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Uniform Pricing Strategy vs. Price Differentiation Strategy in the Presence of Cost Saving and Demand Increasing*

CAI Qiang · LUO Chunlin · TIAN Xin · WANG Shouyang

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Abstract Price differentiation or discrimination strategy has been regarded as the best choice for firms with online and offline channels, however, recent years often witnessed the practices of the uniform pricing strategy. This paper aims to address the question whether the uniform pricing strategy may be better for the manufacturer, when the uniform pricing strategy has a positive impact on increasing the customer demand and reducing the operations cost. The research shows that the uniform pricing strategy can be better than the price differentiation strategy when the cost saving and demand increasing are large enough or the consumers' acceptance of online channel lies in a certain interval. Moreover, the manufacturers or brand owners need a tradeoff between the benefit from online channel and the negative impact from the offline channel when they implement the price differentiation strategy. Finally, the authors obtain some managerial insights and implications based on the numerical analyses, which are in line with the phenomena in practice.

Keywords Cost saving, demand increasing, dual-channel, price differentiation strategy, uniform pricing strategy.

CAI Qiang
School of Economics and Management, University of Chinese Academy of Sciences, Beijing 100190, *China; Key Laboratory of Big Data Mining and Knowledge Management, Chinese Academy Sciences, Beijing* 100190, *China.*
LUO Chunlin
School of Economics and Management, University of Chinese Academy of Sciences, Beijing 100190, *China; School of Information Technology, Jiangxi University of Finance and Economics, Nanchang* 330013, *China.*
TIAN Xin (Corresponding author)
School of Economics and Management, University of Chinese Academy of Sciences, Beijing 100190, *China; Key Laboratory of Big Data Mining and Knowledge Management, Chinese Academy Sciences, Beijing* 100190, *China.* Email: tianx@ucas.ac.cn.
WANG Shouyang
School of Economics and Management, University of Chinese Academy of Sciences, Beijing 100190, *China; Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing* 100190, *China.*
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1 Introduction

Price differentiation or discrimination strategy has been widely regarded as the best choice for manufacturers when they distribute products through both online and offline channels. Such practice was proved reasonable and effective by many academic studies (e.g., [1, 2]). Dolan and Moon[1] studied the pricing decision for the multi-channel retailers and found that it is optimal to implement a different pricing mechanism on different channels. Hughes[2] considered the reduction of information asymmetry and the buyers' searching costs to explain why there were lower prices on average for products sold through the electronic channels compared with the traditional retail stores. Obviously, it seems reasonable for distributors taking advantage of price differentiation strategy to satisfy different types of customers.

However, in recent years, some famous manufacturers or brand owners have chosen the uniform pricing strategy, that is, the same selling price is set on both the online and offline channels. For instance, the Japanese apparel manufacturer UNIQLO and the Spanish apparel manufacturer ZARA have launched the uniform pricing strategy to sell their products on their websites and the retail stores. In China, the famous retailing enterprise SUNING also implemented the uniform pricing strategy. Although these manufacturers or brand owners only implement the uniform pricing strategy for some product categories, such attempts have already achieved great success in attracting customers to expand a larger market share. What's more, the operation capability of the manufacturer can also be improved. For example, the inventory turnover ratio of SUNING has significantly improved since the uniform pricing strategy was implemented in 2013. When the manufacturer and the retailer collaboratively determine to implement the uniform pricing strategy, the customers are allowed to buy online and pick up in store which will save the operations cost and increase the demand. But the uniform pricing strategy requires that the two channels have the same prices, which limits the choice of prices on different channels. Therefore, an interesting research question naturally arises: Whether the uniform pricing strategy or the price differentiation strategy may be better for the manufacturers with dual channels?

To address such questions, we first review the extant research on the pricing strategies in operations management with online and online channel in Section 2. In Section 3, we develop the demand functions and research setting. Uniform pricing strategy and price differentiation strategy are analyzed in Section 4. We conduct analytical and numerical analyses to compare the two strategies in Section 5. Section 6 presents some suggestions for the manufacturer and points out several future directions.

2 Literature Review

Our work is closely related to the operations management with multi-channels. Dual-channel management is testified to improve the total profit of the manufacturer in a number of supply chain literatures. Chiang, et al.[3] studied the impact of customer acceptance of a direct channel on the supply chain design, and found that direct marketing can improve the manufacturer's bargaining power and increase the overall profitability. Subsequently Chiang and Monahan[4] showed that the inventory management in the dual channel strategy can outperform the inventory management in retail-only and direct-only strategies. Cai[5] also obtained a similar result that the manufacturer can gain more negotiation power than the retailer in the dual channel scenario. Bian, et al.[6] similarly found that integrated channel choice can be more profitable to the manufacturer than the decentralized channel when there exists channel competition. Considering the advantage of channel coordination, some studies have shown that the uniform pricing strategy can be better than the price differentiation strategy. Draganska and Jain[7] empirically found that the firms' profits would not significantly increase when the manufacturer implements price differentiation strategy. What's more, Mcafee, et al.[8] demonstrated that there is no theoretical connection between the price differentiation and market power. Cattani, et al.[9] found that the equal-pricing strategy is appropriate for the manufacturer as the internet channel is significantly less convenient or more costly than the traditional channel. Wen, et al.[10] also found that the equal price strategy can be applicable to the manufacturer when the online channel is less convenient than the offline channel. Supply chain coordination can improve the joint benefit of the supply chain through integrating different players and joint decisions[11]. Different from the above researches, we take the cost saving for the manufacturer and the demand increasing into consideration when the uniform pricing strategy is implemented, and then compare the performance of two pricing strategies.

