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Research Article

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The profit pattern analysis of the telecom value-added service supply chain with advertising elements

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ABSTRACT

Based on the fusion of telecom value-added service and the Internet, we study the telecom value-added service chain with one telecom operator and one service provider. Advertisement which is provided by Advertisers is implanted into value-added products as profit elements, and the service provider's income makes up of two parts: information fees share and advertising revenue. First, the model is established by using game theory, then, the optimal strategies are obtained through strict theoretical proof. Finally, we get the optimal decision when telecom operator and service provider have different profit share, and discuss the change of product price, profits when Advertisement is implanted into value-added products as profit elements. The paper proposes some suggestion to improve the telecom value-added business revenue model, and provides a good idea for operations and management of the enterprise.

Key words: Telecom value-added service; Internet; stackelberg model; numerical analysis

INTRODUCTION

Telecom value-added service refers to the additional value-added services with Communication Network developed, it can make the function of the original network, value improved. There are many main kinds of value-added services, such as WAP , MMS , IVP etc [1]. With the restructuring of the telecommunications industry, three major telecom operators launched fierce competition, meanwhile, value-added services as competition farmar increasingly brought to the attention of the operator. In order to win in the fierce competition, service provider changes the method of profit model through value-added services and Internet integration [2]. Such as: telecommunications enterprises ringtone is prepared for business users of fixed phone ringtone. Companies can set the promotion advertising, product introduction and other voice into fixed phone back tone [3]. The diversity of the Internet and value-added services integration makes value-added services industry chain further extended. Profit element from the Internet and traditional media, advertising and other industries will be injected into the value-added services in the design of new products [4, 5].

About the quantitative studies of telecom value-added service, LIU Wei [6] studied value-added service supply chain profit sharing problem with mobile operater as the leading, and got the mobile operater dominant equilibrium coefficient of value-added services in the supply chain.In [7], the single leader multi-followers Stackelberg model was constructed and empirically analyzed which had single telecom operator and multi service providers. The demonstration results show that the Stackelberg model can coordinate the telecom value-added service supply chain partly. WU Jun [8]studied the telecom value-added service chain with one telecom operator and one service provider, and the model is established by using game theory. Finally, numerical examples are given to support the models. In [9], WU Jun studied the telecom value-added service chain with one telecom operator and one service provider, and summarized three kinds of business models between telecom operator and service provider. Then, they formulated the mathematical models by using game theory. Finally, numerical examples are given to support the models. However, profit model of service provider in these models is single, and income only Contains information fees share. In fact, in the modern period of rich value-added products, value-added products can be integrated with the

Internet gradually generalization, and the single profit pattern is gradually replaced in the competition. Based on this, we study the telecom value-added service chain with one mobile operator and one service provider. Advertisement which is provided by Advertisers is implanted into value-added products as profit elements, and the model is established by using game theory. Finally, numerical examples are given to support the models.

1. NOTATION

We use the following notation throughout this paper.

p_0 : Communication fee

p_1 : Information fee

$p_0 + p_1$: Price selling to the customer

c_{s0} : SP's fixed cost

c_{s1} : SP's variable cost per unit

c_{m0} : MP's fixed cost

c_{m1} : MP's variable cost per unit

α : Cooperation parameter, i.e., share of revenue per unit

Π_{SP} : SP's profit function

Π_{MP} : MP's profit function

W : Communication cost

Take an example of China telecom supply chain, MP charges the communication fee $p_0 D$ and shares the information fee $\alpha p_1 D$ with SP . While SP shares $(1-\alpha) p_1 D$ from the information fee with the agreed contract signed with MP . Communication cost W means the concomitant cost when one telecom service is introduced to mobile customer through MP 's network resource[10].

2. ASSUMPTION

To make the problem more clear and avoid unrealistic and trivial cases, we make the following assumptions.

(1) A telecom service chain in this paper consists of one MP and one SP . MP is the leader of the telecom supply chain.

(2) SP provides one single value-added service in one specified period to customer.

(3) The demand[11] follows $D = a - b(p_1 + p_0) + \theta\sqrt{g}$; a stands for capacity of the market; b stands for the market price influence coefficient; $\theta\sqrt{g}$ Stands for the increased demand for propaganda role.

(4) A part of SP 's income is advertising revenue related to the download of users, and assume that advertising revenue is a simple linear relationship with users, that is $G = KD$, K is constant.

