{2} - \frac{1}{2}(1-\lambda)\rho\beta^2(p-c)^2\sigma^2 - \bar{u}\} \end{aligned} \quad (P2)$$

Through solving first-order optimal conditions of the objective function of (P2) with respect to e_m and e_r, we obtain optimal effort levels, $e_m{}^s$ and $e_r{}^s$ under information symmetry:

$$e_m{}^s = \frac{(p-c)k\theta A_m}{\varphi}, e_r{}^s = \frac{(p-c)k(1-\theta)A_r}{b} \, . \quad (4)$$

Under information symmetry, the optimal sharing rate β^s=0, which means the manufacturer will not need to motivate the retailer to work hard because she can observe his behavior. The manufacturer's expected profit is

$$E(\Pi^s)=\frac{(p-c)^2k^2\theta^2A_m{}^2}{2\phi}+\frac{(p-c)^2k^2(1-\theta)^2A_r{}^2}{2b}+(p-c)\Phi-\bar{u}\,. \tag{5}$$

The marginal effort cost of the supply chain is

$$c'(e_m)+c'(e_r)=(p-c)k\theta A_m+(p-c)k(1-\theta)A_r\,. \tag{6}$$

The marginal revenue of the supply chain is

$$E'(\Pi_w)=(p-c)[k\theta A_m+k(1-\theta)A_r]\,. \tag{7}$$

Based on (6) and (7), we know $c'(e_m)+c'(e_r)=E'(\Pi_w)$, meaning under information symmetry, the supply chain achieves Pareto Efficiency.

3.2 Comparative Static Analysis

In this section, we analyze the impacts of overconfidence and manufacturer factors importance on effort levels and the manufacturer's expected profit under information symmetry.

***Conclusion* 1** Under information symmetry, the efforts the manufacturer and the retailer pay in making and processing of products (e_i^s, $i=m$, r) are monotonically increasing functions of the importance of their respective factors (taking θ, when $i=m$; taking $1-\theta$, when $i=r$), but irrelevant to the degree of the retailer's overconfidence (λ).

Based on (3), we know the manufacturer and the retailer's effort levels increase as their respective factors get more important, i.e. $\frac{\partial e_m{}^s}{\partial\theta}>0$, $\frac{\partial e_r{}^s}{\partial(1-\theta)}>0$. No matter how the degree of retailer's overconfidence changes, the manufacturer and the retailer's efforts will keep fixed, i.e. $\frac{\partial e_m{}^s}{\partial\lambda}=0$, $\frac{\partial e_r{}^s}{\partial\lambda}=0$.

***Conclusion* 2** Under information symmetry, the manufacturer's expected profit ($E(\Pi^s)$) is a monotonically increasing function of her factors importance to product quality (θ), but irrelevant to the retailer's overconfidence (λ).

From (4), we see the manufacturer obtains more profit when her factors are more important to product quality, i.e. $\frac{\partial E(\Pi^s)}{\partial\theta}>0$, and also the manufacturer's expected profit is irrelevant to the retailer's overconfidence λ, i.e. $\frac{\partial E(\Pi^s)}{\partial\lambda}=0$.

4. Optimal Incentive Contract Under Information Asymmetry

In the real world, the manufacturer and the retailer cannot observe each other's behaviors, or monitoring cost is rather high. Thus, there exists double-sided information asymmetry between the manufacturer and the retailer.

4.1 The Building and the Solution of the Model

Under information asymmetry, the manufacturer's problem is to set incentive contract (α,β) to maximize her expected profit subject to the retailer's individual rationality and incentive compatibility constraints, and her own incentive compatibility constraint, shown in maximization problem (P3).

