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Dual-channel Supply Chain Pricing Decisions under Network Sales Efficiency and Equity

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Abstract— *Considering the difference in the efficiency of direct selling and e-commerce online sales, this paper takes the manufacture-led dual-channel supply chain as the research object and takes no fair concern as the benchmark to analyze the influence of network marketing efficiency and fair concern mode on the pricing decision of dual-channel supply chain. The research results show that: with the improvement of the network sales efficiency of manufacturers, under the non-dual-member equity concerns (N, M and R modes), both the selling price of e-commerce and the direct selling price of manufacturers will be reduced, and the price reduction rate of manufacturers is faster than that of e-commerce. Under the dual-fair concern (MR) model, the selling price of e-commerce will be reduced, but whether the direct selling price of manufacturers will be reduced depends on the degree of fair concern of both sides. The leading party's equity concern will reduce the impact of network sales efficiency on price reduction, while the follower's equity concern will enhance the impact of network sales efficiency on price reduction. In addition, the influence of network marketing efficiency on price reduction and speed reduction of manufacturers in MR mode is simulated.*

Keywords— ***dual-channel supply chain, equity concerns, Stackelberg games, network sales efficiency.***.

I. INTRODUCTION

With the in-depth integration of the Internet and consumer behavior, manufacturers' sales strategies have been expanded from physical sales to electronic channels such as HP, IBM, and others. They have opened direct selling websites and cooperated with e-commerce platforms to build their products' online sales channels. The involvement of manufacturers in online sales has brought a certain impact on e-commerce, thus intensifying the fierce competition between manufacturers and e-commerce enterprises and causing channel conflicts (Qiu and Xu 2019). Meanwhile, through a large number of experiments, behavioral researchers have learned that decision-making subjects have behavioral characteristics of equity concerns (Güth et al 1982, Kahneman et al 1986, Ho and Zhang 2008). Faced with many problems in the operation of dual-channel mode, many scholars have carried out corresponding researches. For example, Wang (2012) studied the coordination of dual-channel supply chain under different models of equity concern. Li (2017) studied the influence of retailers' fair concerns on cooperative advertising decisions of dual-channel supply chain under the game dominated by manufacturers . Li (2015) studied the impact of the fair concern behavior of traditional retail enterprises on the ordering decision of dual-channel supply chain. The above research shows that the fair concern behavior of traditional retail enterprises affects the decision-making of members of dual-channel supply chain.

In addition, channel cost is becoming the main indicator of competition among supply chain members. In this regard, Li (2009) analyzed the impact of channel sales efficiency on dual-channel game pricing. Liu (2015) studied the influence of network channel entry on double-channel validity under different channel sales efficiency. Zhang (2017) studied the impact of distribution efficiency on pricing and coordination of dual-channel supply chain enterprises. Shu and Jian (2017) studied the impact of e-commerce efficiency on dual-channel game with different rights structure under the concern of traditional

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retail enterprises' equity. Du (2010) studied the influence of manufacturer's network sales efficiency on enterprise pricing and performance under three different rights models under the concern of e-commerce fairness.

To sum up, at present, to consider fair under the concern of dual channel supply chain coordination problem, most of the literature in the traditional retail and direct sales of double channels as the research object, few literature consider sales efficiency and fairness is concerned with the pricing problem of the supply chain. This paper takes the dual channel composed of direct selling and e-commerce as the research object, considers the difference of online sales efficiency between direct selling and e-commerce, and takes no fair concern as the benchmark to analyze the impact of manufacturers' online sales efficiency on manufacturers' and e-commerce's price reduction decisions under different fair concern modes and degrees.

II. PROBLEM DESCRIPTION AND HYPOTHESIS

Assumed that the manufacturer produces a product and sells it through e-commerce wholesale and online direct sales. Because the two sides have a single market, they have competitive behavior, and face different fair concern mode, the bidding game behavior between the two will change.