(5)The fixed cost and variable cost of MP are c_{m0} and c_{m1} respectively, in a specified sales season. The fixed cost and variable cost of SP are c_{s0} and c_{s1} respectively in a specified sales season

4. MODEL FRAME WORK

With the above on hand, we can get the profit functions of SP , MP and SC .

$$\Pi_{SP} = (1-\alpha) p_1 D + KD - c_{s0} - c_{s1} D - W \quad (1)$$

$$\Pi_{MP} = \alpha p_1 D + p_0 D - c_{m0} - c_{m1} D + W - g \quad (2)$$

$$\Pi_{SC} = (p_1 + p_0) D + KD - c_{m0} - c_{m1} D - c_{s0} - c_{s1} D - g \quad (3)$$

With the knowledge of game theory, we know that the interrelation between SP and MP can be modelled by using Stackelberg game. Based on the assumption given in Section 3, we know that MP is the leader and SP is the follower in such a telecom supply chain. So, the decision process is given as follows. First, SP makes its own decision based on an assumption that MP 's decision variable is given. After seeing the SP 's decision has been made, MP will make its own optimal decision. The profit function of the telecom supply chain is the summation of SP and MP 's profits, which is a function of the allocation rate. Finally, a cooperation mechanism based on allocation rate is given for the telecom supply chain.

From the first order derivative $\frac{\partial \Pi_{SP}}{\partial p_1} = 0$, we have

$$p_1 = \frac{a+\theta\sqrt{g}}{2b} + \frac{c_{s1}}{2(1-\alpha)} - \frac{p_0}{2} - \frac{K}{2(1-\alpha)} \quad (4)$$

Then, Taking Eq. (4) into Eq. (2), we get Π_{MP} .from the first order derivative $\frac{\partial \Pi_{MP}}{\partial p_0} = 0$ and $\frac{\partial \Pi_{MP}}{\partial g} = 0$,

we have

$$g^* = [\frac{\theta a - \theta b(c_{m1} + c_{s1} - K)}{4b(2-\alpha) - \theta^2}]^2 \quad (5)$$

$$p_0^* = \frac{4a(1-\alpha)}{4b(2-\alpha)-\theta^2} - \frac{4b-\theta^2\alpha}{(1-\alpha)(4b(2-\alpha)-\theta^2)}(c_{s1}-K) + \frac{4b-\theta^2}{4b(2-\alpha)-\theta^2}c_{m1} \quad (6)$$

Taking Eq. (5) and Eq. (6) into Eq. (4), we get

$$p_1^* = \frac{2a}{4b(2-\alpha)-\theta^2} + \frac{2b(3-\alpha)-\theta^2}{(1-\alpha)(4b(2-\alpha)-\theta^2)}(c_{s1}-K) - \frac{2b}{4b(2-\alpha)-\theta^2}c_{m1} \quad (7)$$

With Eq. (5-7), the profit functions of MP, SP, and SC can be rewritten respectively.
In the next section, we study the impact of allocation rate α on the profits of MP, SP, and telecom supply chain, and conduct an example with data from a MP and a SP in China telecom industry.

5. NUMERICAL EXAMPLE

5.1 Different Profit Allocation Model between MP and SP

After some reasonable data processing and standardization, we use the system parameters given in the following:
SP's fixed cost : $c_{s0} = 10000$; SP's variable cost per unit: $c_{s1} = 1.1$;
MP's fixed cost: $c_{m0} = 24000$; MP's variable cost per unit: $c_{m1} = 0.01$;
Communication cost from SP to MP : $W = 1000$;
The demand follows $D = 250000 - 5000(p_1 + p_0) + 31\sqrt{g}$.

Table 1: Numerical Results for An Example

	$\alpha=0.0$	$\alpha=0.1$	$\alpha=0.2$	$\alpha=0.3$	$\alpha=0.4$	$\alpha=0.5$	$\alpha=0.6$	$\alpha=0.7$	$\alpha=0.8$	$\alpha=0.9$
$p_0^*+p_1^*$	38.45	37.82	37.13	36.35	35.47	34.47	33.32	31.99	30.43	28.57
D	63898	67348	71192	75502	80367	85902	92256	99625	108273	118566
Π_{SP}	805582	805434	799930	787071	764056	726911	669888	584503	457921	270156
Π_{MP} ($\times10^6$)	1.571	1.657	1.753	1.861	1.982	2.119	2.278	2.462	2.678	2.935
Π_{SC} ($\times10^6$)	2.377	2.462	2.552	2.647	2.746	2.847	2.948	3.047	3.136	3.205

Numerical results are obtained by taking the above system parameters into the model in Section 4, which is given in Table 1. It demonstrates the impact of allocation rate α on the MP, SP, and telecom supply chain's profit functions, respectively. We take values of allocation rate α from 0.0 to 0.9 with an increment of 0.1. From Table 1, all of the profits of MP, SP and supply chain are clearly presented. The profits of MP and SC gradually increase, however, the profit of SP gradually reduce, and the falling speed is faster and faster. The experiments in Table 1 propose a basis for the profit allocation. Clearly, MP and SP can select a more proper allocation rate for their cooperation.