$$
\begin{aligned}
&\max_{\alpha,\beta,e_m,e_r} (1-\beta)(p-c)[k\theta A_m e_m + k(1-\theta)A_r e_r + \Phi] - \frac{\varphi e_m^{\ 2}}{2} - \alpha \\
&s.t. \\
&(IC_m) \quad e_m \in \arg\max (1-\beta)(p-c)[k\theta A_m e_m + k(1-\theta)A_r e_r + \Phi] - \frac{\varphi e_m^{\ 2}}{2} - \alpha \\
&(IC_r) \quad e_r \in \arg\max E(\Pi) = \alpha + \beta(p-c)[k\theta A_m e_m + k(1-\theta)A_r e_r + \Phi] \\
&\qquad\qquad - \frac{b e_r^{\ 2}}{2} - \frac{1}{2}(1-\lambda)\rho\beta^2(p-c)^2\sigma^2 \\
&(IR) \quad \alpha + \beta(p-c)[k\theta A_m e_m + k(1-\theta)A_r e_r + \Phi] \\
&\quad - \frac{b e_r^{\ 2}}{2} - \frac{1}{2}(1-\lambda)\rho\beta^2(p-c)^2\sigma^2 \geq \bar{u}
\end{aligned}
\tag{P3}
$$

In (P3), (IC_m) is the manufacturer's incentive compatibility constraint. (IC_r) and (IR) are the retailer's incentive compatibility and participation constraints respectively. Solving (IC_m) and (IC_r), we obtain the manufacturer and the retailer's effort levels, $e_m^{\ a}$ and $e_r^{\ a}$ (superscript a denotes information asymmetry).

$$
e_m^{\ a} = \frac{(1-\beta)(p-c)k\theta A_m}{\varphi}, e_r^{\ a} = \frac{\beta(p-c)k(1-\theta)A_r}{b} \tag{8}
$$

Like solving (P1), we make (IR) in (P3) into equality, calculate the expression of α, and substitute α and (8) into the objective function of (P3). Then, (P3) is transformed into (P4).

$$
\begin{aligned}
&\max_{\beta}\{(p-c)[\frac{(1-\beta)(p-c)k^2\theta^2 A_m^{\ 2}}{\varphi} + \frac{\beta(p-c)k^2(1-\theta)^2 A_r^{\ 2}}{b} + \Phi] - \bar{u} \\
&- \frac{(1-\beta)^2(p-c)^2 k^2\theta^2 A_m^{\ 2}}{2\varphi} - \frac{\beta^2(p-c)^2 k^2(1-\theta)^2 A_r^{\ 2}}{2b} - \frac{1}{2}(1-\lambda)\rho\beta^2(p-c)^2\sigma^2\}
\end{aligned}
\tag{P4}
$$

Solving (P4), we get optimal sharing rate β^a, shown in (9).

$$
\beta^a = \frac{\varphi k^2(1-\theta)^2 A_r^{\ 2}}{bk^2\theta^2 A_m^{\ 2} + \varphi k^2(1-\theta)^2 A_r^{\ 2} + b\varphi(1-\lambda)\rho\sigma^2} \tag{9}
$$

Substituting (9) into (8) gets the manufacturer and the retailer's respective optimal effort levels, shown in (10).

$$
\begin{aligned}
e_m^{\ a*} &= \frac{(p-c)k\theta A_m}{\varphi}\frac{bk^2\theta^2 A_m^{\ 2} + b\varphi(1-\lambda)\rho\sigma^2}{bk^2\theta^2 A_m^{\ 2} + \varphi k^2(1-\theta)^2 A_r^{\ 2} + b\varphi(1-\lambda)\rho\sigma^2} \\
e_r^{\ a*} &= \frac{(p-c)k(1-\theta)A_r}{b}\frac{\varphi k^2(1-\theta)^2 A_r^{\ 2}}{bk^2\theta^2 A_m^{\ 2} + \varphi k^2(1-\theta)^2 A_r^{\ 2} + b\varphi(1-\lambda)\rho\sigma^2}
\end{aligned}
\tag{10}
$$

Substituting (9) into (11) obtains the manufacturer's optimal expected profit under information asymmetry.

