Pricing Decision with Conspicuous Customers: Quick Responses versus Value-Added Services

Abstract: In order to eliminate the negative effects of customer strategic behavior, retailers often adopt quick response or value-added services. While in a luxury market with conspicuous customers, retailers' pricing decisions of these two strategies become more complicated. This paper studies a supply chain with a retailer serving a mixture of conspicuous and ordinary strategic customers. We develop three models so that the retailer provides i) neither quick response nor value-added services; ii) only quick response; iii) only value-added services. Subsequently, we analyze the impacts of conspicuous customers on quick response and value-added services by pricing and strategy comparisons. The model further extends to the situation including both strategies. The results show that, firstly, when the proportion is less than a threshold, the retailer should adopt a low price strategy, and vice versa. Besides, the quick response could induce the retailer to adopt high price while value-added services inhibit it. Secondly, the customer conspicuous behavior can motivate retailers to provide quick response and inhibit their value-added services. Finally, by observing the retailer's decisions when they can adopt two strategies simultaneously, we find that the existence of quick response can amplify the benefits of value-added services.

Keywords: pricing policy; behavioral operations management; retail supply chain; conspicuous customers

1 Introduction

With the rapid development of the global economy and the improvement of living standards, luxury consumption has increased drastically in recent years (Zhan and He, 2012). Similar to fashion goods, luxury goods are not durable and therefore are sometimes for sales. For example, luxury brands such as Louis Vuitton, GUCCI, among others, have several discount seasons each year, including summer discounts in July and August, "Black Friday" and Christmas sales. Some customers are willing to wait till the discount seasons to purchase products (Adegeest, 2018). This is called customer strategic behavior, which may reduce a company's revenue (Aviv and Pazgal, 2008). Therefore, in order to eliminate customer strategic behavior, retailers often use two strategies: quick response or value-added services (Cachon et al., 2011).

Quick response is an operational strategy that increases supply flexibility by reducing lead times (Cachon and Swinney, 2009). It is not only beneficial for companies who integrate producing and selling activities, like ZARA (Rohwedder and Johnson, 2008), but also useful for companies with solely retailing business (Yang et al., 2015), for example, H&M is outsourcing production to independent suppliers (H&M Group, 2019), but it is still famous for its fast-responding supply chain. Retailers with quick response can adjust order quantities based on timely collected market information. In spite of the extra quick response cost, it reduces the necessity of over-order and discount (Yang et al., 2015). Studies have shown that quick response is an important mean to mitigate customer strategic behavior (Shen and Su, 2007). At present, quick response has gradually gained the attention and been adopted in luxury fashion retailers. For example, SMCP's two luxury brands, Sandro and Maje, re-examined the business model in difficult sale periods, adopted quick response strategy and finally transformed to "accessible luxury" which exhibits both characteristics of luxury and fast fashion goods (SMCP Group, 2019). In the case of SMCP, although the production is outsourced, and only sale remains in-house (SCMP Group, 2019), its quick response strategy enables quick replenishment to prevent from out-of-stocks when the retail link faces shortages. Currently, the SMCP's cycle time is about 3 months comparing to 6-12 months of traditional luxury brands (Liu, 2017). Hence, the number of stockouts has been significantly reduced.

Providing value-added services, on the other hand, can increase the customers' valuation and purchase intentions, and make them less willingness to wait for a sale if items have a risk of stockout (Cachon et al., 2011). Value-added services include activities that enhance product design and visibility of brands such as better packaging, brand story, customers service before and after sales, advertising, and product placement (Zhao and Wang, 2015). For example, L&C Leather Workshop opens stores in high-end clubs or high-end shopping malls, provides Japanese-style private butler services and invites customers to participate in the services in a regular basis. In order to attract more high-end consumers, L&C Leather Workshop has also expanded its service scope and gradually cultivated high-end service functions such as flight service and yacht interior (Bonnie Luxury Care Training, 2014).

As we described above, quick response and value-added services address customer strategic behavior concerns with different principles. Specifically, quick response reduces the chance of sales in discount seasons by quickly matching supply and demand (Yang et al., 2015). Therefore, it prompts customers to purchase at a full price (Cachon et al., 2011). Whereas value-added services increase the customers' valuation of the goods, which increases the customers' expected loss if stockout occurs in discount seasons (Cachon et al., 2011), thereby it may change the customer strategic behavior.

Quick response and value-added services can both eliminate customer strategic behavior. Different luxury retailers have adopted different strategies. For example, traditional luxury brands such as Louis Vuitton and GUCCI emphasize brand value and focus on providing value-added services. However, more luxury brands learn from fast fashion and adopt the strategy of quick response, such as Sandro and Maje. They have combined the characteristics of the high-end luxury brands and fast fashion brands and form a new mode called "accessible luxury". This phenomenon has motivated us to investigate the following question: in the context of strategic customers, should luxury retailers learn from fast fashion brands and make the transition to "accessible luxury", or continue to emphasize value-added services?

An important factor influencing luxury retailers' choice of these two strategies is customer conspicuous behavior, which is very common in luxury industry (Chiu et al., 2018). Customers with conspicuous behavior are more inclined to purchase immediately when goods are first launched in order to satisfy their psychological needs. And if the possibility of stockout in the second period (discount seasons) is large, the utility of purchasing immediately in the first period (at full price) of the conspicuous customers will be higher. Therefore, customer conspicuous behavior greatly affects the luxury retailer's pricing strategy under the strategies of quick response and value-added services, which in turn affects the luxury retailer's choice of these two strategies. Some scholars explored the impacts of quick response or/and value-added services in the context of customer strategic behavior (Cachon et al, 2011; Yang et al, 2015), but with the focus on fast fashion retailers. Their study results cannot be applied to luxury retailers facing with conspicuous customers. Therefore, we combine quick response, value-added service and customer strategic behavior together with the characteristics of the luxury industry—customer conspicuous behavior, to study the impact of customer conspicuous behavior on the luxury retailer' pricing decision and the optimal strategy, and subsequently to provide guidance for decision making in luxury retailers.

Based on the above background, as the main part of study, we develop three models dedicating to three scenarios for the retailers to provide i) neither quick response nor value-added services; ii) only quick response; and iii) only value-added services. We aim to answer three research questions: First, how do the retailers optimize pricing decisions when both customer strategic behaviors and conspicuous customers exist? Second, what impacts do the conspicuous customers have on the strategic choices of quick response and value-added services? Third, how should the retailers choose the optimal combination of pricing decision and strategy with different proportions of conspicuous customers?

In extension, we establish the fourth model that considers both value-added services and quick response as a complementary analysis. This is based on the assumption that the company has sufficient resources such as funds and manpower to implement both strategies simultaneously. For example, Burberry, a luxury brand in the UK, while emphasizing value-added services (Burberry, 2019), adopted quick response and launched the mode of 'See Now Buy Now' (Bianca, 2017).Therefore, we further study the impacts of value-added services and quick response on pricing decisions, and investigate the relationship between these two strategies.

