ELSEVIER
CrossMark
Available online at www.sciencedirect.com
ScienceDirect
Procedia Computer Science 60 (2015) 1377 – 1385
Procedia Computer Science

19th International Conference on Knowledge Based and Intelligent Information and Engineering Systems

Pricing Strategies in Dual-online Channels Based on Consumers' Shopping Choice

Jieyu Lei, Junxiu Jia*, Tao Wu

Xidian University, Xi'an, Shaanxi, 710071, China

Abstract

Besides an official website mall (OWM), retail stores on the third party e-commerce platform(3PEP) is an another important online channel that manufacturers adopt to sell online. How to properly price products in these two channels simultaneously is a tough problem to firms and gains much attention by researchers. In this paper, we analyze their channel choice, and give demand functions of the two channels based on the consumers' segmentation and preference. Then we design a sale model including two online channels: OWM and a retail store on 3PEP. According the Stackelberg game theory, we calculate and discuss the optimal pricing strategies of the manufacturer and retailer in three feasible regions. The result shows that manufacturers emphasizing channel sales prefer to choose pricing strategies that helps two online channels share the online market. But some manufacturers think adjusting the OWM's price and the wholesale price to control the retailer's pricing strategies is reasonable and necessary, even if nobody will prefer the OWM.

Peer-review under responsibility of KES International

Keywords: dual-online channels, pricing strategies, Stackelberg game, consumers' segmentation and preference

1. Introduction

An official website provides a good chance for manufacturers to satisfy their consumers. With the development of the internet, many companies start to exhibit products by colorful pictures and detailed descriptions on their official website, some of them even try to sell products through this new channel. Actually, the official website Mall(OWM) is not the only way selling online. Before the birth of OWM, some retailers have brought kinds of products to the third party e-commerce platform (3PEP), such as e-Bay, Taobao, etc.

* Corresponding author. Tel.: +86-29-88201949; fax: +86-29-81891360.
E-mail address: jiajunxiu@mail.xidian.edu.cn

Peer-review under responsibility of KES International
doi:10.1016/j.procs.2015.08.212

3PEP is often the first stop that people learn to shop online, on which they know how to search for aimed goods, make a purchase, and evaluate a purchased good. With the accumulation of shopping experience online, people become more and more experienced and sensitive about price. So when discovering an OWM, they prefer to compare it with the 3PEP, and choose a cheapest sale channel to purchase. To avoid being eliminated by consumers and the channel price conflict, OWM's managers and 3PEP's retailers usually have to make price strategies reasonably.

In this paper, we consider two online-selling channels with a direct channel named by OWM and a retail channel located on 3PEP. Then we study three kinds of price strategies that OWM's managers and 3PEP's retailers might adopt, and analyze how consumers with different experience make their final decision under the three strategies. Finally, we aim to characterize what types of pricing strategies are optimal for OWM's managers and 3PEP's retailers in their market competition.

The rest of this paper is structured as follows. Section 2 provides a brief review of the related pricing literature. Section 3 shows the basic model and donations of dual online channels. Section 4 describes the competitions and pricing strategies between these two online channels. Finally, Section 5 draws the conclusion and discussion.

2. Literature review

Multi-channel operation tends to make companies to face dilemmas, for it not only helps them to expand the market share and brand influence, but also bring channel conflicts and confused management. Economists have given lots of study on multi-channels pricing and production strategies. Channel optimization in multiple-channel systems is a basic problem in marketing (Corstjens and Doyle 1979, Jørgensen and Kort 2002)[1,2] Xu (2009)[3] explores the optimal pricing and product quality decisions in a distribution channel. Rodríguez and Aydın (2015)[4] characterizes the pricing decisions in a dual-channel structure. With the development of the electronic commerce, some researchers gradually pay attention to the online channel. Brynjolfsson and Smith (2000)[5] compare pricing behavior at 41 Internet and conventional retail outlets, and conclude that there is lower friction in many dimensions of Internet competition. Chiang et al. (2003)[6] point out that the online direct channel can increase the manufacturer's negotiated share of cooperative profits. Overby and Forman (2015)[7] study how the diffusion of an e-channel affected the geographic trading patterns and price dispersion of the wholesale. When a manufacturer try to expand her market through two online channels, she meets the same questions in these traditonal researches. One of key questions is to price simutaneously in two online channels.