$$
\begin{aligned}
E(\Pi^a) &= \frac{(1-\beta^a)(p-c)^2 k^2\theta^2 A_m^{\ 2}}{\varphi} + \frac{\beta^a(p-c)^2 k^2(1-\theta)^2 A_r^{\ 2}}{b} \\
&+ (p-c)\Phi - \frac{(1-\beta^a)^2(p-c)^2 k^2\theta^2 A_m^{\ 2}}{2\varphi} \\
&- \frac{\beta^{a^2}(p-c)^2 k^2(1-\theta)^2 A_r^{\ 2}}{2b} - \frac{1}{2}(1-\lambda)\rho\beta^{a^2}(p-c)^2\sigma^2 - \bar{u}
\end{aligned}
\tag{11}
$$

Under information asymmetry, the manufacturer suffers the costs caused by opportunism and risks, called as agent cost, which does not exist under information symmetry. To put simply, agent cost is the loss of the principal (i.e. the manufacturer)'s expected profit due to information asymmetry, relative to that under information symmetry. Based on (5) and (11), we calculate agent cost AC, shown in (12).

$$
\begin{aligned}
&AC = E(\Pi^s) - E(\Pi^a) = \\
&\frac{(p-c)^2 k^2 \theta^2 A_m{}^2}{2\varphi}\left(\frac{\varphi k^2 (1-\theta)^2 A_r{}^2}{bk^2\theta^2 A_m{}^2 + \varphi k^2 (1-\theta)^2 A_r{}^2 + b\varphi(1-\lambda)\rho\sigma^2}\right)^2 + \\
&\frac{(p-c)^2 k^2 (1-\theta)^2 A_r{}^2}{2b}\left(\frac{bk^2\theta^2 A_m{}^2 + b\varphi(1-\lambda)\rho\sigma^2}{bk^2\theta^2 A_m{}^2 + \varphi k^2 (1-\theta)^2 A_r{}^2 + b\varphi(1-\lambda)\rho\sigma^2}\right)^2 \\
&+ \frac{1}{2}(1-\lambda)\rho(p-c)^2\sigma^2\left(\frac{\varphi k^2 (1-\theta)^2 A_r{}^2}{bk^2\theta^2 A_m{}^2 + \varphi k^2 (1-\theta)^2 A_r{}^2 + b\varphi(1-\lambda)\rho\sigma^2}\right)^2
\end{aligned} \tag{12}
$$

4.2 Comparative Static Analysis

In this section, we analyze the influences of the retailer's overconfidence and manufacturer factors importance on optimal sharing rate, effort levels under information asymmetry.

Conclusion 3 Under information asymmetry, the optimal sharing rate, β^a increases as retailer overconfidence λ gets bigger, and decrease as the importance of manufacturer factors to product quality, θ gets smaller.

Based on (9), we get first-order differentials of β^a with respect to λ and θ, respectively.

$$
\frac{\partial\beta^a}{\partial\lambda} = \frac{\varphi^2 k^2 (1-\theta)^2 A_r{}^2 b\rho\sigma^2}{[bk^2\theta^2 A_m{}^2 + \varphi k^2 (1-\theta)^2 A_r{}^2 + b\varphi(1-\lambda)\rho\sigma^2]^2} > 0 \tag{13}
$$

$$
\frac{\partial\beta^a}{\partial\theta} = \frac{-2\varphi(1-\theta)bk^4\theta^2 A_r{}^2 A_m{}^2 - 2k^2(1-\theta)A_r{}^2 b\varphi^2(1-\lambda)\rho\sigma^2 - 2b\varphi k^4\theta(1-\theta)^2 A_r{}^2 A_m{}^2}{[bk^2\theta^2 A_m{}^2 + \varphi k^2 (1-\theta)^2 A_r{}^2 + b\varphi(1-\lambda)\rho\sigma^2]^2} < 0 \tag{14}
$$

(13) and (14) implies under information asymmetry, when the retailer is more overconfident (corresponding to a lager λ), the manufacturer will impose stronger incentive on the retailer, i.e. β^a is larger, and when manufacturer factors are more important (corresponding to a lager θ), the manufacturer will impose weaker incentive on the retailer, i.e. β^a is smaller.

Conclusion 4 Under information asymmetry, the manufacturer and the retailer's respective effort levels, $e_m{}^a$ and $e_r{}^a$ are decreasing function and increasing function of retailer overconfidence λ respectively.