Based on this, this paper proposes the following hypothesis:

(1)Single manufacturer and single e-commerce are rational decisions, complete information to each other;

(2)The manufacturer's production cost is c , the wholesale price of per unit product is w ,the network selling cost of e-commerce and the direct selling cost of manufacturers are x and $kx, k>0$ respectively, Where k is the efficiency coefficient of online sales of manufacturers relative to e-commerce. The larger k is, the lower the efficiency of online sales of manufacturers relative to e-commerce;

(3) The direct selling price and e-commerce selling price under different fair concern models are p_m^i and p_e^i respectively, $i=N,M,R,MR$;

(4) The market demand of e-commerce and manufacturers is $q_e^i=\mu a-p_e^i+\beta p_m^i, q_m^i=(1-\mu)a-p_m^i+\beta p_e^i$. Since the product pricing of competitive enterprises has less impact on the network market demand than the product pricing of the enterprise has on the network market demand, $0<\beta<1$, The profit for both parties is $\pi_e^i=(p_e^i-w-x)q_m^i, \pi_m^i=(p_m^i-kx-c_m)q_m^i+(w-c)q_e^i$;

(5) If the fair concern coefficient $\lambda_m\geq 0, \lambda_e\geq 0$ of manufacturer and retailer is introduced, then the utility function of manufacturer and e-commerce under fair concern is $u_e^i=(1+\lambda_e)\pi_e^i-\lambda_e\pi_m^i, u_m^i=(1+\lambda_m)_m^i-\lambda_m\pi_e^i$.

III. GAME MODEL CONSTRUCTION AND SOLUTION UNDER DIFFERENT FAIR CONCERN MODELS

3.1 Unfair concerns（N mode）

In this mode $\lambda_m=\lambda_r=0$, the profit function of the manufacturer and the e-commerce is:

$$\begin{aligned}\pi_e&=(p_e-w-x)(\mu a-p_e+\beta p_m)\\ \pi_m&=(p_m-kx-c)[(1-\mu)a-p_m+\beta p_e]+(w-c)(\mu a-p_e+\beta p_m)\end{aligned}\tag{1}$$

Under the guidance of manufacturers, the game solution results are shown in equations (2) and (3)

$$p_m^N=\frac{(\beta\mu+2-2\mu)\mathrm{a}}{2(2-\beta^2)}+\frac{(1-\beta)(2+\beta)c}{2(2-\beta^2)}+\frac{(\beta+2k-\beta^2\,\mathrm{k})x}{2(2-\beta^2)}+\frac{\beta w}{(2-\beta^2)}\tag{2}$$

$$p_e^N=\frac{\mu a+w+x}{2}+\frac{(\beta\mu+2-2\mu)\beta\mathrm{a}}{4(2-\beta^2)}+\frac{(1-\beta)(2+\beta)\beta c}{4(2-\beta^2)}+\frac{(\beta+2k-\beta^2\,\mathrm{k})\beta x}{4(2-\beta^2)}+\frac{\beta^2 w}{2(2-\beta^2)}\tag{3}$$

3.2 E-commerce equity concerns (mode E)

In this mode, $\lambda_m=0, \lambda_e>0$,the profit function of the manufacturer and the e-commerce is:

$$\begin{aligned}u_e^E&=(1+\lambda_e)[(p_e^E-w-x)(\mu a-p_e^E+\beta p_m^E)]-\lambda_e[(p_m^E-kx-c)[(1-\mu)a-p_m^E+\beta p_e^E]+(w-c)(\mu a-p_e^E+\beta p_m^E)]\\ \pi_m^E&=(p_m^E-kx-c)[(1-\mu)a-p_m^E+\beta p_e^E]+(w-c)(\mu a-p_e^E+\beta p_m^E)\end{aligned}\tag{4}$$

Under the guidance of manufacturers, the game solution results are shown in equations (5) and (6)

$$p_m^E=(1+\lambda_e)\frac{(2-2\mu+\beta\mu)}{2(2+2\lambda_e-\beta^2)}a+\frac{(1-\beta)(2+\beta+(2-\beta)\lambda_e)}{2(2+2\lambda_e-\beta^2)}c+\frac{2k+\beta-k\beta^2+\lambda_e(\beta+2k+k\beta^2)}{2(2+2\lambda_e-\beta^2)}x+\frac{(2\lambda_e+1)w\beta}{2+2\lambda_e-\beta^2}\tag{5}$$