This study contributes the followings to the literature and practice. Firstly, compared with the existing studies (Fisher and Raman, 1996; Dumrongsiri et al., 2008; Cachon et al, 2011; Tereyağoğlu and Veeraraghavan, 2012), this paper provides an in-depth investigation of the pricing decision with highlights on conspicuous customers, quick response and value-added services. The results show that with the conspicuous customers, the quick response could induce the retailer to adopt high price while value-added services inhibit it. Therefore, this study enriches the related theoretical research and provides the decision basis for luxury retailers with conspicuous customers.

Secondly, this paper innovatively discovers the impact of conspicuous customers on the quick response and value-added services strategies when customers have strategic behaviors. Specifically, when luxury retailers sell products, the more conspicuous customers, the more they are inclined to choose quick respond rather than value-added services. This finding complements the literature on customer strategy behavior (Su and Zhang, 2008; Feng and Zhang., 2017).

Thirdly, our research offers important guidance for practice. For luxury retailers, both quick response and value-added services can improve profits when costs are sufficient low. However, considering the conspicuous customers, when their proportion in a market is high, retailers should adopt a quick response strategy and timely replenish goods with market demand, so as to reduce the possibility of selling goods at a reduced price, and adopt high-price strategy to meet the needs of conspicuous customers.

The rest of this paper is arranged as follows: Section 2 presents a literature review, and Section 3 provides the problem description and model building; Section 4 offers pricing decision analysis; Section 5 further investigates the quick response and value-added services strategies; Section 6 exhibits the results of numerical simulation; Section 7 is model extension and finally Section 8 draws study conclusions, management insights and limitations.

2 Literature review

This paper mainly involves three aspects, namely, customer behavior, quick response, and value-added services. Therefore, the literature review will focus and elaborate the progress of relevant research, and correspondingly the research gap.

2.1 Conspicuous customers and strategic customer behavior

As the market economy has become more active, customer behavior has an increasing impact on the supply chain and companies' decision-making. There are several studies that pertain to conspicuous customers, and most of them adopt methods of economics analysis. Tereyağoğlu and Veeraraghavan (2012) analyzed production and pricing decisions of a retailer with the consideration of conspicuous customers. Most recently, Chiu et al. (2018) studied the optimal advertising budget allocation in luxury fashion markets with social influences. They considered two groups of conspicuous customers and investigated the optimal customer portfolios and budget allocation problem using the mean-variance (MV) framework. However, the interaction of pricing and the conspicuous customers is rarely studied; the gap will be filled with this study.

The customers' strategic behavior has a mechanism of affecting pricing decisions and profits of a supply chain. Coase (1972) first researched such customer behavior; he concluded that a delay in customer purchase would reduce the earnings of the company. In recent years, many scholars have conducted research on customer strategic behavior and have expanded the topic into the field of supply chains. The existing research in this direction mainly focuses on supply chain pricing and supply chain performance. For example, both Su and Zhang (2008) and Feng et al. (2017) studied supply chain coordination based on customer behavior strategy. In addition, Yang et al. (2015), Ziani et al. (2015) studied the profits of supply chain members in different modes with strategic customers. In summary, the research on customer strategic behavior mainly focuses on its negative impact on supply chain profits and the pricing decisions.

2.2 Quick response

Quick response is an effective way to deal with the uncertainty of supply and demand and is applied by many enterprises in practice. Many scholars have conducted studies on quick response, but most have studied the value of quick response and its impact on supply chain members. For example, Fisher and Raman (1996), Cachon et al. (2011), and Yang et al. (2015) all studied the value of quick response with respect to customers behavior. They showed that when the costs of quick response are low, the value of quick response in a centralized system is higher than in a decentralized system. However, some authors claimed that quick response may reduce the retailer's profit. For example, Cachon et al. (2011) suggested that quick response may increase or decrease the retailer's profit depending on the market environment. In addition, some scholars have studied the supply chain coordination mechanism with quick response, using a series of contracts (such as a wholesale price contract or a revenue sharing contract) and other policies (such as quantity commitment) to realize supply chain coordination (Iyer and Bergen, 1997; Choi and Chow, 2008).

Among the existing literature, the most relevant research to our study is Cachon et al. (2011), who studied the value of quick response combined with customer behavior strategy. They found that quick response can mitigate the adverse effects of strategic customers. Unlike their research, this paper faces the challenge of including conspicuous customers and quick response on the retailer's pricing decision; at the same time, we compare the strategies of quick response and value-added services. Therefore, our study adds new knowledge in literature.

2.3 Value-added services

As an important way for enterprises to convince customers and to increase their competitiveness, value-added services have drawn a wide attention from industry to academia. In terms of value-added services, the existing research can be divided into several types, according to the different entities that provide activities associated with value adding.

The first type pertains to value-added services provided only by manufacturers. It includes customer service before and after sales, product advertising, and delivery services. Hsu et al. (2006), Lin et al. (2007), among others, studied the impact of manufacturers' different delivery strategies, delivery efficiencies, and delivery times on consumer satisfaction and manufacturers' profit, in order to achieve coordination between delivery costs and services. Generally, most scholars focus on the delivery service provided by manufacturers, and few studies focus on other types of value-added services such as return or replacement products service, information consultation, after-sales service. The second type of research involves value-added services provided by retailers. This includes better packaging, gifts, product advertising, and product placement (Dumrongsiri et al., 2008; Ferno et al., 2010). Dumrongsiri et al. (2008) studied the effect of retailer service levels and customers' sensitivity on supply chain profitability in a two-channel supply chain. Ferno et al. (2010) used the Stakelberg game to study how to choose the right service level in order to maximize profits. There are also some researchers studied value-added services which are provided at the same time in two different channels. For example, Chiang et al. (2007) studied the possibilities and methods of replacing value-added services between these two channels. Generally, the existing research on value-added services focuses on channel selection or determining the service level to achieve the maximum return. Value-added services are seldom associated with conspicuous customers in literature; the gap will be filled by this paper.

2.4 Summary of the literature

Table 1 lists the most relevant papers discussed in the literature review. It is clear that the existing research on conspicuous customers mainly focuses on retailers' pricing and production decisions. However, the effect of retailers' choices (such as value-added services and quick response) on pricing decisions has not been studied comprehensively. Therefore, this paper will focus on this important research gap.

Table 1. The comparisons among this paper and the relevant papers.

	Tereyağoğlu and Veeraraghavan (2012)	Fisher and Raman (1996)	Cachon et al.(2011)	Dumrongsiri et al.(2008)	This paper
Research objectives	Optimal pricing and production decisions with conspicuous customers	Optimal production plan, decisions under quick response	The value of quick response and enhanced design in dealing with strategic customers	Channel choice considering price and quality of Service	Optimal pricing and strategy of retailers with conspicuous customers
Conspicuous customers	✓	×	×	×	✓
Customer strategic behavior	✓	×	✓	×	✓
Quick response	×	✓	✓	×	✓
Value-added services	×	×	×	✓	✓

3 Problem description and model building

3.1 Problem description

This paper studies a supply chain consisting of a retailer and a group of strategic customers. Strategic customers are further divided into two groups: conspicuous strategic customers (hereinafter referred to as conspicuous customers) and ordinary strategic customers (hereinafter referred to as ordinary customers). The retailer needs to determine selling prices and order quantity. The customers determine the time point of purchasing, according to the prices offered at different times. The unit wholesale price of the product is w. The entire selling season is divided into two periods. The first period sells products at a full price p, and the second period uses a discounted price s (this assumption follows the phenomenon of discount seasons every year, such as July and Black Friday).