Based on (10), we can get the first-order differentials of $e_m{}^a$ and $e_r{}^a$ with respect to λ respectively.

$$
\frac{\partial e_m{}^a}{\partial\lambda} = -\frac{(p-c)\theta A_m b\rho\sigma^2\varphi k^3(1-\theta)^2 A_r{}^2}{[bk^2\theta^2 A_m{}^2 + \varphi k^2 (1-\theta)^2 A_r{}^2 + b\varphi(1-\lambda)\rho\sigma^2]^2} < 0, \tag{15}
$$

$$
\frac{\partial e_r{}^a}{\partial\lambda} = \frac{(p-c)\varphi^2 k^3 (1-\theta)^3 A_r{}^3 \rho\sigma^2}{bk^2\theta^2 A_m{}^2 + \varphi k^2 (1-\theta)^2 A_r{}^2 + b\varphi(1-\lambda)\rho\sigma^2} > 0 \tag{16}
$$

Based on (15) and (16), we know under information asymmetry, when the retailer is more overconfident, the manufacturer will exert less effort in making semi-manufactured products, but he will pay more effort in processing semi-manufactured products.

5. Numerical Analysis

This section analyzes the impacts of the retailer's overconfidence, λ and manufacturer factors importance, θ on the manufacturer's expected profit, $E(\Pi^a)$ and agent cost AC. The influences of θ on effort levels $e_m{}^a$ and $e_r{}^a$ under information asymmetry are also analyzed.

5.1 The Impact of Retailer Overconfidence and Manufacturer Factors Importance on the Manufacturer's Expected Profit under Information Asymmetry

With p=5, c=2, ρ=3, b=1, φ=1, k=2, σ^2=4, A_r=2, A_m=3, Φ=5, $\bar{u}$=3, 0<λ<1, 0≤θ≤1, we simulate the impacts of θ and λ, on the manufacturer's expected profit $E(\Pi^a)$, which is shown in Fig.1.

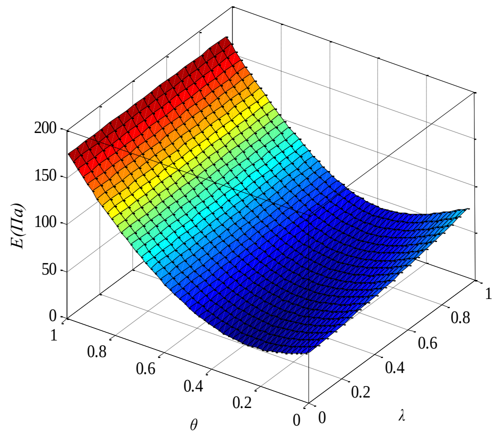

Fig. 1: The impacts of retailer overconfidence and the importance of manufacturer factors on the manufacturer's expected profit

In Fig.1, we see for a fixed value of θ, the manufacturer's expected profit, $E(\Pi^a)$ increases as λ gets bigger. The increment of $E(\Pi^a)$ when λ increases from 0.01 to 0.99 is defined as $\Delta E(\Pi^a)= E(\Pi^a)|_{\lambda= 0.99} - E(\Pi^a)|_{\lambda= 0.01}$. $\Delta E(\Pi^a)$ decreases as θ gets bigger, which means that when manufacturer factors are more important, the impact of retailer overconfidence on the manufacturer's expected profit is less. For a certain fixed value of λ, the manufacturer's expected profit, $E(\Pi^a)$ decreases at first and then increases as θ increases. On the whole, the impact of manufacturer factors importance, θ on the manufacturer's expected profit, $E(\Pi^a)$ is greater than that of the retailer's overconfidence degree, λ on $E(\Pi^a)$.

5.2 The Impacts of the Importance of Manufacturer Factors on Effort Levels under Information Asymmetry

With λ equal to 0.8 and other parameters with the same value in section A of V, we simulate the influence of θ on e_m^a and e_r^a respectively, which is shown in Fig. 2. In Fig. 2, we see that under information asymmetry, the manufacturer's effort level, e_m^a increases as the importance of her factors θ gets bigger, and the retailer's effort levels, e_r^a decreases as the importance of her factors θ gets bigger. Therefore, the importance of manufacturer factors has the same impacts on effort levels under information symmetry and information asymmetry.