Our work is also related to the pricing strategy in marketing. Many empirical studies (e.g., [12–15]) have shown that the uniform pricing strategy can achieve a cost saving of the channel coordination. For instances, Slade empirically investigated costs associated with adjusting prices[12]. Bergen, et al.[13] found that the complexity of dealing with online and offline pricing increases the managerial costs. Kano[14] provided empirical evidence to convince that the adjustment costs of prices are important for retailers' pricing decisions. Chen, et al.[15] highlighted the significance of price adjustment costs for the total profit. The different prices in the dual channels increase the cost of channel coordination because the manufacturer needs to change the prices or produce specific products for the online channel. What's more, the different decisions in the dual channels increase the total inventory, which in turn increase the optimal pricing path[16]. On the contrary, the uniform pricing strategy can effectively decrease the price adjustment costs and enhance the service level. Besides, the uniform pricing strategy can also effectively alleviate the channel competition and conflict in the competitive market[17].

The uniform pricing strategy can improve the customers' cognition of the manufacturer's brand which leads to a larger customer demand than the price differentiation strategy. The comparison of prices leads to a sense of fairness in price, and thus affects the consumer purchasing decisions (see [18, 19]). Gerardi and Shapiro (see [20, 21]) found that price differentiation decreases in the intensity of market competition, and that the reduction of price differentiation is greater when consumers have relatively heterogeneous elasticities of demand. Kauffman, et al.[22] found that the channel migration would lead a firm to manage dual channels as one when the level of channel migration is high enough. Shen, et al.[23] found that price comparison is harmful to the profit of retailers and supplier in a dual-channel supply chain when there is a difference between the online price and offline price. Zhang, et al.[24] also found that the increase of retail price will lead to an increasing order cancellation rate which abates the joint demand especially when the customers are highly price-sensitive. To the best of our knowledge, seldom research has studied the question of whether the uniform pricing strategy can be better than the price differentiation strategy in the presence of cost saving and demand increasing. These papers considered the cost reduction and demand increase resulting from the uniform pricing strategy, but they did not investigate the impact of the cost reduction and demand increase on the firm's performance and the choice of pricing strategies. Our work contributes to the literature by incorporating the cost reduction and demand increase of the uniform pricing strategy into the operations management with dual-channel marketing and exploring the impact on the firm's choice of pricing mode.

3 Preliminaries: Demand Functions and Research Setting

In practice, a manufacturer may sell the product through own online channel or traditional offline channel. Accordingly, we assume that the manufacturer sells the product through his own online channel at a price p_m, and through the offline channel where the offline retailer buys the product from the manufacturer with a wholesale price w and sells it to the end customers with a price p_r. The manufacturer's unit cost including the production cost and operations cost is c. When the uniform pricing strategy is implemented, the two channels have the same selling prices, that is $p_r = p_m \equiv p$. The manufacturer and the retailer are both assumed to be risk neutral and thus their objectives are to maximize their expected profit.

Following the classical researches in operations management (see, e.g., [11, 25–30]), we also assume that the demand functions on both channels are linear in self- and cross-prices with different parameters. Let D_m and D_r denote the demand on the online channel and the offline channel respectively. Suppose the potential demand is a and θ $(0 < \theta < 1)$ represents the degree of customer acceptance to the online channel. Thus, $1 - \theta$ means the degree of customer acceptance to the offline channel. The parameters b_1 and b_2 are the coefficients of price elasticity of D_m and D_r. For the cross impact of the price difference between the dual channels, we let f_1 and f_2 denote the cross sensitivities of the price differences of $(p_r - p_m)$ and $(p_m - p_r)$ respectively (similar assumption, see, e.g., [31]). Thus, the demand functions on the online and offline channels can be characterized as

$$D_m = \theta a - b_1 p_m + f_1(p_r - p_m), \tag{1}$$

and

$$D_r = (1 - \theta)a - b_2 p_r + f_2(p_m - p_r), \tag{2}$$

respectively.

In practice, the own-price effects are always larger than the cross-price effects, which means $0 \le f_i < b_j$ for $i, j = 1, 2$. On the other hand, to reflect that the total impact of uniform pricing strategy on the customer demand is positive, we assume that $f_1 < f_2$ (which means that the offline channel is more sensitive to the price difference) and $p_r \ge p_m > w$ (see, e.g., [25, 28, 32]).

In other words, the uniform pricing strategy can improve the total demand of the product in the dual channels. This fact gives the incentive for implementing the uniform pricing strategy.