Up to now, there are two wide-applied methods for pricing: one is cost-based pricing, the other is value-based pricing, and the latter is usually much better for companies (Nagle et al. 2008)[8]. Consumers' behavior is another critical factor that managers consider in pricing decision. Strategic consumers wish to maximize individual utility. At each time point, they may purchase the product at current price, remain at a cost to purchase later, or exit[9]. Understanding the difference and similarity among consumers in diverse regions is significant for businesses to sustain in the competitive market (Lim and Cham 2015)[10]. Effective retail management strategies are often linked to the creation of consumer experience (Rose et al. 2012)[11]. We can get that manufacturers' pricing strategies are closely dependent on consumers' behaviors. In this paper, we try to find the optimal pricing strategies for manufacturers setting two online channels based on consumers' behavior.

Economists have realized the difference and relationship between online and traditional channels, and mainly discuss some hybrid channel design problems when a company introduces the online direct channel, such as consumers' behaviors, managers' strategies, and channels' competition (Moon et al. 2010, Vinhas and Heide 2015)[12,13]. But most of them usually overlook the conflicts of online channels. Actually, before a company set a direct channel on the internet, a lot of retailers have sold their products on the 3PEP. Besides the OWM, these retail stores are also important sale channels for companies. This paper extends the literature related to the manufacturers' dual-online-channel problems by addressing following questions. How do consumers with different online shopping experience make their purchase decisions? How do these two online channels affect each other through pricing strategies? We try to find the optimal pricing strategies for OWM's managers and 3PEP's retailers.

3. Dual-online demand model based on consumers' segmentation and preference

The product is sold at price P_d in the OWM and at price P_r on the 3PEP, as shown in Fig.1. So when a consumer buys the product in OWM, his economic utility can be denoted as $U_d=V-P_d-f$ versus $U_r=V-P_r-f$ on the 3PEP, where V and f are the valuation (alternatively called "willingness to pay") and the express delivery fee of the product respectively. We assume that the express fee is identical in these two channels.

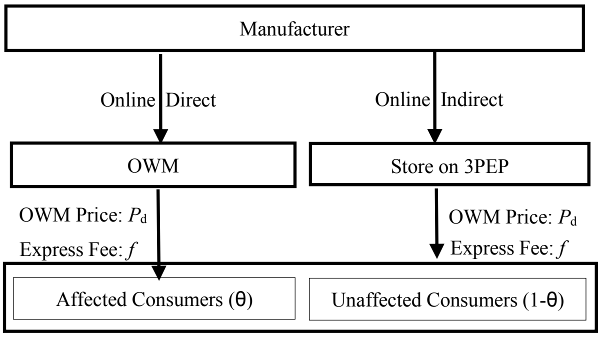


Fig. 1. Dual-online-channel structure.

In fact, almost every online consumer is familiar to the famous 3PEP, such as Taobao. But not all of them realize the existence of the OWM. Traditional researches (e.g., Chiang et al. 2003, Yoo and Lee 2011)[6,14] often pay attention to the difference between the offline retail channel and the online direct channel, but overlook that channels' promotion and influence can affect consumers' decision process. They suppose all of consumers know all the channels in their models. But in this paper, we divide online consumers into affected consumers and unaffected consumers. The former means those consumers who know both of online channels and whose purchase decisions are affected by OWM. The latter means those consumers who are never affected by OWM. So they just know the 3PEP. Denote the ratio of affected consumers by θ ($0\leq\theta\leq1$).

Table 1. Month sales of handbags in the Mbaobao official website and a retail store.

Product ID	The official website		A retail store on the Taobao	
	Price	Month Sales	Price	Month Sales
No.1508006401	159	705	159	11
No.14080056	139	2238	139	46
No.15120173	169	326	169	81
No.1510009702	159	339	159	0
No.1408005702	69	3292	68	28
No.1512017001	189	286	149	7
No.1411006704	159	841	149	90
No.1408005302	158	5701	131	50
No.1309002901	358	17661	298	1
No.1507025302	169	2141	138	27
No.15070256	269	2588	239	14

We assume the online demand D of the product is constant in a period. Unaffected consumers choose the retail store to purchase by judging $U_r \geq 0$. Affected consumers choose either the retail store or the OWM by comparing U_d and U_r.