We assume that all customers are forward-looking. They know that products may be sold with discount price in the second period and therefore consider deferring purchases to maximize their utilities (Ye and Sun, 2016). But for luxury goods, the retailers sometimes supply with shortage, in order to encourage consumers to purchase as soon as possible, i.e. purchase in the first period in our setting. So, in the second period, products may be out-of-stock. We assume that the consumer's estimated probability of stockout in the second period is ξ. Furthermore the ordinary customers' valuation of the product is v, and $r(r<v)$ denotes the customer's reservation price. The retailer, on the other hand, cannot observe either customer's reservation price r or estimated probability of stockout in the second period ξ. We use rational expectations for analysis, that is, the retailer will estimate r and ξ, and the retailer's expectations are consistent with what actually happened. The rational expectation approach is widely used in the study of strategic customers (Ye and Sun, 2016). Therefore, we use ξ to represent the actual probability of stockout for the second period, and the retail price p is equal with the customers' reservation price r.

The ordinary customers' valuation of the product is v, which is different from the conspicuous customers. This is due to the greater psychological satisfaction when a conspicuous customer receives a luxury product in its new launch, which is called the flaunting effect. Therefore, the conspicuous customers' valuation of the unit product will be higher than the ordinary customers' valuation. In addition, the conspicuous customers' valuation is related to the probability of stockout for the second period ξ. A high value of ξ will enlarge the conspicuous customer's valuation of product, thus the conspicuous customers' valuation becomes $v+k\xi$, where k is the sensitivity coefficient for conspicuous customers concerning the stockout in the second period. We have $k>0$.

The proportion of conspicuous customers is defined as α, $\alpha\in(0,1)$. The customers determine the purchase period by comparing the consumer surplus obtained in the first and second period. Consumer surplus value refers to the difference between consumers' willingness to pay and the price actually paid in purchasing (Hitt and Brynjolfsson, 1996). Consumer surplus reflects the psychological satisfaction. This measure is widely used to indicate the consumer purchase decisions. Furthermore, the market demand faced by the retailer is assumed to be a random variable d with the mean μ, the distribution function and the probability density function are represented as $F(x)$ and $f(x)$, respectively. The notations used in this paper are shown in Table 2.

Table 2. Parameters of this paper.

parameters	Description
d	Market demand
$f(x)$	Probability density function of market demand, $X \sim N(\mu,\sigma^2)$
$F(x)$	The distribution function of market demand, $0 \le F(x) \le 1$
p	The unit retail price
Q	Order quantity
r	The reservation price of customers in the first stage
s	The discounted price in the second period
i	Subscript, i=1, 2, 3, 4 represent the Models 1, 2, 3, 4, respectively
j	Subscript, j=1, 2 represent the cases where all the customers or only the conspicuous customers buy in the first period, respectively
π_{ij}, p_{ij}, Q_{ij}	The profit, price, order quantity of the retailer of Model i in the case j, superscript * indicates the optimal decision
v	Ordinary customer's valuation (willingness to pay) for unit product
w	The unit wholesale price
α	The proportion of conspicuous customers, $\alpha \in (0,1)$
w_q	The cost of quick response
ξ	The probability of out of stock in the second period
k	The sensitivity of conspicuous customers on out-of-stock
e	Service level when providing value-added services
θ	The parameter of customer utility increase when providing value-added services
τ	The parameter of cost increase when providing value-added services

3.2 Basic model (model 1)

In this section, we first analyze the intertemporal decision-making of different customers in the market, then construct the basic model without considering quick response and value-added services. This basic model serves as a benchmark for later analyses.

For ordinary customers, if a purchase is made in the first period, the consumer surplus is $v-p$. If a purchase is made in the second period, considering the possible stockouts, the consumer surplus is $(v-s)(1-\xi)$. Therefore, the indifference condition between the first and second period is $v-p=(v-s)(1-\xi)$.

If the conspicuous customers buy in the first period, they obtain products in the first hand, and there is a greater satisfaction. The consumer surplus is $v+k\xi-p$. However, if conspicuous customers wait for until the second period, they cannot obtain products in the first hand, the flaunting effect does not exist anymore, so the consumer surplus of the second period is $(v-s)(1-\xi)$ (Tereyağoğlu and Veeraraghavan, 2012). Therefore, the indifference condition for buying in the first and second period is $v+k\xi-p=(v-s)(1-\xi)$.

If the retailer only has one opportunity for placing an order, two possible optimal pricing options are available: (1) Set a low price as $v-(v-s)(1-\xi)$, so both the conspicuous and ordinary customers will purchase in the first period; (2) Set a high price as $v+k\xi-(v-s)(1-\xi)$, so conspicuous customers will buy in the first period and ordinary customers will wait until the second period.

The retailer's expected profit when all customers buy in the first period:

$$\pi_{11}(Q)=pE\min(d,Q)+s(Q-E\min(d,Q))-wQ. \quad (1)$$

The retailer's expected profit when only conspicuous customers buy in the first period:

$$\pi_{12}(Q)=pE\min(\alpha d,Q)+s(Q-E\min(\alpha d,Q))-wQ. \quad (2)$$

In the expected profit functions, the first term is the sales revenue in the first period, the second term is the residual revenue in the second period, and the third term is the procurement cost.

3.3 Model with quick response (model 2)

When a retailer has quick response ability, in addition to one ordering opportunity before the selling season, the retailer has another order opportunity in the beginning of the first period as the market demand updates. The unit cost of the first order is w, whereas the unit cost of the second order is $w+w_q$, where w_q refers to the extra cost due to quick response. If the initial order quantity is less than the market demand, a second replenishment is needed. The replenishment quantity is $d-Q$ ($\alpha d-Q$) when all customers (only conspicuous customers) buy in the first period.

The retailer's expected profit when all customers buy in the first period:

$$\pi_{21}(Q)=(p-w)E(d)-w_q E(d-Q)^+ +(s-w)E(Q-d)^+ . \tag{3}$$

The retailer's expected profit when only conspicuous customers buy in the first period:

$$\pi_{22}(Q)=(p-w)E(\alpha d)-w_q E(\alpha d-Q)^+ +(s-w)E(Q-\alpha d)^+ . \tag{4}$$

In the expected profit functions, the three terms on the right refer to the profit by meeting the demand of customers in the first period, the additional cost due to quick response, and the profit obtained in the second period, respectively.

3.4 Model with value-added services (model 3)

This section assumes that the retailer provides value-added services to customers, and the service level is e. In this paper, we assume e exogenous for following three reasons. Firstly, many value-added services provided by luxury retailers are unified in the luxury brands, for instance, extending the return and exchange time to 30 days (e.g. GUCC, LV); highly qualified staffs to provide high standard service. Secondly, some value-added services provided by luxury retailers, such as maintenance and repair, require investment in personnel and equipment at early stage. Therefore, retailers cannot easily change their value-added services at operational stage once early investment is made. Lastly, our research aims at studying the retailer's optimal pricing decisions under the two strategies of quick response and value-added services, and further investigating the optimal strategy. This assumption is essential in highlighting our research focus.