On the other hand, when the uniform pricing strategy is implemented, the customers can buy online and pick up in offline store which will save the operations cost. Suppose that the manufacturer will achieve a unit cost saving $\Delta c > 0$ from the channel coordination of the uniform pricing strategy. Then the manufacturer's profit can be expressed as

$$\pi_m^i = \begin{cases} (p_m - c + \Delta c)D_m + (w - c + \Delta c)D_r, & i = U, \\ (p_m - c)D_m + (w - c)D_r, & i = D, \end{cases} \tag{3}$$

where $i = U$ and $i = D$ denote the uniform pricing strategy and the price differentiation strategy respectively, and the retailer's profit is

$$\pi_r = (p_r - w)D_r. \tag{4}$$

4 Analyses of Uniform Pricing Strategy and Price Differentiation Strategy

In this section, we first analyze the pricing decision and performance of the uniform pricing strategy. Next in the price differentiation strategy model, we first investigate the centralized price differentiation strategy as a benchmark, and then explore the decentralized price differentiation strategy.

4.1 Uniform Pricing Strategy

When the manufacturer and the retailer collaboratively determine to implement the uniform pricing strategy, the prices on the two channels are the same, that is, $p_r = p_m \equiv p$. Then the joint profit function can be obtained as

$$\pi_t^U = \pi_r + \pi_m^U = (p - c + \Delta c)(D_m + D_r), \tag{5}$$

where the index t and U denote the total quantity in the Uniform pricing strategy.

Direct calculation shows that $\frac{\partial^2 \pi_t^U}{\partial p^2} = -2(b_1 + b_2) < 0$, which means that π_t^U is concave with respect to p. Thus, the optimal price can be obtained by solving the first-order condition as:

$$p^U = \frac{1}{2}\left(c - \Delta c + \frac{a}{b_1 + b_2}\right). \tag{6}$$

It therefore follows that the optimal joint demand $D_t^U (= D_m + D_r)$ and joint profit π_t^U are

$$D_t^U = \frac{1}{2}[a - (c - \Delta c)(b_1 + b_2)], \tag{7}$$

and

$$\pi_t^U = \frac{[a - (c - \Delta c)(b_1 + b_2)]^2}{4(b_1 + b_2)}. \tag{8}$$

Next, we investigate the impact of Δc on the optimal price, demand and profit when the uniform pricing strategy is implemented.

Proposition 4.1 $\frac{\partial p^U}{\partial \Delta c} = -\frac{1}{2} < 0$, $\frac{\partial D_t^U}{\partial \Delta c} = \frac{1}{2(b_1+b_2)} > 0$, $\frac{\partial \pi_t^U}{\partial \Delta c} = \frac{1}{2}[a-(c-\Delta c)(b_1+b_2)] > 0$.

Proposition 4.1 means that the joint demand and joint profit of the uniform pricing strategy both increase in Δc, while the optimal price of the uniform pricing strategy decreases in Δc. Such result implies that if the manufacturer can save more cost from implementing the uniform pricing strategy, the manufacturer will set a lower price as the cost of the product is reduced. Meanwhile, with the increasing demand due to the lower price, the manufacturer can obtain more profit from the increasing customer demand. These results will lead to a win-win situation for the manufacturer and the retailer.

4.2 Price Differentiation Strategy

As a benchmark, we first examine the centralized price differentiation strategy whose objective is to maximize the joint profit of the manufacturer and the retailer.

4.2.1 Centralized Price Differentiation Strategy

Under the centralized price differentiation strategy, the joint profit of the manufacturer and the retailer can be calculated as

$$\pi_{tc}^D = \pi_r + \pi_m^D = (p_m - c)D_m + (p_r - c)D_r, \tag{9}$$

where the index t, c and D denote the total quantity in the centralized price differentiation strategy, respectively.

The optimal online price p_{cm}^D and offline price p_{cr}^D can be obtained by optimizing π_{tc}^D as

$$p_{cm}^D = \frac{f_1(a-c\theta-cf_1)+[a(1+\theta)+2c(b_1+f_1)]f_2-cf_2^2 + b_2(2a\theta + 2cb_1 + 3cf_1 - cf_2)}{4b_2f_1 - (f_1 - f_2)^2 + 4b_1(b_2 + f_2)} \tag{10}$$

and

$$p_{cr}^D = \frac{-cf_1^2 + f_2(a\theta-cf_2)+b_1(2a-2a\theta+2cb_2-cf_1+3cf_2) + f_1[a(2-\theta) + 2c(b_2 + f_2)]}{4b_2f_1 - (f_1 - f_2)^2 + 4b_1(b_2 + f_2)}. \tag{11}$$