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$$p_e^E = \frac{a\mu + x + w}{2} + \frac{(2-2\mu+\beta\mu)}{4(2+2\lambda_e-\beta^2)}a + \frac{(1-\beta)(\beta(2+\beta)-4\lambda_e)}{4(2+2\lambda_e-\beta^2)}c + \frac{2k+\beta-k\beta^2+4k\lambda_e}{4(2+2\lambda_e-\beta^2)}\beta x + \frac{w\left(\beta^2+2\lambda_e\right)}{2(2+2\lambda_e-\beta^2)} \quad (6)$$

3.3 Manufacturer's equity concerns(mode M)

In this mode, $\lambda_m > 0, \lambda_e = 0$, the profit function of the manufacturer and the e-commerce is:

$$\begin{aligned} \pi_e^M &= (p_e^M - w - x)(\mu a - p_e^M + \beta p_m^M) \\ u_m^M &= (1+\lambda_m)[(p_m^M - kx - c)[(1-\mu)a - p_m^M + \beta p_e^M] + (w-c)(\mu a - p_e^M + \beta p_m^M)] - (p_e^M - w - x)(\mu a - p_e^M + \beta p_m^M)] \end{aligned} \quad (7)$$

Under the guidance of manufacturers, the game solution results are shown in equations (8) and (9)

$$p_m^M = \frac{(1+\lambda_m)(2-2\mu+\mu\beta)-\mu\lambda_m\beta}{2(1+\lambda_m)(2-\beta^2)+\beta^2\lambda_m}a + \frac{(1+\lambda_m)(2-\beta^2-\beta)}{2(1+\lambda_m)(2-\beta^2)+\beta^2\lambda_m}c + \frac{(1+\lambda_m)(2\mathrm{k}+\beta-\beta^2k)+\lambda_m\beta}{2(1+\lambda_m)(2-\beta^2)+\beta^2\lambda_m}x + \frac{2+3\lambda_m}{2(1+\lambda_m)(2-\beta^2)+\beta^2\lambda_m}\beta w \quad (8)$$

$$p_e^M = \frac{\mu a + w + x}{2} + \frac{(1+\lambda_m)(2-2\mu+\mu\beta)+\mu\lambda_m\beta}{4(1+\lambda_m)(2-\beta^2)+\beta^2\lambda_m}\beta a + \frac{(1+\lambda_m)(2-\beta^2-\beta)}{4(1+\lambda_m)(2-\beta^2)+\beta^2\lambda_m}\beta c + \frac{(1+\lambda_m)(2\mathrm{k}+\beta-\beta^2k+\lambda_m\beta)}{4(1+\lambda_m)(2-\beta^2)+\beta^2\lambda_m}\beta x + \frac{2+3\lambda_m}{4(1+\lambda_m)(2-\beta^2)+\beta^2\lambda_m}\beta^2 w \quad (9)$$

3.4 Fair concerns on both sides (MR model)

In this mode, $\lambda_m > 0, \lambda_e > 0$, the profit function of the manufacturer and the e-commerce is:

$$\begin{aligned} u_e^{MR} &= (1+\lambda_e)[(p_e^{MR} - w - x)(\mu a - p_e^{MR} + \beta p_m^{MR})] - \lambda_e[(p_m^{MR} - kx - c)[(1-\mu)a - p_m^{MR} + \beta p_e^{MR}] + (w-c)(\mu a - p_e^{MR} + \beta p_m^{MR})] \\ u_m^{MR} &= (1+\lambda_m)[(p_m^{MR} - kx - c)[(1-\mu)a - p_m^{MR} + \beta p_e^{MR}] + (w-c)(\mu a - p_e^{MR} + \beta p_m^{MR})] - \lambda_m(p_e^{MR} - w - x)(\mu a - p_e^{MR} + \beta p_m^{MR})] \end{aligned} \quad (10)$$