Previous dual channels researchers (e.g., Kacen et al. 2013, Wang and Wang 2014)[15,16] think that consumers prefer offline retail stores more than online direct channels because the former is more familiar and convenient. But in dual-online channel structure, affected consumers are familiar to both of online channels. Meanwhile, there is no much difference in payment and delivery between these two channels. In practice, when the OWM's pricing is acceptable, affected consumers prefer the direct channel rather than an online retail store. A list of recent sale datashown in Table 1 can illustrate the opinion by handbag sales in the Mbaobao official website and a retail store on the Taobao. It is shown that the official website has higher sales than the retail store even when the former's price is higher than the latter's.

As to Wang and Wang (2014)[16], we assume the preference of consumers to the OWM as δ . It represents the proportion of affected consumers who prefer to afford the product in the OWM. For P_d - $P_r < a$, all of the affected consumers prefer to the OWM. For P_d - $P_r > b$, nobody will be glad to choose the OWM. For $a \leq P_d$ -$P_r \leq b$, affected consumers make a choice between these two channels. a and b represent the consumers' minimum and maximum acceptance of price differential ($0 \leq a \leq b$) respectively. The function of consumers' preference can be written as

$$\delta = \begin{cases} 1 , & P_d - P_r < a, \\ \dfrac{b - (P_d - P_r)}{b - a}, & a \leq P_d - P_r < b, \\ 0 , & P_d - P_r \geq b. \end{cases} \tag{1}$$

Based on consumers' segmentation and preference, we have

$$Q_d = D \cdot \theta \cdot \delta , \tag{2}$$

$$Q_r = D \cdot (1 - \theta \cdot \delta) , \tag{3}$$

where Q_d is the demand for the OWM, and Q_r is the demand for the retail store on the 3PEP. Fig.2 illustrates the demand functions. When $P_r > V - f$, nobody will purchase the product in the retail store because their utility U_r is negative. The same goes for P_d and the OWM's sale. So we only consider the case of max (P_d , P_r) $\leq V - f$.

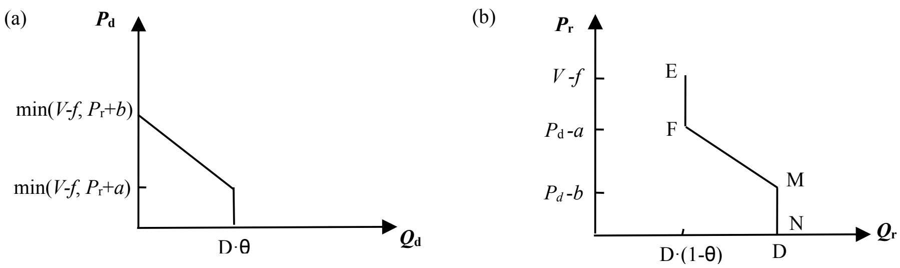


Fig. 2 (a) Demand of the OWM; (b) Demand of the retail store.

4. Pricing strategies of dual online channels based on demand competition

In this section, we analyze two online channels' pricing strategies based on the Stackelberg game theory, and then observe the optimal price and firms' profit by the parameters sensitivity analysis.

In the first stage, the manufacturer, as a Stackelberg leader, sets the wholesale price W and the OWM's price P_d. In the second stage, the retailer determines the retail price P_r to maximize his profit. $W \le P_d$, since the wholesale price W should not exceed P_d in case the retailer buys the product in the OWM.