It thus follows that the optimal joint demand D_{tc}^D $(= D_m + D_r)$ and joint profit of π_{tc}^D are

$$\begin{aligned} D_{tc}^D = &\frac{-2cb_1^2(b_2 + f_2) + b_2[(2a - a\theta - 2cb_2)f_1 + a\theta f_2]}{4b_2f_1 - (f_1 - f_2)^2 + 4b_1(b_2 + f_2)} \\ &+\frac{b_1\{a(1-\theta)f_1 - 2cb_2^2 + a(1+\theta)f_2 + 2b_2[a - c(f_1 + f_2)]\}}{4b_2f_1 - (f_1 - f_2)^2 + 4b_1(b_2 + f_2)} \end{aligned} \tag{12}$$

and

$$\begin{aligned} \pi_{tc}^D = &\frac{c^2b_2^2f_1 + cb_1^2(b_2 + f_2) + a^2(f_1 - \theta f_1 + \theta f_2) + ab_2[a\theta^2 - c(2-\theta)f_1 - c\theta f_2]}{4b_2f_1 - (f_1 - f_2)^2 + 4b_1(b_2 + f_2)} \\ &+\frac{b_1\{c^2b_2^2 - a(1-\theta)[cf_1 - a(1-\theta)] - ac(1+\theta)f_2 + cb_2[c(f_1 + f_2) - 2a]\}}{4b_2f_1 - (f_1 - f_2)^2 + 4b_1(b_2 + f_2)}. \end{aligned} \tag{13}$$

We then examine the impact of θ on the optimal prices and profit and obtain the following proposition.

Proposition 4.2 $\frac{\partial p_{cm}^D}{\partial\theta}=\frac{a(2b_2-f_1+f_2)}{4b_2f_1-(f_1-f_2)^2+4b_1(b_2+f_2)}>0$, $\frac{\partial p_{cr}^D}{\partial\theta}=\frac{-a(2b_1+f_1-f_2)}{4b_2f_1-(f_1-f_2)^2+4b_1(b_2+f_2)}<0$; $\frac{\partial\pi_{tc}^D}{\partial\theta}>0$, *as* $\theta>\theta_1$,*and* $\frac{\partial\pi_{tc}^D}{\partial\theta}<0$, *as* $\theta<\theta_1$, *where* $\frac{\partial\pi_{tc}^D}{\partial\theta}$ *and* θ_1 *are given by*

$$\frac{\partial\pi_{tc}^D}{\partial\theta}=\frac{a[a(f_2-f_1)+b_1(cf_1-cf_2-2a+2a\theta)+b_2(2a\theta+cf_1-cf_2)]}{4b_2f_1-(f_1-f_2)^2+4b_1(b_2+f_2)}$$

and

$$\theta_1=\frac{(a-cb_2)(f_1-f_2)+b_1(2a-cf_1+cf_2)}{2a(b_1+b_2)}.$$

Proposition 4.2 indicates that the manufacturer's online optimal price p_{cm}^D increases in the customers' acceptance of online channel θ, while the retailer's optimal price p_{cr}^D decreases in the customers' acceptance of online channel θ. This fact is reasonable because when customers have higher willingness to choose the online channel, the manufacturer has larger power on raising price, and the retailer needs to reduce its price to improve the attractiveness of offline channel. We can also find that when θ is smaller than θ_1, the joint profit is decreasing in θ. But when θ is larger than θ_1, the joint profit increases in θ. This fact indicates that whether to increase customers' acceptance of online channel is decided by the initial value of θ. Increasing customers' acceptance of online channel may not benefit the joint profit, which is counter-intuitive and deserves more attention.

4.2.2 Decentralized Price Differentiation Strategy

In this subsection, we consider the decentralized price differentiation strategy with the manufacturer as the leader and the retailer as the follower, and both the manufacturer and the retailer make their pricing decisions sequentially to maximize their individual profits. The manufacturer's and the retailer's profits are

$$\pi_{dm}^D=(p_m-c)D_m+(w-c)D_r \tag{14}$$

and

$$\pi_{dr}^D=(p_r-w)D_r, \tag{15}$$

where the lower index d, and D denote the decentralized price differentiation strategy.

Obviously, the manufacturer and the retailer form a Stackelberg game. To find the optimal wholesale and retail prices in Stackelberg equilibrium, we need to use the following backward approach. First, we maximize the retailer's profit π_{dr}^D in (15) to find the retailer's best response pricing decisions given the manufacturer's wholesale price w and the online price p_m. Secondly, we substitutue the retailer's best-response pricing decisions into the manufacturer's price π_{dm}^D in (14), which is then maximized to obtain the manufacturer's optimal wholesale price and online price. Thirdly, replacing w and p_m in the retailer's best responses with the manufacturer's wholesale price and online price, we can find the offline price of the retailer in Stackelberg equilibrium.

Proposition 4.3 *Under the decentralized selling mode, the manufacturer's wholesale price and online price in Stackelberg equilibrium are obtained as*

$$\begin{aligned} w^D = &\frac{f_1[4cb_2^2+a(1-\theta)f_1+2b_2(2a-\theta a-cf_1]+f_2[f_1(3a-\theta a-cf_1)+b_2(2a\theta+7cf_1)]}{(b_2+f_2)[8b_2f_1-(f_1-f_2)^2+8b_1(b_2+f_2)]} \\ &+\frac{(2a\theta-cb_2+2cf_1)f_2^2-cf_2^3+2b_1(b_2+f_2)(2a-2a\theta+2cb_2-cf_1+3cf_2)}{(b_2+f_2)[8b_2f_1-(f_1-f_2)^2+8b_1(b_2+f_2)]} \end{aligned} \quad (16)$$

and

$$p_{dm}^D = \frac{f_1[3a(1-\theta)-cf_1]+(a+3a\theta+4cb_1+2cf_1)f_2-cf_2^2+b_2(4a\theta+4cb_1+5cf_1-cf_2)}{8b_2f_1-(f_1-f_2)^2+8b_1(b_2+f_2)}. \quad (17)$$