5.2 Compared with the Literature

Profit model of service provider in[8] is single, and income only Contains information fees share,however, in this paper advertisement which is provided by advertisers is implanted into value-added products as profit elements, and the service provider's income makes up of two parts: information fees share and advertising revenue.

In the next section, we compare the two models under the product price and profit of supply chain each node through the simulation，as shown in figure 1-4，where The red line represents the numerical results in this paper, the green line represents the numerical results of the literature [8].

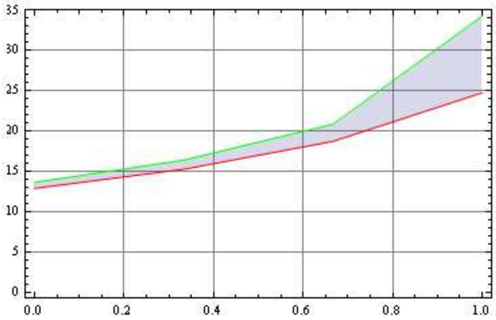

Figure 1: $p_1^* \quad VS \quad \alpha$

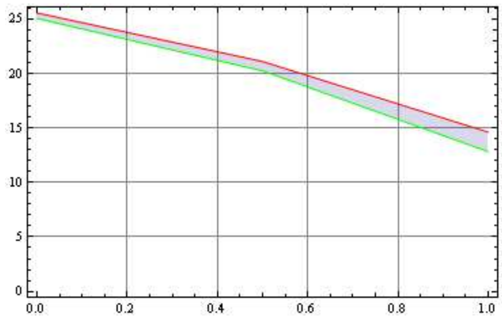

Figure 2: $p_0^* \quad VS \quad \alpha$

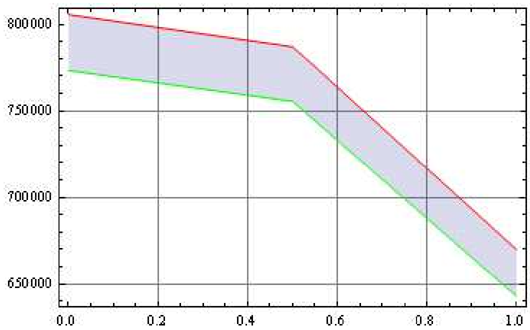

Figure 3: $\prod_{SP} \quad VS \quad \alpha$

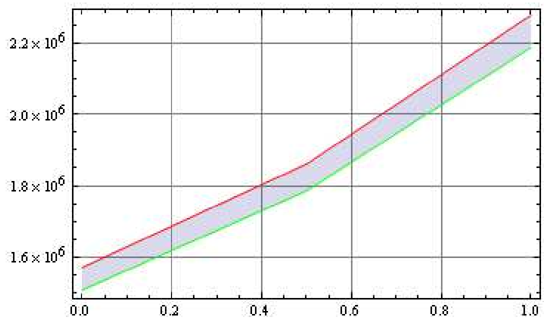

Figure 4: $\prod_{MP} \quad VS \quad \alpha$

Figures 1-4 show: (1) compared with the literature [8], information fee p_1 in this paper is lower, and communication fee p_0 in this paper have improved. Appearing this situation is reasonable, the reason is that service provider's income Contains advertising revenue. SP Will decrease information fee to attract more users, while MP will take the opportunity to improve communication fee to maximize their own profits. (2) In the literature [8] and this paper model, MP 's profits are far outweigh SP 's profits among all kinds of cooperation mode. That is MP Squeezes profits in the supply chain as much as possible, which fully shows the nature of the capital market that is pursuing profit maximization. (3) Compared with the literature [8], all of the profits of MP , SP and supply chain are improved obviously In this paper. So, under the trend of telcom and the Internet integrated, SP Can increase their income by implanting advertisement into value-added products. Simulation results provide the theoretical basis, and has the certain reference value.

CONCLUSION

In this paper, we have studied the telecom value-added service chain with one telecom operator and one service provider. We have formulated the model by using game theory and derived the profit functions of SP , MP , and the telecom supply chain. Finally, we have presented a numerical example based on some real data derived from one SP and one MP in China telecom industry. Simulation results provide the theoretical basis, and has the certain reference value.

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