The unit cost of value-added services is τe. Similar linear cost assumption can be found in Huang et al. (2017). In addition, since e is an exogenous variable, the linear cost assumption does not affect the final result of this paper. By providing the value-added services, the customers' willingness to pay will increase to $v+\theta e$.

For ordinary customers, the consumer surplus obtained in the first period is $v+\theta e-p$, and in the second period, it is $(v+\theta e-s)(1-\xi)$. Therefore, the indifference condition between the first and second period is: $v+\theta e-p=(v+\theta e-s)(1-\xi)$.

The conspicuous customers' surplus of the first period is $v+\theta e+k\xi-p$, and that of the second period is $(v+\theta e-s)(1-\xi)$. Therefore, the indifference condition between the first and second period is: $v+\theta e+k\xi-p=(v+\theta e-s)(1-\xi)$.

Suppose the retailer only has one ordering opportunity. According to the analysis, the retailer has two pricing options: (1) Set a low price as $v+\theta e-(v+\theta e-s)(1-\xi)$, with which, both the conspicuous customers and ordinary customers will choose to buy in the first period; (2) Set a high price as $v+\theta e+k\xi-(v+\theta e-s)(1-\xi)$, with which, the conspicuous customers will purchase in the first period and the ordinary customers will wait until the second period.

The retailer's expected profit when all customers buy in the first period:

$$\pi_{31}(Q)=pE\min(d,Q)+s\big(Q-E\min(d,Q)\big)-(w+\tau e)Q. \quad (5)$$

The retailer's expected profit when only conspicuous customers buy in the first period:

$$\pi_{32}(Q)=pE\min(\alpha d,Q)+s\big(Q-E\min(\alpha d,Q)\big)-(w+\tau e)Q. \quad (6)$$

In the expected profit functions, the first term is the sales revenue in the first period, the second term is the residual revenue in the second period, and the third term is the procurement and value-added services costs.

The optimal equilibriums and proofs of three models are shown in the Appendix A.

4 Pricing decision analysis

In this section, we first analyze the optimal pricing decisions in three different models and further investigate the impact of quick response and value-added services on the pricing decisions.

4.1 Optimal pricing decisions in three models

By comparing the profits in the two cases where all customers buy in the first period and only conspicuous customers buy in the first period, we summarize optimal pricing decisions of three models in Theorem 1.

Theorem 1: There exists a conspicuous customer proportion a_i^****, when*** $\alpha \in (0, \ \alpha_i^*]$ ***, we have*** $\pi_{i2}(Q) \le \pi_{i1}(Q)$ ***and the retailer should set a low price to make all customers purchase in the first period; when*** $\alpha \in (\alpha_i^*, 1)$ ***, we have*** $\pi_{i2}(Q) > \pi_{i1}(Q)$ ***and the retailer should set a high price to make only conspicuous customers purchase in the first period, where*** $i = 1, 2, 3$ ***represent models 1, 2 or 3, respectively.***

(The proof of Theorem 1 and characterization of a_i^* ***are shown in Appendix B.)***

Theorem 1 shows that no matter what strategy the retailer adopts, when the number of conspicuous customers is large, that is, $\alpha > \alpha_i^*$, the retailer should set a higher selling price, otherwise the retailer should choose low price strategy. Because only when there are enough conspicuous customers in the market, a high-margin strategy can make up for the sales loss of ordinary customers. This finding provides an explanation for the practices in luxury industry. For example, in China where materialism and conspicuous consumption are much more obvious (Podoshen et al., 2010), the prices of luxury goods are on average over 50 per cent higher than those in Italy and France, according to the "Global Powers of Luxury Goods 2017" report of Deloitte (Deloitte, 2017). Theorem 1 inspires luxury retailers in two aspects. On one hand, before making the pricing strategy, luxury retailers should do deep analysis of market conditions and customer consumption behavior, based on which the they can set different prices for the same product in different markets to maximize profits. On the other hand, for retailers who want to adopt a high price strategy, they can use advertisements or other publicity methods to induce consumers to buy products at once. For example, many retailers motivate consumers to buy immediately by showing a low inventory.

4.2 The impact of strategy on pricing decision

In this section, we compare the threshold α^* of three models and propose Theorem 2, based on which we summarize the optimal pricing strategies and corresponding optimal profits under different proportions of conspicuous customers in Table 3.

Theorem 2: comparing the thresholds of different pricing strategies of three models, we have $\alpha_2^* < \alpha_1^* < \alpha_3^*$.

(The proof of Theorem 2 is shown in Appendix C.)

Theorem 2 indicates that, with the conspicuous customers in the market, the quick response could induce the retailer to adopt high price while surprisingly, value-added services inhibit it. Quick response can only increase the willingness to pay of the conspicuous customers by reducing the probability of discounted sales. However, the value-added services increase the willingness to pay of all customers. In this way, target customers for quick response and value-added services should be conspicuous customers and all customers, respectively. Intuitively, luxury retailers that provide value-added services will have higher market positioning, therefore should set higher prices. Our finding shows it exactly oppositely. This provides an important insight for luxury retailers adopting value-added services such as L&C Leather Workshop: positing the products to all customers may be more profitable than market segmentation strategy.

Table 3. Retailer's optimal pricing strategies and profits.

	$0 < \alpha \le \alpha_2^*$	$\alpha_2^* < \alpha < \alpha_1^*$	$\alpha_1^* \le \alpha \le \alpha_3^*$	$\alpha_3^* \le \alpha < 1$
Model 1	Low price π_{11}	Low price π_{11}	High price π_{12}	High price π_{12}
Model 2	Low price π_{21}	High price π_{22}	High price π_{22}	High price π_{22}
Model 3	Low price π_{31}	Low price π_{31}	Low price π_{31}	High price π_{32}

5 Analysis of quick response and value-added services

In order to obtain insights about optimal strategy, now we further compare the profits of three models with optimal pricing decisions.

5.1 Analysis of quick response (model 1 vs. model 2)

This section compares the results of models 1 and 2 to determine whether retailer should respond quickly to deal with market uncertainty and the associated customer strategic behavior.