Thus, the retailer's optimal selling price is calculated as

$$p_{dr}^D = \frac{a(1-\theta)+w^Db_2+f_2(w^D+p_{dm}^D)}{2(b_2+f_2)}. \quad (18)$$

It then follows that the manufacturer and the retailer's profits are

$$\pi_{dm}^D = (p_{dm}^D-c)[\theta a-b_1p_{dm}^D+f_1(p_{dr}^D-p_{dm}^D)]+(w^D-c)[(1-\theta)a-b_2p_{dr}^D+f_2(p_{dm}^D-p_{dr}^D)] \quad (19)$$

and

$$\pi_{dr}^D = (p_{dr}^D-c)[(1-\theta)a-b_2p_{dr}^D+f_2(p_{dm}^D-p_{dr}^D)], \quad (20)$$

where w^D, p_{dm}^D, p_{dr}^D are shown as in (16), (17), (18).

Therefore, we can obtain the optimal joint profit π_{td}^D $(=\pi_{dm}^D+\pi_{dr}^D)$. It is obvious that the profit in the decentralized dual channel is less than that in the centralized case.

4.3 Applications and Discussions for Brand Owners Under Drop Shipping Mode

When we study the firms that implemented the uniform pricing strategy, we can find that most of them are brand owners (e.g., WalMart, SUNING, UNIQLO etc.) that can control the downstream of the supply chain and use the drop shipping mode to sell their products through both online and offline channels. Some previous research have shown that the price differentiation strategy can benefit the firms more. But these firms still choose the uniform pricing strategy. One underlying logic is that the uniform pricing strategy releases the consumers' worry about price fairness and thus increases the demand. Another reason is the cost saving from inventory management, pricing management and retail store operation. Thus, the brand owners have the motivation of implementing the uniform pricing strategy, which can inspire the consumers transferring from offline channel to online channel, and increase the customer demand of online channel and reduce the necessity of opening a large number of direct retail stores.

When the brand owners use the drop shipping mode, the decision of the wholesale price does not exist. Then we can obtain the same results as shown in Subsection 4.1 for brand owners under the uniform pricing strategy. Meanwhile, when the centralized price differentiation strategy is implemented, we also can find the same results as shown in Subsection 4.2.1 where the wholesale price also does not exist.

However, when the brand owners turn to the traditional wholesale mode where the franchised stores are independent of the brand owners, they need to decide a wholesale price for the stores. We can obtain the same results as shown in Subsection 4.2.2 for brand owners under the decentralized price differentiation strategy. Hence, the case that the brand owners implemented drop shipping mode can be seen as a specific case of Subsection 4.2.1.

5 Comparison Between Uniform Pricing Strategy and Price Differentiation Strategy

We first focus on the analytical comparison between the uniform pricing strategy and the centralized price differentiation strategy, because the two models are both centralized. Then we perform a numerical comparison between the two pricing strategies to investigate under what conditions the uniform pricing strategy can be better than the price differentiation strategy.

5.1 Analytical Comparison

To compare the uniform pricing strategy and centralized price differentiation strategy, we first calculate the demand difference and profit difference between two strategies as

$$\Delta D_t \equiv D_t^U - D_{tc}^D = \frac{1}{2}[a-(c-\Delta c)(b_1+b_2)] - D_{tc}^D, \tag{21}$$

$$\Delta \pi_t \equiv \pi_t^U - \pi_{tc}^D = \frac{[a-(c-\Delta c)(b_1+b_2)]^2}{4(b_1+b_2)} - \pi_{tc}^D. \tag{22}$$

Then, we can obtain the following proposition.

Proposition 5.1 (i) *When the cost saving Δc is greater than the threshold $\Delta c_1 \equiv c - \frac{a-2D_{tc}^D}{b_1+b_2}$, the joint demand in the uniform pricing strategy will be larger than that in the price differentiation strategy, that is, $D_t^U > D_{tc}^D$; otherwise, $D_t^U \le D_{tc}^D$.*

(ii) *The joint profit in the uniform pricing strategy π_t^U will be larger than that in the price differentiation strategy π_{tc}^D, if $\Delta c > \Delta c_2 \equiv c + \frac{\sqrt{4\pi_{tc}^D(b_1+b_2)}-a}{b_1+b_2}$; Otherwise, $\pi_t^U \le \pi_{tc}^D$.*

Proposition 5.1 indicates that, if the cost saving from the channel coordination in the uniform pricing strategy compared with the price differentiation strategy is large enough, the manufacturer can obtain more profit under the uniform pricing strategy than that under the price differentiation strategy. This can in some sense justify the fact that some manufacturers are willing to implement the uniform pricing strategy in their business.

5.2 Numerical Comparison

To further investigate the impact of the reduced cost and increased demand on the firm's performance under uniform pricing strategy, we conduct a numerical analysis. Based on a small data collection of the goods being sold and annual report from Company UNIQLO, the values of the parameters are set as $a = 400$, $b_1 = 5$, $b_2 = 4$, $w = 45$ and $c = 10$. We present the main results in the following Figures 1–5. Based on these results, we can find some managerial insights which may be helpful for the managers who want to implement the uniform pricing strategy in their dual channels.