Under the guidance of manufacturers, the game solution results are shown in equations (11) and (12)

$$\begin{aligned} p_m^{MR} = {} & \frac{1}{4(1+\lambda_m)(1+\lambda_e)-\beta^2(2+(1-2\lambda_e)\lambda_m)}\{[(2-2\mu+\mu\beta)(1+\lambda_e)+2(1-\mu)\lambda_m(1+\lambda_e)]\mathrm{a} \\ & +(2k+\beta-k\beta^2+(2\beta+2k-k\beta^2)\lambda_m-2k\beta^2\lambda_e^2\lambda_m+\lambda_e(\beta+2k+k\beta^2+(2\beta+2k+k\beta^2)\lambda_m))x \\ & +(1-\beta)(2\beta\lambda_e^2\lambda_m+(2+\beta)(1+\lambda_m)+(2-\beta)\lambda_e(1+\lambda_m))\mathrm{c}+(1+2\lambda_e)[2+(3-\lambda_e)\lambda_m]w\beta\} \end{aligned} \quad (11)$$

$$\begin{aligned} p_m^{MR} = {} & \frac{a\mu+x+w}{2} + \frac{[(2-2\mu+\mu\beta)+2(1-\mu)\lambda_m]\mathrm{a}\,\beta}{8(1+\lambda_m)(1+\lambda_e)-2\beta^2(2+(1-2\lambda_e)\lambda_m)} \\ & + \frac{(1-\beta)(\beta(2+\beta)(1+\lambda_m)-4\lambda_e^2(1+\lambda_m)-\lambda_e(4-2\beta-\beta^2+2(2-\beta)\lambda_m)}{2(1+\lambda_e)[4-2\beta^2+(4-\beta^2)\lambda_m+2\lambda_e[2+(2+\beta^2)\lambda_m]]}c \\ & + \frac{2k+\beta-k\beta^2+(2\beta+2k-k\beta^2)\lambda_m+4k\lambda_e^2(1+\lambda_m)+\lambda_e(\beta+6k-k\beta^2+2(\beta+3k)\lambda_m)}{2(1+\lambda_e)[4-2\beta^2+(4-\beta^2)\lambda_m+2\lambda_e[2+(2+\beta^2)\lambda_m]]}x\beta \\ & + \frac{4\lambda_e^2(1+\lambda_m)+\beta^2(2+3\lambda_m)+2\lambda_e(2+\beta^2+(1+\beta^2)\lambda_m)\mathrm{w}}{2(1+\lambda_e)[2M_4+(2+M_4)\lambda_m+2\lambda_e[2+(2+\beta^2)\lambda_m]]} \end{aligned} \quad (12)$$

IV. COMPARISON AND ANALYSIS

This section takes no fair concerns as the benchmark to explore the influence of network sales efficiency k on the game of dual-channel supply chain under different fair concerns. Through comparative analysis, propositions 1,2 and 3 can be obtained.

Proposition 1: p_m^N、p_m^E、p_m^M、p_e^N、p_e^E、p_e^M、p_e^{MR} is positively correlated with k; If p_m^{MR} is positively correlated with k, then λ_m, λ_e must satisfy certain conditions.

Proof:

$$\frac{\partial p_m^N}{\partial k} = \frac{x}{2}, \quad \frac{\partial p_e^N}{\partial k} = \frac{\beta x}{4} \quad (13)$$

$$\frac{\partial p_m^E}{\partial k} = \frac{2-\beta^2+\lambda_e(2+\beta^2)}{2(2-\beta^2+2\lambda_e)}x \ , \quad \frac{\partial p_e^E}{\partial k} = \frac{2-\beta^2+4\lambda_e}{4(2-\beta^2)+8\lambda_e}\beta x \quad (14)$$

$$\frac{\partial p_m^M}{\partial k} = \frac{(2-\beta^2)(\lambda_m+1)}{2(2-\beta^2)+(4-\beta^2)\lambda_m}, \quad \frac{\partial p_e^M}{\partial k} = \frac{(2-\beta^2)(1+\lambda_m)}{2(2-\beta^2)+(4-\beta^2)\lambda_m}\beta x \quad (15)$$