Theorem 3:

1) in the case of $0<\alpha\le\alpha_2^*$***, if*** $w_q<w_q^I$***,we have*** $\pi_{21}>\pi_{11}$***, vice versa.***

2) in the case of $\alpha_2^*<\alpha<\alpha_1^*$***, if*** $w_q<w_q^{II}$***,we have*** $\pi_{22}>\pi_{11}$***, vice versa.***

3) in the case of $\alpha_1^*\le\alpha<1$***, if*** $w_q<w_q^{III}$***,we have*** $\pi_{22}>\pi_{12}$***, vice versa.***

Where $w_q^I<w_q^{II}<w_q^{III}$***.***

(The proof of Theorem 3 and characterizations of w_q^I***,*** w_q^{II} ***and*** w_q^{III} ***are shown in Appendix D.)***

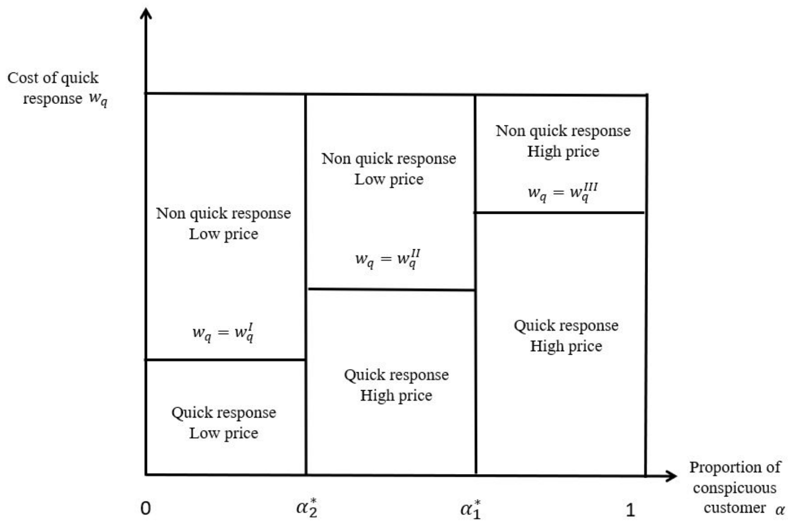


Figure 1. Optimal pricing decision and strategy by comparing the models 1 and 2.

Theorem 3 indicates the conditions for adopting quick response and the optimal pricing strategy in different situations. It can be seen intuitively from Figure 1 that, regardless of the proportion of conspicuous customers, it is advantageous to have quick response strategy only when the cost is low. The quick response grants the retailer two opportunities to order in the first period, making the order quantity close to the actual demand in the first period. Thus, it decreases the necessity of selling goods at a discounted price, and reduces the losses of price reduction. But as the cost of the secondary ordering increases, the quick response strategy becomes less economical when the extra cost diminishes the benefits. This is of course in line with the managerial principle of companies.

Theorem 3 also shows that the higher the proportion of conspicuous customers in the market, the more incline retailers are to adopt a quick response strategy. More specifically, when the proportion of conspicuous customers is ($\alpha_1^* \le \alpha \le 1$), the cost threshold for taking quick response is the highest. The explanation is that the quick response can reduce the probability that the goods being sold in the second period by matching the supply and demand of the first period, so that the probability of stockout in the second period ξ becomes higher. As for the conspicuous customers, a high probability of stockout in the second period imposes a high psychological utility of purchasing immediately. In short, when more conspicuous customers exist in the market, the retailer can withstand a higher cost of quick response, motivating the retailer to adopt quick response strategy.

An important managerial implication of Theorem 3 is that luxury retailers should adopt a combination of high price and quick-response strategies when there are more conspicuous customers. On the one hand, retailers can improve the willingness to pay of conspicuous customers through quick response, as the possibility of stockout in the second period can be higher. On the other hand, retailers can obtain the maximum surplus value of conspicuous customers by setting a high price. The existence of conspicuous customers will amplify the advantages of quick response strategy, which is a good explanation for some of the luxury brands mentioned in the introduction, such as Sandro and Maje, which have begun to incorporate the characteristics of luxury and fast fashion brands and adopted a quick response strategy.

5.2 Analysis of value-added services (model 1 vs. model 3)

This section compares the results of model 1 and 3 to determine whether the retailer should adopt value-added services.

Theorem 4:

1) in the case of $0 < \alpha \le \alpha_1^*$***, if*** $\tau < \tau^I$ ***,we have*** $\pi_{31} > \pi_{11}$***, vice versa.***

2) in the case of $\alpha_1^* < \alpha < \alpha_3^*$***,if*** $\tau < \tau^{II}$ ***,we have*** $\pi_{31} > \pi_{12}$***, vice versa.***

3) in the case of $\alpha_3^* \le \alpha < 1$*, if* $\tau < \tau^{III}$ *,we have* $\pi_{32} > \pi_{12}$*, vice versa.*

Where $\tau^{I} > \tau^{II} > \tau^{III}$.

(The proof of Theorem 4 and characterizations of τ^{I} *,* τ^{II} *and* τ^{III} *are shown in Appendix E.)*

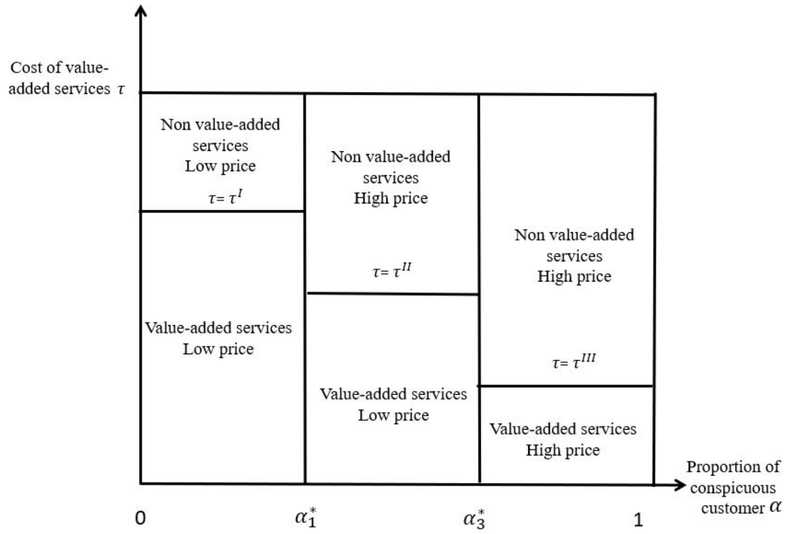


Figure 2. Optimal pricing decision and strategy by comparing models 1 and 3.

Similar as in Theorem 3, Theorem 4 also shows that value-added services are beneficial only when the cost is relatively low. Different from Theorem 3, Theorem 4 reflects that the existence of conspicuous customers will prevent the retailer from choosing value-added service strategy. As can be seen visually in Figure 2, when α increases, the cost of value-added services needs to be reduced to a lower level to make value-added services beneficial. In the contrast, Figure 1 illustrates that as α increases, even if the cost of quick response becomes higher, the quick response strategy can be profitable. Theorem 4 reminds traditional luxury retailers that a focus on value-added services may result in profit reduction when there are more conspicuous customers in the market. For example, when conspicuous markets such as China become the fastest-growing regions for luxury consumption, some traditional luxury brands focusing on value-added services cannot adjust their strategies according to market conditions, resulting in huge profit losses. In 2016, sales of the famous luxury brand Prada declined by about 10% (Deloitte, 2018).

5.3 Comparison of quick response and value-added services (model 2 vs. model 3)

This section focuses on the retailer's profit comparisons when providing quick response and value-added services, and analyzes the retailer's optimal strategy and pricing decision with different proportions of conspicuous customers. Therefore, we consider only the situation when providing value-added services or the quick response is better than the basic model, that is, the following analysis is based on $w_q < w_q^I$ and $\tau < \tau^{III}$.