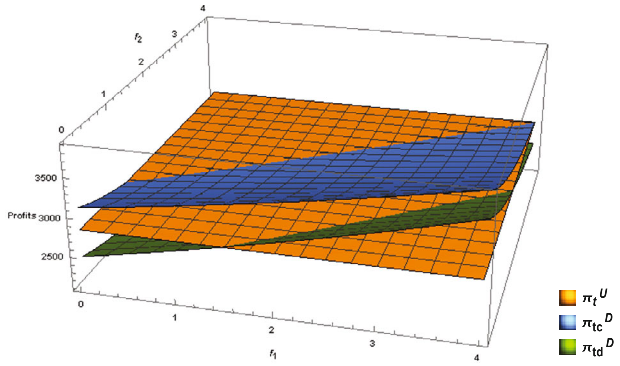

Figure 1 Total profits with respect to f_1 and f_2 ($\theta = 0.4, \Delta c = 1$)

As shown in Figure 1, when the cross sensitivity of the price differences f_2 is large enough, the total profit of the uniform pricing strategy π_t^U can be larger than the total profit of centralized price differentiation strategy π_{tc}^D and the total profit of decentralized price differentiation strategy π_{td}^D. From Figure 2 and Figure 3, we can see that uniform pricing strategy can be feasible if the degree of customer's acceptance of online channel θ lies in a certain interval. When θ is out of the interval, the uniform pricing strategy would be confined by customer's acceptance of online channel or be eroded by the demand decreasing in the offline channel. Hence, they need to consider a tradeoff between the benefit from online channel and the negative impact from the offline channel. Besides, we can find that centralized price differentiation strategy is better than the uniform pricing strategy in most regions of Figure 2 and Figure 3, which explains why most of manufacturers or brand owners with dual channels are willing to choose the price differentiation strategy in their practices.

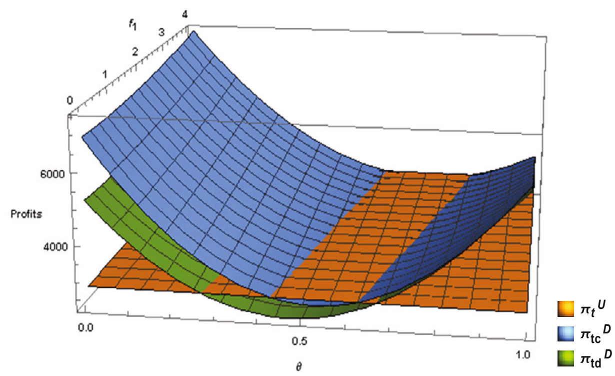

Figure 2 Total profits with respect to θ and f_1 ($\Delta c = 1$)

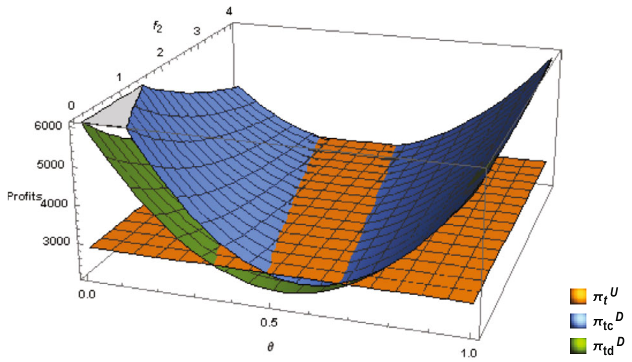

Figure 3 Total profits with respect to θ and f_2 ($\Delta c = 1$)

From Figure 4, we can see that when the cost saving $\triangle c$ from the channel coordination of the uniform pricing strategy is large enough, the total profit of uniform pricing strategy π_t^U can be larger than that of the centralized price differentiation strategy π_{tc}^D and that of decentralized price differentiation strategy π_{td}^D. On the other hand, the intersecton of two surfaces indicates that the cross sensitivity of the price differences f_1 changes in the same direction with $\triangle c$, which means that demand increasing in online channel needs to induce enough cost saving while the demand in offline channel decreases. Similar results also can be obtained from Figure 5. The difference is that when the cross sensitivity of the price differences f_2 is large enough, the demand in offline channel will decrease significantly which reduces the chance of implementing price differentiation strategy. It means that customers' concerns of price fairness notably influence the firm's strategic choice, which also explains the fact that the manufacturers or brand owners implementing the uniform pricing strategy are mainly focusing on price-sensitive customers and price fairness sensitive customers.