According to Eq.(2) and Eq.(3), we have

$$\pi_r = (P_r - W)\cdot Q_r , \tag{4}$$

$$\pi_m = (P_d - C)\cdot Q_d - (W - C)\cdot Q_r , \tag{5}$$

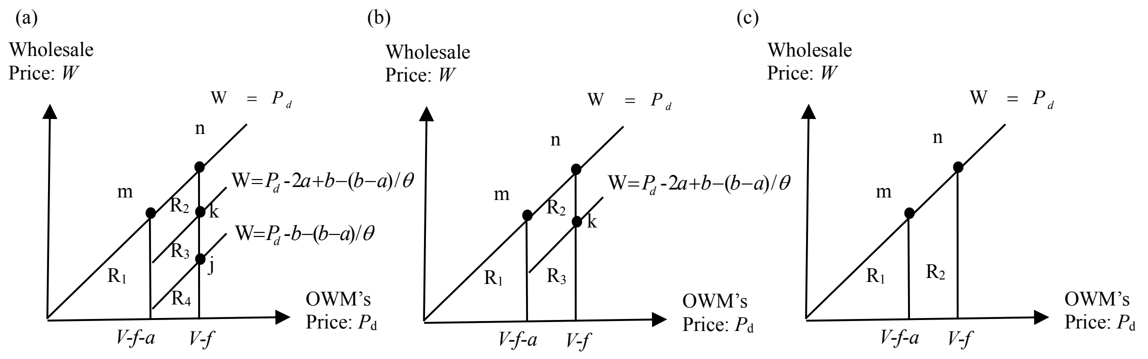
where π_r and π_m are the profit of the retailer and the manufacturer respectively. C is the marginal cost incurred by the manufacturer for the product. The manufacturer sells the product to retailer at W, and to consumers at P_d. Considering the sub-game perfection, we adopt the reverse analysis method to discuss these two channels' pricing decisions.

4.1. Retailer's pricing strategies

The retailer controls the variable P_r to maximize his profit. According to Eq.(3) and Fig.2(b)， we obtain the optimal price as follow by maximizing the retailer's profit.

$$P_r^* = \begin{cases} V - f, & (P_d, W) \in R_1 \cup R_2, \\ \dfrac{P_d + W + (b-a)/\theta - b}{2}, & (P_d, W) \in R_3, \\ P_d - b, & (P_d, W) \in R_4, \end{cases} \tag{6}$$

where R_1-R_4 (shown as Fig.3.) are feasible regions for the OWM's price and wholesale price when the retail price on different branches in Fig.2(b).



Region R_1-R_2.: Retail price located on EF in Fig. 2(b)
Region R_3: Retail price located on FM in Fig. 2(b)
Region R_4: Retail price located on MN in Fig2(b)

(a): Figure of R_1- R_4 for $b+(b-a)/\theta \le V-f$
(b): Figure of R_1- R_4 for $b+(b-a)/\theta > V-f$ and $3a-b+(b-a)/\theta \le V-f$
(c): R_1- R_4 for $3a-b+(b-a)/\theta > V-f$

Fig. 3. Feasible regions for the OWM's price and wholesale price.

The manufacturer can acquire the valuation of the product V, the ratio of affected consumers θ and the minimum and maximum price differential acceptance: a and b through investigations or other methods. Then she can set P_d less than V-f-a, and control the wholesale price less than P_d. Namely, she sets her pricing strategies in R_1. Likewise, she can also set her pricing strategies in R_2-R_4.

Different strategies regions make the retailer change his pricing decision. When the manufacturer set her pricing decision in R_1 and R_2, the retailer wants to maximize his profit by adjusting P_r, so his optimal pricing decision is $P_r^* = V - f$, which is independent on W and P_d. In this case, all affected consumers prefer to buy the product in the OWM. And the unaffected consumers would buy the product when the retail price $P_r \leq V - f$.

When the manufacturer chooses her price strategies in R_4, nobody will be glad to buy the product in the OWM because the price P_d is too much higher than P_r. So the retailer can set the price at $P_d - b$ to attract all of online consumers and maximize her profit. At that time, the optimal price P_r^* is related to P_d, and independent on the wholesale price.

Finally, when the manufacturer makes price decisions in R_3, the optimal price of the retail depends on the wholesale price and the OWM's price. Thus, we need to analyze the manufacturer's strategies further.

4.2. Manufacturer's pricing strategies

Anticipating the retailer's choices, the manufacturer will maximize her total profits by choosing the wholesale price W and the OWM's price P_d subject to $W \leq P_d$. Meanwhile, W cannot be higher than P_r because the retailer will not buy the product with a negative profit. There are three feasible figures of R_1, R_2 R_3 and R_4, which are shown as Fig.3(a), (b) and (c).