Theorem 5:

1) in the case of $0 < \alpha \le \alpha_2^*$***,if*** $\tau < \bar{\tau}^I$ ***,we have*** $\pi_{31} > \pi_{21}$***, vice versa.***

2) in the case of $\alpha_2^* < \alpha < \alpha_3^*$***, if*** $\tau < \bar{\tau}^{II}$ ***,we have*** $\pi_{31} > \pi_{22}$***, vice versa.***

3) in the case of $\alpha_3^* \le \alpha < 1$***, if*** $\tau < \bar{\tau}^{III}$ ***,we have*** $\pi_{32} > \pi_{22}$***, vice versa.***

Where $\bar{\tau}^I > \bar{\tau}^{II} > \bar{\tau}^{III}$.

(The proof of Theorem 5 and the characterizations of $\bar{\tau}^I$, $\bar{\tau}^{II}$ ***and*** $\bar{\tau}^{III}$ ***are shown in Appendix F.)***

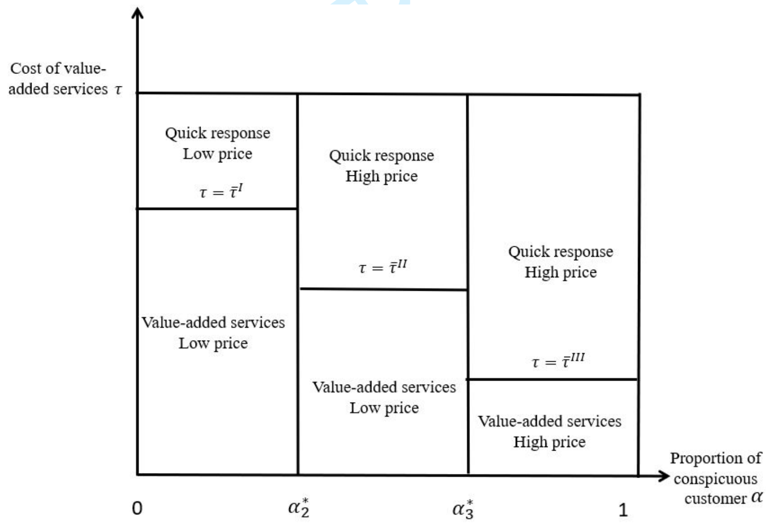


Figure 3. Optimal pricing decision and strategy by comparing models 2 and 3.

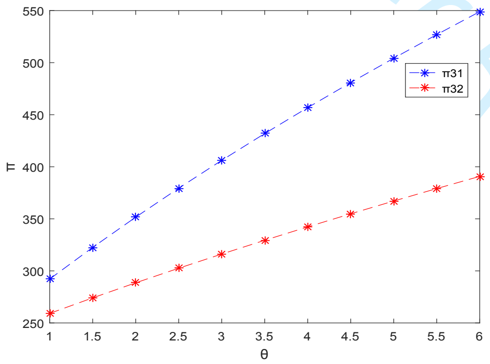
Theorem 5 compares the profits of models 2 and 3. It can be seen intuitively from Figure 3 that there are three different thresholds for value-added service cost τ under different proportions of conspicuous customers. When the value-added service cost is lower than the thresholds, adopting value-added services outperforms the quick response strategy. However, when the proportion of conspicuous customers is very large, setting a high price with quick response strategy is more likely profitable than providing value-added services. Theorem 5 further indicates an important implication for luxury retailers, that is, when there are more conspicuous customers in the market and the value-added services are relatively costly, they should try to learn from the fast fashion and adopt quick response, just like Sandro and Maje did.

6 Numerical simulation

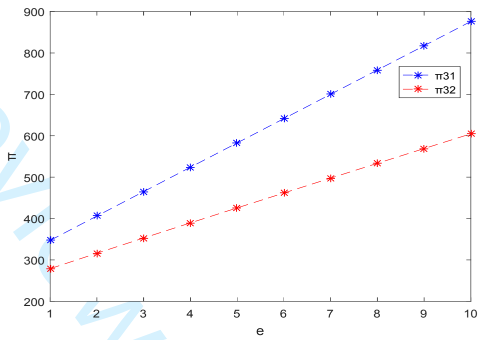
In this section, we used MATLAB2016 software for numerical analysis to simulate the impact of some parameters on profits in order to discover new management findings. The basic data for the numerical analysis follows Tereyağoğlu and Veeraraghavan (2012). In this paper, the parameters are assigned as follows: $v=20$, $k=5$, $s=6$, $N\left(100,20^2\right)$, $w_q=2$, $e=2$, $\tau=1$, $\theta=3$ and $\alpha\in\left(0,1\right)$.

6.1 The impact of value-added services on retailer's profits

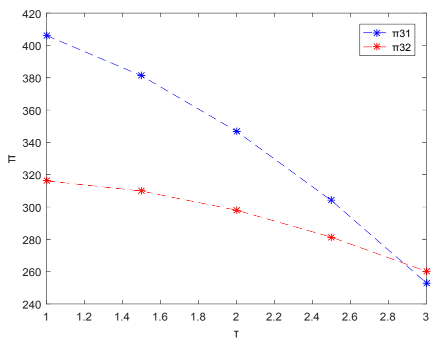
This part mainly analyzes the impact of the parameters on the retailer's profits in model 3 (see Figure 4).



(a) The impact of θ on π_3.



(b) The impact of e on π_3.



(c) The impact of τ on π_3

Figure 4. The impact of value-added services on retailer's profits.

As can be seen from Figure 4, the retailer's profit increases with the utility increase coefficient θ, the service level e, while decreases with the cost coefficient of value-added service τ. This conclusion is relatively intuitive. When θ or e increases, customers' willingness to pay increases accordingly, so the retailer can specify higher prices to increase profits. While when the cost of value-added services increases, profits will decrease.

6.3 The impact of other parameters on profits

In this section, we analyze the impact of other parameters such as sensitivity coefficient of stockout for conspicuous customers k, the discounted price s, and the difference between full price and discounted price $p-s$ on the retailer's profits.

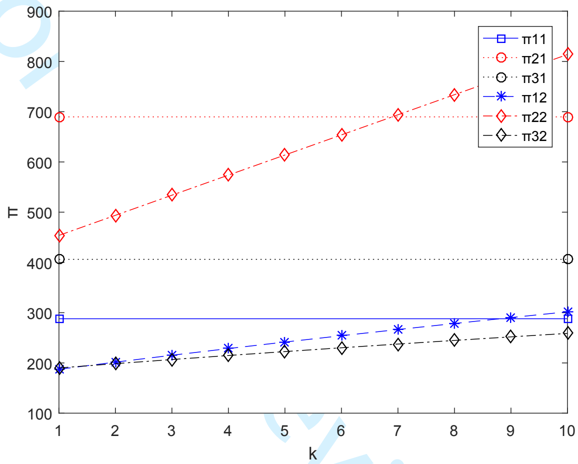


Figure 5. The impact of k on the retailer's profits.

It can be seen from Figure 5: with the increase of the sensitivity coefficient of stockouts for conspicuous customers, π_{11},π_{21} and π_{31} remain unchanged, whereas π_{12},π_{22} and π_{32} increase. This phenomenon is also consistent with reality. When the sensitivity coefficient of stockouts for conspicuous customers is high, the conspicuous customer is willing to pay more (psychologically), and thus the retailer can set a higher price to increase profits.