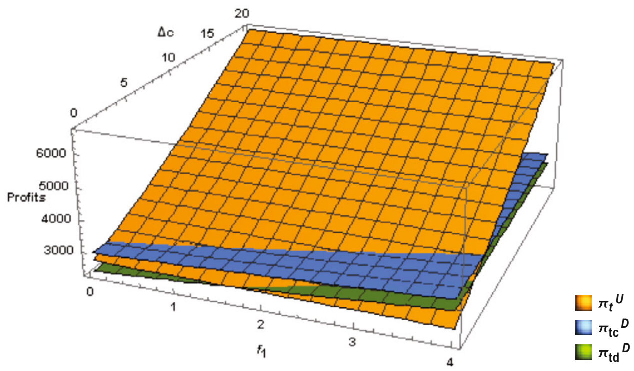

Figure 4 Total profits with respect to Δc and f_1 (θ =0.4, f_2=0.7)

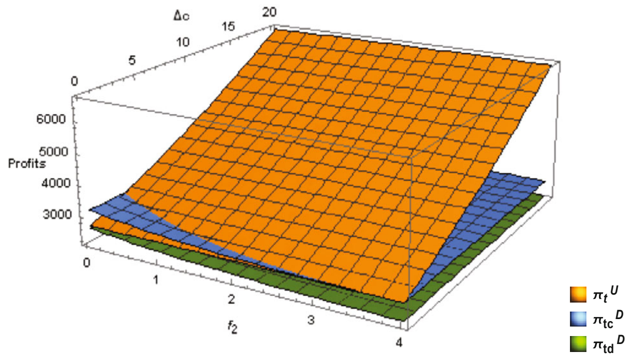

Figure 5 Total profits with respect to Δc and f_2 (θ =0.4, f_1=0.7)

6 Conclusions

In recent years, many firms choose the uniform pricing strategy in their online and offline channels. In this paper, we take the cost saving and demand increasing from the uniform pricing strategy into our consideration. Different from the extant researches, the analyses show that when the cost saving is large enough or the consumers' acceptance of online channel lies in a certain interval, the uniform pricing strategy can be better than the centralized price differentiation strategy and the decentralized price differentiation strategy. Some managerial implications are derived from the numerical analyses. When the manufacturers or brand owners decide to implement the uniform pricing strategy, they should consider demand increasing induced by the consumers' concerns of price fairness, the cost saving induced by supply chain coordination and the shift of consumers from offline to online. When consumers care more about the price difference between the two channels, the manufacturers or brand owners would be more inclined to use the uniform pricing strategy. The manufacturers or brand owners need a tradeoff between the benefit from online channel and the negative impact for the offline channel when they implement the price differentiation strategy. These findings can help the manufacturers or brand owners decide whether to implement the uniform pricing strategy or not.

This paper investigates the widespread use of uniform pricing strategy in the business practices and explore the underlying reasons. There are several potential research directions that deserve further exploration. It would be interesting to examine how manufacturers or brand owners design a compensatory contract under the uniform pricing strategy to compensate the reduced profit of retailers. Such contract is significantly valuable when manufacturers or brand owners adopt the franchise mode in offline channel. Another valuable issue is to conduct some empirical studies to support the assumptions supposed in the related literatures.

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Appendix: Proofs

Proof of Proposition 4.2 Direct calculation will give rise to $\frac{\partial p_{cm}^D}{\partial\theta} = \frac{a(2b_2-f_1+f_2)}{4b_2f_1-(f_1-f_2)^2+4b_1(b_2+f_2)}$ and $\frac{\partial p_{cr}^D}{\partial\theta} = \frac{-a(2b_1+f_1-f_2)}{4b_2f_1-(f_1-f_2)^2+4b_1(b_2+f_2)}$. According to our assumption of $0 \leq f_i < b_j$ and $f_1 < f_2$ in the model, we can easily find that $\frac{\partial p_{cm}^D}{\partial\theta} > 0$, and $\frac{\partial p_{cr}^D}{\partial\theta} = \frac{-a(2b_1+f_1-f_2)}{4b_2f_1-(f_1-f_2)^2+4b_1(b_2+f_2)} < 0$.

Differentiating π_{tc}^D with respect to θ will give rise to

$$\frac{\partial\pi_{tc}^D}{\partial\theta} = \frac{a[a(f_2-f_1)+b_1(cf_1-cf_2-2a+2a\theta)+b_2(2a\theta+cf_1-cf_2)]}{4b_2f_1-(f_1-f_2)^2+4b_1(b_2+f_2)}.$$

Setting $\frac{\partial\pi_{tc}^D}{\partial\theta} = 0$ will give the threshold $\theta = \theta_1 \equiv \frac{(a-cb_2)(f_1-f_2)+b_1(2a-cf_1+cf_2)}{2a(b_1+b_2)}$. It then follows from direct comparison that $\frac{\partial\pi_{tc}^D}{\partial\theta} > 0$, as $\theta > \theta_1$, and $\frac{\partial\pi_{tc}^D}{\partial\theta} < 0$, as $\theta < \theta_1$. ∎

Proof of Proposition 4.3 We first compute the retailers' best response given the manufacturer's wholesale price w and online price p_m. Solving the first-order condition $\partial\pi_{dr}^D/\partial p_r = 0$, we can obtain the retailer's best response as

$$p_r = \frac{a(1-\theta)+wb_2+f_2(w+p_m)}{2(b_2+f_2)},$$

where the lower index d and r means the decentralized model and the retailer.