In R_1 and R_2 of Fig.3(a), the retailer sets his price as V-f (see Eq.(6)). The OWM's price, relative to P_r, is so low that all the affected consumers prefer to buy the product in the OWM.

Theorem 1. The manufacturer's optimal prices in R_1 are located at point "m" in Fig.3(a), where the optimal wholesale price and the OWM's price are equal. That is, $P_d^*=W^*= V- f- a$. In R_2, the manufacturer's optimal prices are located at point "n" in Fig.3(a), where the wholesale price and the OWM's price are equal. That is, $P_d^*=W^*= V- f$. Moreover, the price strategies at point "n" are better than them at point "m".

The proof of Theorem 1 is given in Appendix A. The manufacturer knows the retailer's optimal price when she makes the price decision in R_1. So she wishes to find the optimal price combination of W and P_d in R_1 to maximize her profit. In fact, "m" is the optimal price combination point in R_1 which has been proved in Appendix A. Similarly, "n" is the optimal price combination point in R_2. So when the manufacturer wants to attract all of the affected consumers to buy the product in the OWM, she will compare the profit of these two point: "m" and "n", and then choose her optimal decision: P_d^* and W^*. It is proved that price strategies at point "n" could gain more profit for the manufacturer.

In region R_3 of Fig.3(a), the manufacturer adjusts her OWM's price P_d and wholesale price W, where the retailer's optimal price $P_r^*=[P_d+W+(b-a)/\theta-b]/2$ (see Eq.(6)). In fact, the adjustment causes the OWM to lose some affected consumers who prefer the retail store due to his lower price. So in R_3, the manufacturer wants to find the combined optimal wholesale pricing W^* and OWM's pricing P_d^* to maximize her profit. Substituting P_r^* into manufacturers' profit Eq.(5), we find the optimal pricing strategies.

Theorem 2. In region R_3, The manufacturer's optimal prices are located at point "k" in Fig.3(a), where the optimal wholesale price is $W^*= V- f- 2a+b-(b-a)/\theta$, and the optimal OWM's price is $P_d^* =V-f$.

The proof of theorem 2 is given in Appendix B.

In R_4, P_d, relative to P_r, is raised so high that no one would like to purchase the product in the OWM. The retailer sets the optimal price at $P_r^* = P_d - b$. For $P_d \leq V - f$, P_r is also lower than $V - f$. All of the online consumers will buy the product in the retail store.

Theorem 3. When the manufacturer makes her price decision in R_4, her optimal decisions are located at the point "j", where the OWM's price is V-f, and the wholesale price is V-f-b-$(b$-$a)/\theta$. So the optimal retail price is $P_r^* = V$-f-b.

The proof of Theorem 3 is given in Appendix C. When the manufacturer makes her price decision in R_4, she prefers to sell the product only in the retail channel. Under this condition, all of online consumers buy the product in the retail store when $P_r \leq V - f$. The profit structure of the manufacturer becomes very simple. Although the OWM's demand is zero, P_d still influences the optimal pricing decision.

Table 2. Optimal pricing decision of the manufacturer and the retailer in R_1-R_4.

Regions	The optimal decision point in Fig.1(a)	The optimal OWM's price: P_d*	The optimal wholesale price: W*	The optimal retail price: P_r*
R_1	"m"	V-f-a	V-f-a	V-f
R_2	"n"	V-f	V-f	V-f
R_3	"k"	V-f	V- f- $2a$+b-$(b$-$a)/\theta$	V-f-a
R_4	"j"	V-f	V-f-b-$(b$-$a)/\theta$	V-f-b

The optimal pricing decisions in different feasible regions in Fig.3(a) are listed in table 2. The related results in Fig.3(b) and Fig.3(c) can be analyzed using the same method. In fact, some manufacturers are not willing to use the OWM without any sale. So the pricing strategies in Theorem 3 are usually abandoned by these managers because no consumer comes in. But other manufacturers think the pricing decision in R_4 is reasonable, because they control the optimal pricing right. Retailers have to set their optimal price based on the OWM's price.