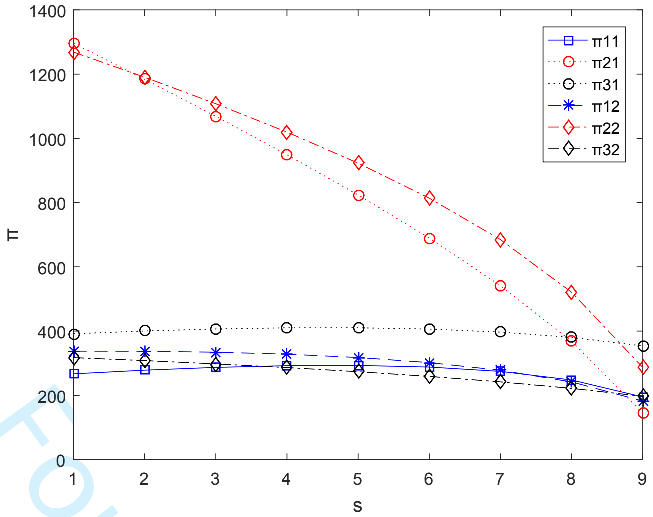
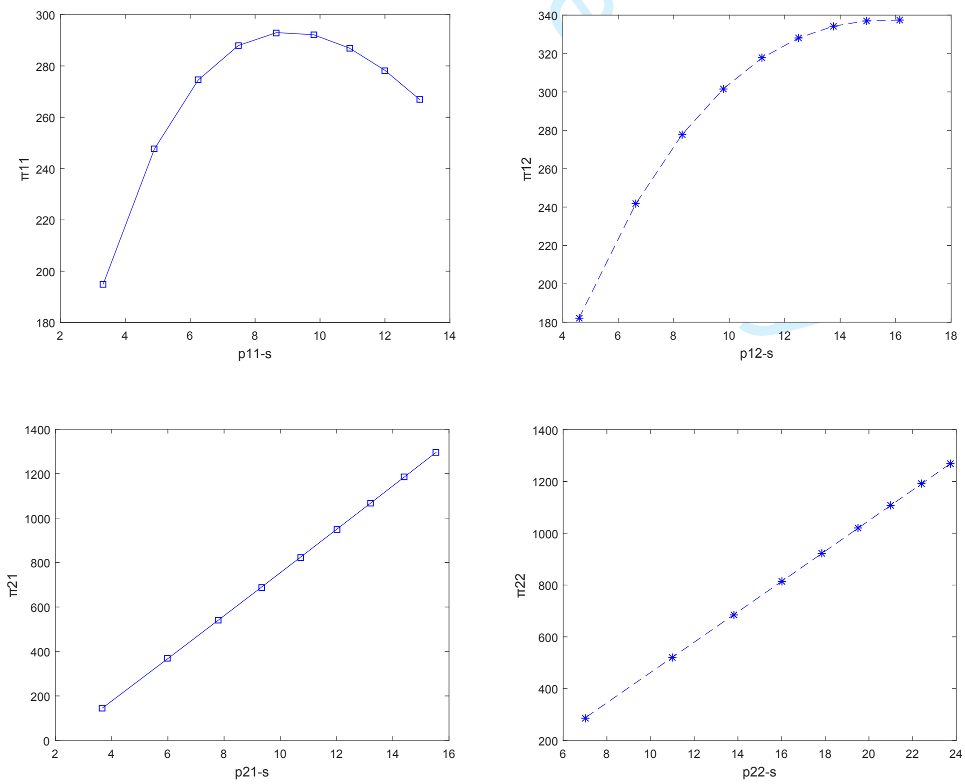


Figure 6. The impact of s on the retailer's profits.

As seen from Figure 6, with an increase in the discounted price, the profits of the retailer decrease. The discounted price has the greatest impact on the profit under the quick response, and has less impact on the profits under the basic model and value-added services. This gives some inspiration to the retailer that, in the case of quick response, the retailer should set a low discounted price, which promotes rapid sales of products and capital return, while in the case of value-added services, applying a discount price will not bring any significant improvement.



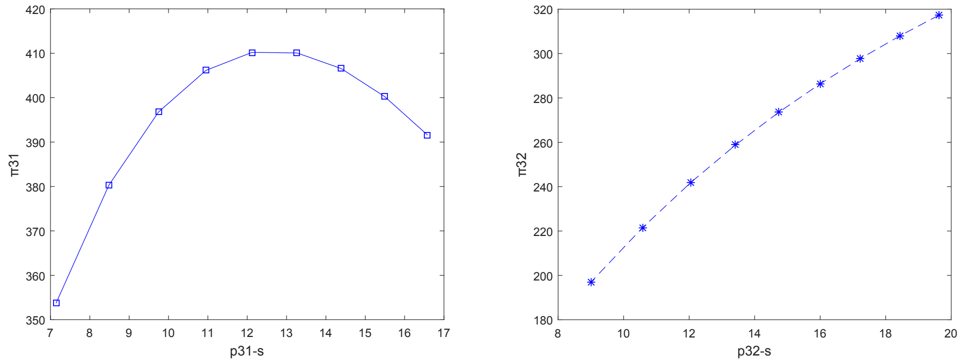


Figure 7. The impact of $p-s$ on the retailer's profits.

As seen from Figure 7, with an improvement in the $p-s$, the profits in different models show different trends. Generally, as the increase of $p-s$, the retailer's profits will be increased. However, there are two exceptions in the basic model and the value-added services model when all customers are buying in the first period. In these two cases, the retailer's profits first increase then decrease, which suggests the retailer set a correct $p-s$ value to maximize the profit.

7 Model extension

Considering that value-added services and quick response are not completely mutually exclusive, there is a trend in luxury industry to adopt both strategies as long as resources allow. Therefore, we model this situation and further investigate the relationship between these two strategies.

7.1 Model with quick response and value-added services (model 4)

The expected profits of the retailer in the two cases where all customers buy in the first period or only conspicuous customers buy in the first period are shown in Eqs. (7) and (8), respectively.

$$\pi_{41}(Q)=(p-w-\tau e)E(d)-w_q E(d-Q)^{+}+(s-w-\tau e)E(Q-d)^{+}. \tag{7}$$

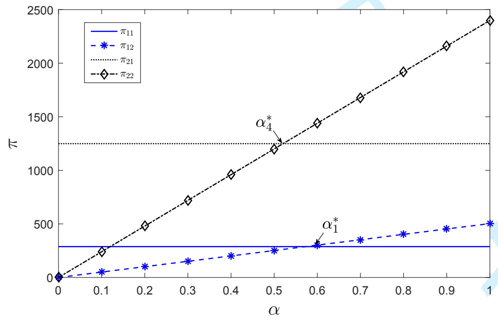
$$\pi_{42}(Q)=(p-w-\tau e)E(\alpha d)-w_q E(\alpha d-Q)^{+}+(s-w-\tau e)E(Q-\alpha d)^{+}. \tag{8}$$

In these two equations, three terms on the right refer to the profits by satisfying all customers (or conspicuous customer only) in the first period, the additional cost due to quick response, and the profit obtained in the second period, respectively.