It then follows that the manufacturer's profit function is

$$\pi_{dm}^{D} = (p_m - c)\left\{\theta a - b_1 p_m + f_1\left[\frac{a(1-\theta) + wb_2 + f_2(w+p_m)}{2(b_2+f_2)} - p_m\right]\right.$$
$$\left. + (w-c)\left\{(1-\theta)a - b_2 p_r + f_2\left[p_m - \frac{a(1-\theta) + wb_2 + f_2(w+p_m)}{2(b_2+f_2)}\right]\right\}\right\}.$$

To maximize manufacturer's profit function π_{dm}^{D}, we need to consider the second-order partial derivatives of π_{dm}^{D} with respect to w and p_m, and get the Hessian matrix as

$$H = \begin{pmatrix} \frac{\partial^2 \pi_{dm}^{D}}{\partial w^2} & \frac{\partial^2 \pi_{dm}^{D}}{\partial w \partial p_m} \\ \frac{\partial^2 \pi_{dm}^{D}}{\partial p_m \partial w} & \frac{\partial^2 \pi_{dm}^{D}}{\partial p_m^2} \end{pmatrix} = \begin{pmatrix} -b_2 - f_2 & \frac{1}{2}(f_1+f_2) \\ \frac{1}{2}(f_1+f_2) & -2b_1 + f_1(-2 + \frac{f_2}{b_2+f_2}) \end{pmatrix},$$
$$|H| = \frac{1}{4}[8b_2 f_1 + 8b_1(b_2+f_2) - (f_1-f_2)^2] > 0.$$

Since $\frac{\partial^2 \pi_{dm}^{D}}{\partial w^2} = -b_2 - f_2 < 0$ and $|H| > 0$, it then follows that the manufacturer's profit π_{dm}^{D} is strictly joint concave in w and p_m. Therefore, π_{dm}^{D} has a unique optimal solution for given θ, f_1, f_2. Solving the first order conditions, we obtain the optimal wholesale price w^D and the manufacturer's direct selling price p_{dm}^{D} as

$$w^D = \frac{f_1[4cb_2^2 + a(1-\theta)f_1 + 2b_2(2a - \theta a - cf_1] + f_2[f_1(3a - \theta a - cf_1) + b_2(2a\theta + 7cf_1)]}{(b_2+f_2)[8b_2 f_1 - (f_1-f_2)^2 + 8b_1(b_2+f_2)]}$$
$$+ \frac{(2a\theta - cb_2 + 2cf_1)f_2^2 - cf_2^3 + 2b_1(b_2+f_2)(2a - 2a\theta + 2cb_2 - cf_1 + 3cf_2)}{(b_2+f_2)[8b_2 f_1 - (f_1-f_2)^2 + 8b_1(b_2+f_2)]}$$

and

$$p_{dm}^{D} = \frac{f_1[3a(1-\theta) - cf_1] + (a + 3a\theta + 4cb_1 + 2cf_1)f_2 - cf_2^2 + b_2(4a\theta + 4cb_1 + 5cf_1 - cf_{2)}}{8b_2 f_1 - (f_1-f_2)^2 + 8b_1(b_2+f_2)},$$

respectively. It follows that the retailer's optimal price is $p_{dr}^{D} = \frac{a(1-\theta) + w^D b_2 + f_2(w^D + p_{dm}^{D})}{2(b_2+f_2)}$. ∎

Proof of Proposition 5.1 Differentiating ΔD_t with respect to Δc and setting it to be 0, that is $(\partial \Delta D_t)/\partial \Delta c = 0$, we obtain the unique critical point $\Delta c_1 = c - \frac{a - 2D_{tc}^{D}}{b_1+b_2}$. Moreover, $(\partial \Delta D_t)/\partial \Delta c > 0$, as $\Delta c > \Delta c_1$; and $(\partial \Delta D_t)/\partial \Delta c < 0$, as $\Delta c < \Delta c_1$. Thus, the first part of Proposition 5.1 is proved.

On the other hand, setting $\Delta \pi_t \equiv \pi_t^U - \pi_{tc}^{D} = 0$, we can obtain two distinct roots $\Delta c_0 = \frac{-a + c(b_1+b_2)}{b_1+b_2} - \sqrt{\frac{4\pi_{tc}^{D}}{b_1+b_2}}$ and $\Delta c_2 = \frac{-a + c(b_1+b_2)}{b_1+b_2} + \sqrt{\frac{4\pi_{tc}^{D}}{b_1+b_2}}$. It is obvious that $\Delta c_0 = \frac{-a + c(b_1+b_2)}{b_1+b_2} - \sqrt{\frac{4\pi_{tc}^{D}}{b_1+b_2}} < 0$. According to our assumption, $\Delta c > 0$, and it thus follows that Δc cannot be less than Δc_0. Because $\Delta \pi_t$ is a parabola with respect to Δc and concave upward, we can find that $\pi_t^U > \pi_{tc}^{D}$, as $\Delta c > \Delta c_2 \equiv \frac{-a + c(b_1+b_2)}{b_1+b_2} + \sqrt{\frac{4\pi_{tc}^{D}}{b_1+b_2}} = c + \frac{\sqrt{4\pi_{tc}^{D}(b_1+b_2)} - a}{b_1+b_2}$, and $\pi_t^U \le \pi_{tc}^{D}$, as $\Delta c \le \Delta c_2$. ∎