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$$\frac{\partial p_m^{MR}}{\partial k}=\frac{(1+\lambda_m)(2-\beta^2+\lambda_e(2+\beta^2))-2\beta^2\lambda_e^2\lambda_m}{4(1+\lambda_m)(1+\lambda_e)+2\lambda_e(2+(2+\beta^2)\lambda_m)}x \quad (16)$$

$$\frac{\partial p_e^{MR}}{\partial k}=\frac{4\lambda_e(1+\lambda_m+\lambda_e\lambda_m)+(2-\beta^2)(1+\lambda_m+\lambda_e)+6\lambda_e\lambda_m}{2(1+\lambda_e)[2(2-\beta^2)(1+\lambda_m)+\lambda_e[4+\beta^2+2(2+\beta^2)\lambda_m]]}x\beta$$

Because of $x>0$, $\frac{\partial p_m^N}{\partial k}>0$ is true; Because of $0<\beta<1$, so $2-\beta^2,4-\beta^2$ are both greater than zero, and $\frac{\partial p_m^E}{\partial k},\frac{\partial p_e^E}{\partial k},\frac{\partial p_m^M}{\partial k},\frac{\partial p_e^M}{\partial k},\frac{\partial p_e^{MR}}{\partial k}>0$ is true. Because of $0<\beta<1,\lambda_m\geq 0,\lambda_e\geq 0$, formula 1 has a positive denominator.

$(1+\lambda_m)(2-\beta^2+\lambda_e(2+\beta^2))-2\beta^2\lambda_e^2\lambda_m>0$ gives us $\lambda_m>\frac{2-\beta^2+2\lambda_e+\beta^2\lambda_e}{\lambda_e(2\beta^2\lambda_e-2-\beta^2)+\beta^2-2}$,It is that Plus or minus $\frac{\partial p_m^{MR}}{\partial k}$ is determined by $\lambda_m$and λ_e together. Due to the complexity of calculation, the relationship between $\frac{\partial p_m^{MR}}{\partial k}$ and λ_m,λ_e is illustrated by simulation below.

From proposition 1, it can be seen that with the decrease of k (That is, the improvement of the network sales efficiency of manufacturers relative to e-commerce), the selling price of e-commerce and the direct selling price of manufacturers will decrease under the three non-dual-member equity concerns (N, M and R modes). With the decrease of k, under the dual-member fair concern (MR model), the selling price of e-commerce will be reduced, but whether the manufacturer's direct selling price is reduced or not is related to the degree of fair concern of both parties. Due to the complexity of formula $\frac{\partial p_m^{MR}}{\partial k}>0$, the relationship between $\frac{\partial p_m^{MR}}{\partial k}>0$ and λ_m,λ_e will be illustrated by simulation method below.

Proposition 2: $\frac{\partial p_m^N}{\partial k}>\frac{\partial p_e^N}{\partial k}>0$, $\frac{\partial p_m^M}{\partial k}>\frac{\partial p_e^M}{\partial k}>0$, $\frac{\partial p_m^E}{\partial k}>\frac{\partial p_e^E}{\partial k}>0$

Proof:

From equation (13), it can be known that: $\frac{\partial p_m^N}{\partial k}-\frac{\partial p_e^N}{\partial k}=\frac{(2-\beta)x}{4}$, Because of $x>0$, so $\frac{\partial p_m^N}{\partial k}>\frac{\partial p_e^N}{\partial k}>0$ is true.

From equation (14), it can be known that: $\frac{\partial p_m^E}{\partial k}-\frac{\partial p_e^E}{\partial k}=\frac{4-2\beta-2\beta^2+\beta^3+2(2-2\beta+\beta^2)\lambda_e}{4(2-\beta^2+2\lambda_e)}x$, Because of $4-2\beta-2\beta^2>0,2-2\beta>0,2-\beta^2>0$, so $\frac{\partial p_m^E}{\partial k}>\frac{\partial p_e^E}{\partial k}$ is true.

From equation (15), it can be known that: $\frac{\partial p_m^M}{\partial k}-\frac{\partial p_e^M}{\partial k}=\frac{(2-\beta^2)(\lambda_m+1)(1-\beta)}{2(2-\beta^2)+(4-\beta^2)\lambda_m}x$, Because of $2-\beta^2>0,4-\beta^2>0,1-\beta>0$, so $\frac{\partial p_m^M}{\partial k}>\frac{\partial p_e^M}{\partial k}$ is true.