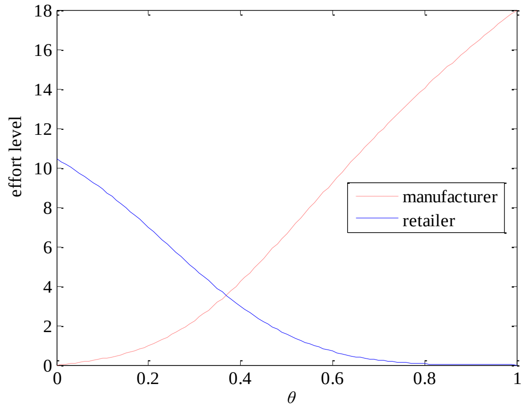

Fig. 2: The impacts of the importance of manufacturer factors on the manufacturer and the retailer's effort levels under information asymmetry

5.3 The Impacts of Retailer Overconfidence and the Importance of Manufacturer Factors on Agent Cost

With the same values of all parameters in section A of V, we simulate the impacts of retailer overconfidence λ and the importance of manufacturer factors θ on agent cost AC, which is shown in Fig. 3. In Fig. 3, we see that for a fixed value of θ which is not equal to 1, AC decreases as λ gets bigger. This means that the retailer's overconfidence bias can reduce agent cost. Besides, when retailer factors are more important,

λ has a greater effect on AC. When manufacturer factors totally determines product quality, i.e. θ=1, λ will not affect AC.

The influence of θ on agent cost AC is complicated. For a fixed value of λ which is smaller than 0.5, AC decreases as θ increases. However, for a fixed value of λ which is larger than 0.5 and smaller than 0.75, AC decreases firstly, then increases and finally decreases as θ is bigger. For a fixed value of λ which is larger than 0.75 and smaller than 1, AC increases at first and then decreases as θ gets bigger.

To sum up, when manufacturer factors are less important to product quality, the manufacturer should choose a more overconfident retailer, because he will pay more effort in processing semi-manufactured products. If manufacturer factors largely determine product quality, the manufacturer need not consider the influence of retailer overconfidence.

6. Conclusion

This paper explores the impact of retailer overconfidence on incentive contracts in a manufacturer-retailer supply chain under symmetric and asymmetric information situations. Under asymmetric information, the manufacturer and the retailer cannot observe each other's behaviors, existing double-sided moral hazard.

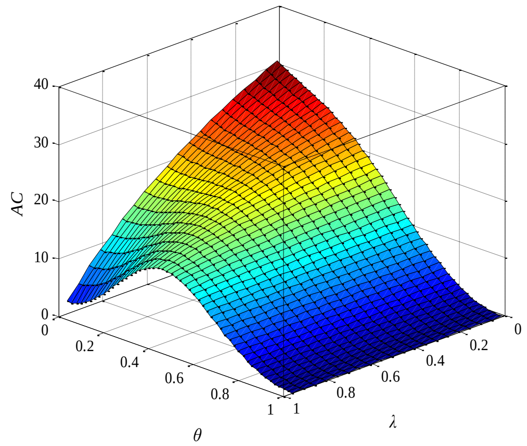

Fig. 3: The impact of retailer overconfidence and the importance of manufacturer factors on agent cost

The results indicate under information symmetry, the optimal sharing rate, the manufacturer and the retailer's respective effort levels, and the manufacturer's expected profit are irrelevant to retailer overconfidence. Under information asymmetry, the optimal sharing rate, the retailer's effort level and the manufacturer's expected profit will increase as the retailer is more overconfident, and the manufacturer's effort level and agent cost decrease. As manufacturer factors are more important, the impact of the retailer's overconfidence on agent cost under information asymmetry is less. Therefore, under double moral hazard, when retailer factors affect product quality, retailer overconfidence mitigates principal-agent relationship between the manufacturer and the agent, and improves supply chain efficiency.

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