5. Concluding remarks

Selling a product by two online channels, the manufacturer has to make a sufficient analysis of channels' difference and consumers' behaviors. In this paper, we find that consumers affected by the OWM often compare it with the retail store before making a decision. When buying a well-known brand of products, some consumers will have a strong preference for the OWM, although sometimes, the price in the OWM is higher than that in the retail store. Different pricing decisions lead consumers to make variable shopping choices. In this paper, we discuss consumers how to make a final decision in three feasible pricing regions, and give the optimal pricing strategies for a manufacturer and a retailer in these regions based on the Stackelberg game theory. When the manufacturer make her pricing decisions in R_1 and R_2, all of affected consumers prefer the OWM channel. At the moment, the retailer sets his price as V-f, and the manufacturer has her optimal pricing decisions at point "n" in Fig.3(a). When the manufacturer adjust her pricing decisions in R_3, some affected consumers will prefer the retail store due to his lower price. In this case, the manufacturer has her optimal pricing decisions at point "k" in Fig.3(a). When the manufacturer continues to change her decision in R_4, no one will be glad to buy the product in the OWM. Under this sale strategy, the optimal pricing decision of the manufacturer is at point "j" in Fig.3(a).

Future work upon this topic should include the comparison of different pricing decisions. We might illustrate the algorithm further using a lot of examples and compare the profit of the manufacturer and retailer. Moreover, the operation data online about prices and sales can be used to examine the pricing methods above.

Acknowledgments

This work is supported in part by the National Natural Science Foundation of China under Grant 71101113 and 71272093, the Natural Science Basic Research Plan in Shaanxi Province of China under Grant 2014JQ9375 and China Postdoctoral Science Foundation Funded Project under Grant 2012M511980.

Appendix A. Proof of the optimal wholesale price and OWM's price in region R_1 and R_2

In R_1 and R_2, demands of the OWM and the retail store are $D\cdot\theta$ and $D\cdot(1\text{-}\theta)$ respectively. The manufacturer's profit is

$$\begin{aligned}\pi_m &= (P_d - C)\cdot D\cdot\theta + (W - C)\cdot D\cdot(1-\theta) \\ &= D\theta\cdot P_d + D(1-\theta)\cdot W - DC.\end{aligned} \tag{7}$$

The profit function is a linear function of P_d and W. Based on the linear programming theory, the optimal pricing strategy in R_1 is at point "m" in Fig.4., where $P_d^* = W^* = V\text{-}f\text{-}a$.

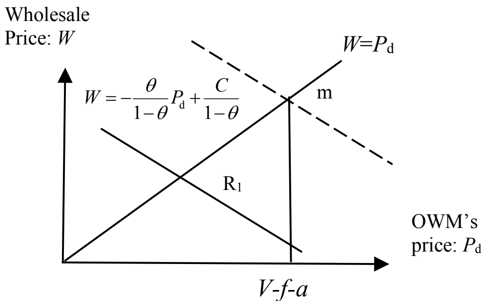


Fig. 4. The Optimal wholesale price and OWM's price in Region R1

In the same way, we can get "n" is the optimal point in R_2. The values of P_d and W at "n" are higher than them at "m". Meanwhile, the manufacturer has the same profit function when her pricing decisions are in R_1 and R_2. It is easy to prove that price strategies at point "n" could gain more profit for the manufacturer.

Appendix B. Proof of the optimal wholesale price and OWM's price in region R_3

In R_3, $P_r^* = [P_d + W + (b-a)/\theta - b]/2$. Substituting P_r^* into the manufacturers' profit function Eq.(5), we can get the profit function of the manufacturer as follow.

$$\pi_m = (P_d - C)\cdot D\cdot\theta\cdot\frac{b-(P_d-P_r^*)}{b-a} + (W-C)\cdot D\cdot[1-\theta\cdot\frac{b-(P_d-P_r^*)}{b-a}] \tag{8}$$

Since $P_r^* \leq V\text{-}f$, we have

$$W \leq -P_d + 2(V-f) - b - (b-a)/\theta \tag{9}$$

All of points in R_3 match the condition above. Then we assume $W = P_d - r$, where r is an arbitrary constant. Substitute the relation into Eq. (8), we can get

$$\pi_m = (W-C)\cdot D + r\cdot\theta\cdot D\cdot\frac{b+[(b-a)/\theta-b-r]/2}{b-a}. \quad (10)$$