According to proposition 2, it can be seen that: With fewer k(that is, the improvement of the network sales efficiency of manufacturers relative to e-commerce), three members of double fairness concerns (N, M, R mode), rate of price reduction in direct sales is higher than the rate at which e-commerce prices are falling, But in dual member fair concern mode (MR mode), two members of the speed reduction compared with a fair degree of concern about each other, Due to the complexity of formula calculation, this relationship between $\frac{\partial p_m^{MR}}{\partial k}-\frac{\partial p_e^{MR}}{\partial k}$ and λ_m,λ_e will be illustrated by simulation method below.

Proposition 3: $\frac{\partial p_m^E}{\partial k}>\frac{\partial p_m^N}{\partial k}>\frac{\partial p_m^M}{\partial k}$ 且 $\frac{\partial p_m^{MR}}{\partial k}<\frac{\partial p_m^N}{\partial k}$; $\frac{\partial p_e^E}{\partial k}>\frac{\partial p_e^N}{\partial k}>\frac{\partial p_e^M}{\partial k}>0,\frac{\partial p_e^{ME}}{\partial k}>\frac{\partial p_e^N}{\partial k}$

Proof:

This simplifies to （13）（14）（15）, so we know that :

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$$\frac{\partial p_m^E}{\partial k}=\frac{x}{2}+\frac{\lambda_e\beta^2 x}{2(2+2\lambda_e-\beta^2)},\frac{\partial p_m^M}{\partial k}=\frac{x}{2}-\frac{0.5\beta^2\lambda_m}{2(2-\beta^2)+(4-\beta^2)\lambda_m}$$
$$\frac{\partial p_m^{MR}}{\partial k}=\frac{x}{2}-\frac{\lambda_e\left(2-\beta^2+2\lambda_m\right)+2\beta^2\lambda_e^2\lambda_m+\beta^2\left(1+\lambda_m\right)}{4(1+\lambda_m)(1+\lambda_e)+2\lambda_e(2+(2+\beta^2)\lambda_m)}x \quad (17)$$
$$\frac{\partial p_e^E}{\partial k}=\frac{\beta x}{4}+\frac{\lambda_e}{2(2(1+\lambda_e)-4\beta^2}\beta x,\frac{\partial p_e^M}{\partial k}=\frac{\beta x}{4}+\frac{(4-2\beta^2)+(4-3\beta^2)\lambda_m}{4[(4-2\beta^2)+(4-\beta^2)\lambda_m]}$$
$$\frac{\partial p_e^{MR}}{\partial k}=\frac{\beta x}{4}+\frac{(4-\beta^2+4\lambda_m+\lambda_e(4-\beta^2+(4-2\beta^2)\lambda_m)\lambda_e x\beta}{4(1+\lambda_e)[(4-2\beta^2)(1+\lambda_m)+\lambda_e[4+\beta^2+(4+2\beta^2)\lambda_m]]}x\beta$$

Therefore $0<\beta<1$, the second term of all expressions in formula (17) is greater than zero. By contrast with equation (13), we can see that this proposition is true.

Proposition 3 is comparing different fairness concerns modes of pricing decision, the conclusion is that: from the perspective of the direct selling price drop speed, with no fair concern as a benchmark, as k reduce (that is, with manufacturer network sales efficiency improvement) , the fair concern model of e-commerce has the fastest price reduction and is better than the no fair concern model, the two models of fair concern (E and ME) in which manufacturers participate are slower and lower than those without fair concern. From proposition 3, it can be seen that the leading party's equity concern will weaken the impact of network sales efficiency on price reduction, while the follower's equity concern will enhance the impact of network sales efficiency on price reduction.

V. SIMULATED ANALYSIS

In this section, the influence of network sales efficiency on members' pricing decisions under the dual-fair concern model is simulated and analyzed, taking $a=200, w=5, \beta=0.4, \mathrm{x}=20, c=2, \mu=0.2$.

5.1 Network sales efficiency and direct selling price reduction under MR model

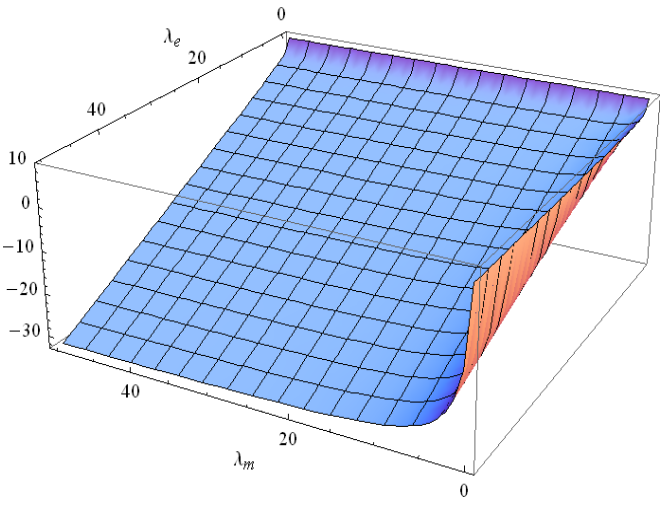

Fig.1: Network sales efficiency and direct selling price reduction under MR model

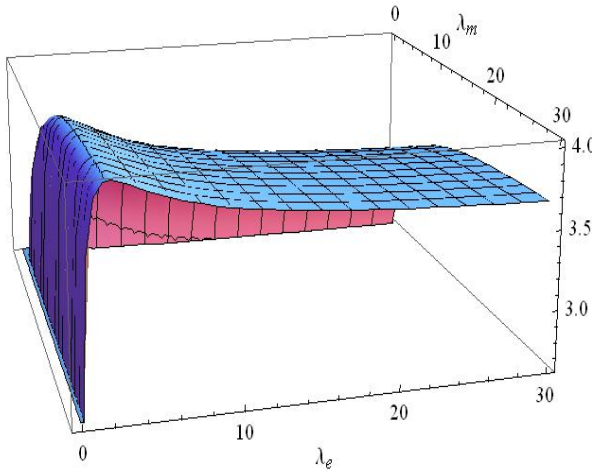

Fig.2: Network sales efficiency and e-commerce price reduction decision under MR mode

As can be seen from Figure 1, in MR mode, with the improvement of network sales efficiency, whether the two sides reduce prices depends on each other's fair concern coefficient.

The specific rules are as follows:

(1) When λ_m or λ_e is small, the manufacturer's direct selling price remains low;

(2) When λ_m is large, with the increase of λ_e, the manufacturer's direct selling price changes from reducing price to increasing price;

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(3) when λ_e is large, with the increase of λ_m the manufacturer's direct selling price changes from reducing price to increasing price.

As can be seen from figure 2, under MR fair concern mode, with the improvement of network sales efficiency, the selling price of e-commerce has been in a state of reduction. This verifies proposition 1.

5.2 MR model network sales efficiency and relative speed of price reduction

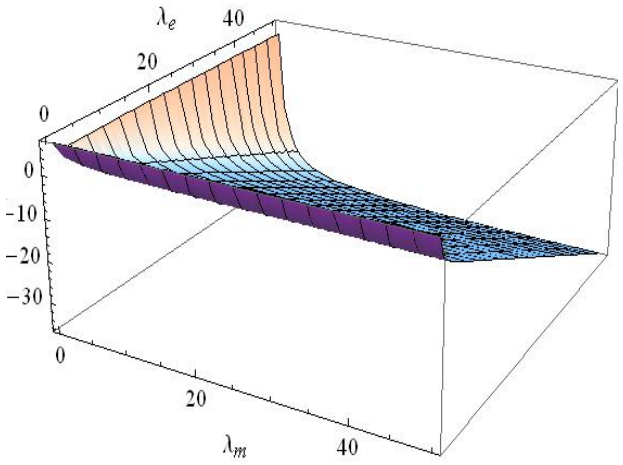

Fig.3: Network sales efficiency and price reduction under MR model

As can be seen from figure 3, under MR fair concern mode, with the improvement of network sales efficiency, the law of price reduction of both parties is as follows:

(1) Manufacturers are cutting prices faster than e-commerce prices;

(2) When λ_e is small, the difference between the two speed drops is small, and the correlation between the difference and λ_m is minimal. When λ_e is large, the difference between them increases sharply, and the difference is positively correlated with λ_e;

(3) When λ_m is small, the difference between the two speed drops is small, and the correlation between the difference and λ_e is minimal. When λ_m is large, the difference between them increases sharply and is positively correlated with λ_e;

VI. CONCLUSION

In this paper, considering the direct and the efficiency of the online sales of business fairness concerns behavior differences and members, constructing a dynamic game model of manufacturers dominated the double channel, contrast network sales productivity for equity concerns without fairness concerns, manufacturers, electricity fairness concerns, double fairness concerns four different fairness concern mode member pricing decision-making behavior, the influence of the main conclusions include:

(1) With manufacturers to promote the efficiency of network marketing, the members of the double fairness concerns (N, M, R mode), the electricity price and the manufacturer direct selling price will be lower and the manufacturers price faster than electricity, members of the double fairness concerns (MR mode), the electricity price will be lower, but the manufacturer direct selling price is the price depends on the two sides a fair degree of concern;

(2) From the perspective of direct selling price reduction speed, with the improvement of manufacturers' online sales efficiency, e-commerce fair concern reduction speed is the fastest and better than no fair concern mode. The two fair concern modes (E mode and ME mode) that manufacturers participate in are slower and slower than no fair concern mode.

(3) From the perspective of price reduction of e-commerce, with the improvement of network sales efficiency of manufacturers, two fair concerns (E mode and ME mode) involving e-commerce are better than no fair concerns, while the fair concerns of manufacturers are lower than no fair concerns.

REFERENCES

[1] Du, S.F., Du, C., Liang, L., et al. (2010) Supply chain contract and coordination considering equity concerns. Journal of Management Science, 13: 41-48.

[2] He, L.H., Li, Z.D. (2017) Analysis of dual-channel supply chain cooperative advertising decision considering retailers' equity concerns. Industrial Engineering and Management, 22: 107-114.

[3] Ho, T.H, Zhang, J. (2008) Designing Pricing Contracts for bloodedly Rational Customers: Does the Framing of the Fixed Fee Matter? Management Science, 54: 686-700.

https://dx.doi.org/10.22161/ijaers.68.18 *ISSN: 2349-6495(P) | 2456-1908(O)*

[4] Kahneman, D., Knetsch, J.L., Thaler, R. (1986) Fairness Competition on Profit Seeking Entitlements in the Market. American Economics Review, 76: 728-741.

[5] Li, B., Li, Y.N., Hou, L.T., et al (2015). Analysis of the impact of retailers with equity concerns on dual-channel supply chain decision-making. Control and decision, 30: 955-961.

[6] Li, C.H. (2009) Price game between direct selling and retail channels based on channel demand function. Journal of Zhongnan University of Economics and Law, 2: 114-120.

[7] Liu, H.J., Fan,X.J., Chen, H.M. Research on dual-channel pricing strategy under price leadership structure of retailers. China Management Science, 23: 1-8.

[8] Qiu, G.B, Xu, B. (2019) Analysis on the impact of network sales efficiency on the two-channel game of equity concern under different power models. Statistics and Decision-making, 14: 56-60.

[9] Wang, L., Cheng, K.H., Wang, S.W. (2012) Research on dual-channel supply chain pricing strategy considering equity concerns. China Management Science, 20: 563-568.

[10] Werner, G., Schmittberger, R., Schwarze, B. (1982) An experimental analysis of ultimatum bargaining. Journal of Economic Behavior & Organization, 3: 338-367.

[11] Shu, S.L., Liu, J. (2017) The impact of e-commerce efficiency on dual-channel game with different power structures under the concern of equity. Soft Science, 11: 139-144.

[12] Zhang, T.L., Fang, J.J. (2017) Research on pricing and coordination of retailer dual-channel supply chain considering distribution efficiency. Statistics and Decision Making, 8: 33-47.