The manufacturer's profit increases with the wholesale price W. So in R_2, when r changes, all of the optimal pricing points are located on line segment "jk" in Fig.3 (a), that means $P_d^*=V-f$. Substituting P_d^* into Eq. (8), we can get

$$\frac{\partial\pi_m}{\partial W} = \frac{D}{b-a}[-W+V-f+(b-a)/(2\theta)-b/2]. \quad (11)$$

And $\frac{\partial^2\pi_m}{\partial W^2} = -\frac{D}{b-a} < 0$, so $W^*=V-f+(b-a)/(2\theta)-b/2$. It can be proved that $W^*=V-f+(b-a)/(2\theta)-b/2$ is beyond the line segment "jk" based $b\geq a$. On the line segment "jk", "k" is the closest point near to the optimal point. So the real optimal price in R_3 should be "k".

Appendix C. Proof of the optimal wholesale price and OWM's price in region R_4

In R_4, the manufacturer's profit is $\pi_m = (W-C)\cdot D$, which increases with the wholesale price. In region R_4, the retailer set his price as P_d-b. Since $P_r\geq W$, so the optimal wholesale price is $W\leq P_d-b$. It is easy to prove that all of points in R_4 meet the condition above. So the optimal wholesale price is $W^*=V-f-b-(b-a)/\theta$ when $P_d^*=V-f$, the optimal pricing decisions are located at point "j".

References

1. Corstjens M., Doyle P. Channel optimization in complex marketing systems. Management Science 1979; 25(10): 1014-1025.
2. Jørgensen S., Kort P. M. Optimal pricing and inventory policies: Centralized and decentralized decision making. European Journal of Operational Research 2002; 138(3): 578-600.
3. Xu X. Optimal price and product quality decisions in a distribution channel. Management Science 2009; 55(8): 1347-1352.
4. Rodríguez B., Aydın G. Pricing and assortment decisions for a manufacturer selling through dual channels. European Journal of Operational Research 2015; 242(3): 901-909.
5. Brynjolfsson E., Smith M. D. Frictionless commerce? A comparison of Internet and conventional retailers. Management Science 2000; 46(4): 563-585.
6. Chiang W. K., Chhajed D., Hess J. D. Direct marketing, indirect profits: A strategic analysis of dual-channel supply-chain design. Management Science 2003; 49(1): 1-20.
7. Overby E., Forman C. The effect of electronic commerce on geographic purchasing patterns and price dispersion. Management Science 2014; 61(2), 431-453.
8. Nagle T. T., Hogen J. H. The strategy and tactics of pricing: a guide to growing more profitably. Beijing: Huaxai Publishing House; 2008. P. 1-70.
9. Su X. Intertemporal pricing with strategic customer behavior. Management Science 2007; 53(5): 726-741.
10. Lim Y. M., Cham T. H. A profile of the Internet shoppers: Evidence from nine countries. Telematics and Informatics 2015; 32(2): 344-354.
11. Rose S., Clark M., Samouel P., et al. Online customer experience in e-retailing: an empirical model of antecedents and outcomes. Journal of Retailing 2012; 88(2): 308-322.
12. Moon Y., Yao T., Friesz T. L. Dynamic pricing and inventory policies: A strategic analysis of dual channel supply chain design. Service Science 2010; 2(3): 196-215.
13. Sa V. A., B H. J. Forms of competition and outcomes in dual distribution channels: the distributor's perspective. Marketing Science 2014; 34(1), 160-175.
14. Yoo W S, Lee E. Internet channel entry: a strategic analysis of mixed channel structures. Marketing Science, 2011; 30(1): 29-41.
15. Kacen J., Hess J., Chiang W. K. Bricks or clicks? Consumer attitudes toward traditional stores and online stores. Global Economics and Management Review 2013; 18(1):12-21.
16. Wang W., Wang H. Pricing decision in dual channel supply chain with channel preference. Journal of WUT (Information & Management engineering) 2014; 36(4): 533-536.