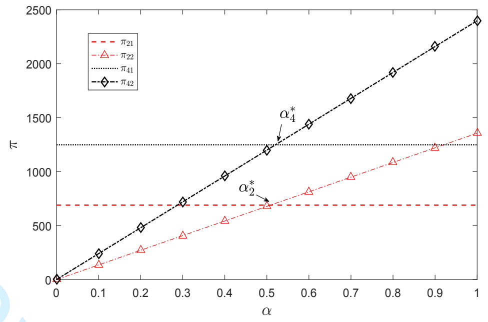
Similar to the models 1, 2 and 3, there is also a threshold α_4^*, making a low price strategy is better when $\alpha \in (0, \ \alpha_4^*]$. The detailed analysis and proofs can be found in Appendix G.

7.2 Impact of quick response and value-added services on α^*

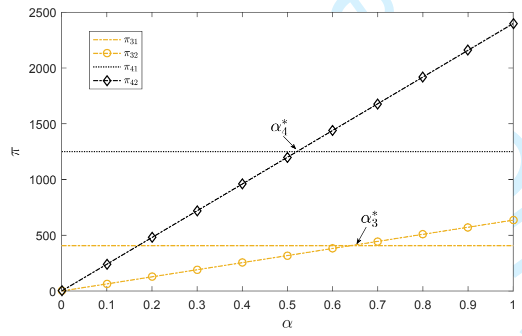
Due to the complicated calculation results when considering two strategies at the same time, the following investigation of model extension is based on the numerical simulation with the parameter setting $v=20$, $k=5$, $s=6$, $w=10$, $w_q=2$, $e=2$, $\tau=1$, $\theta=3$, $d \sim N\left(100, 20^2\right)$. The comparisons of α_4^*, α_1^*, α_2^* and α_3^* are shown in Figure 8.



(a) Model 1 vs. model 4.



(b) Model 2 vs. model 4.



(c) Model 3 vs. model 4.

Figure 8. Comparasions of α^* in different models.

Through the numerical examples we know that $\alpha_2^* < \alpha_4^* < \alpha_1^*$, with our parameter setting. Combined with Theorem 2, we have $\alpha_2^* < \alpha_4^* < \alpha_1^* < \alpha_3^*$, with which we can suggest the optimal pricing decisions for the retailer in four models, as shown in Figure 9.

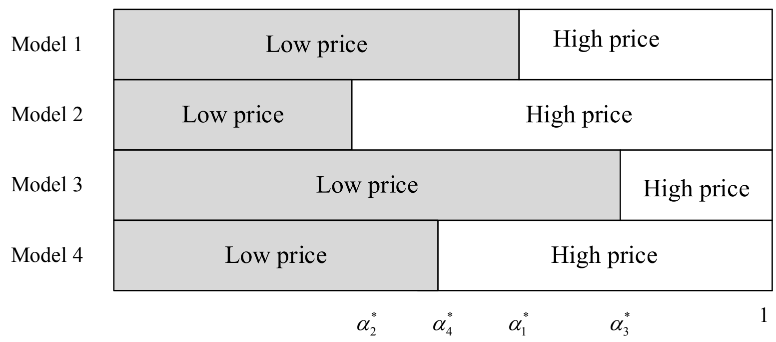


Figure 9. Optimal pricing decisions in four models.

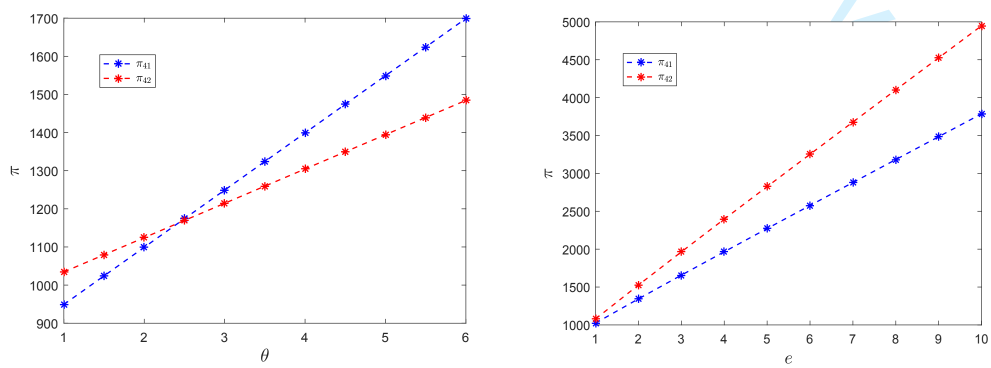
Observation 1:

The range of α to adopt a high price strategy is largest in the model 2 with quick response, while it is smallest in the model 3 with value-added services.

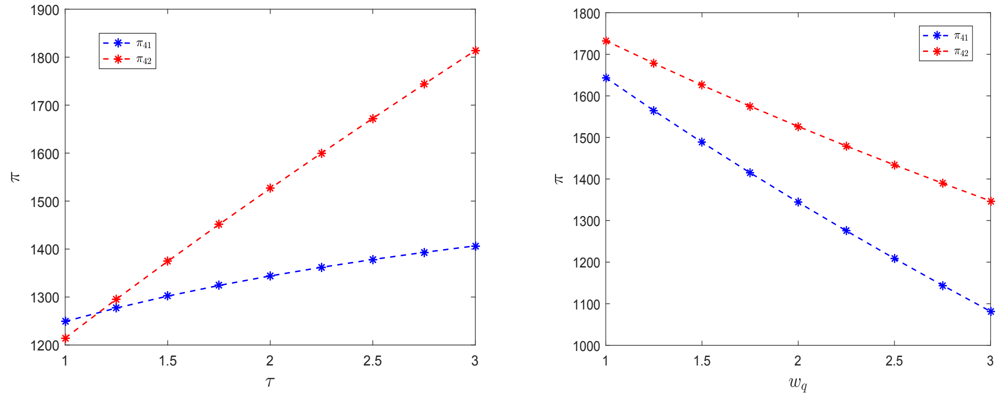
When the retailer adopts a high price strategy, only conspicuous customers will purchase in the first period. Recall that a high price strategy is optimal only when the proportion of conspicuous customers is high. Observation 1 shows that, the range of α to adopt a high price strategy is the largest in model 2. It further explains the important conclusion of this paper, that is, the quick response could induce the retailer to adopt high price while value-added services inhibit it. According to model 4, in this case quick response and value-added services bring positive and negative impacts, respectively. Therefore, we have $\alpha_2^* < \alpha_4^* < \alpha_3^*$.

7.3 Impact of other parameters on the profit in model 4

In this section, we simulate the impact of the utility increase coefficient θ, the service level e, the cost coefficient of value-added service τ and the cost of quick response w_q on the retailer's profits in model 4. The results are shown in Figure 10.



(a) The impact of θ on π_4. (b) The impact of e on π_4.



(c) The impact of τ on π_4 (d) The impact of w_q on π_4

Figure 10. The impact of parameters on retailers' profits in model 4.

Figure 10 shows that, the retailer's profit increases as the utility increase coefficient θ, the service level e, and the cost coefficient of value-added service τ, while decreases as the cost of quick response w_q. The effect of θ, e and w_q could be intutively obvious. Interestingly, the profit changes in a reverse direction with τ. We now propose Observation 2.

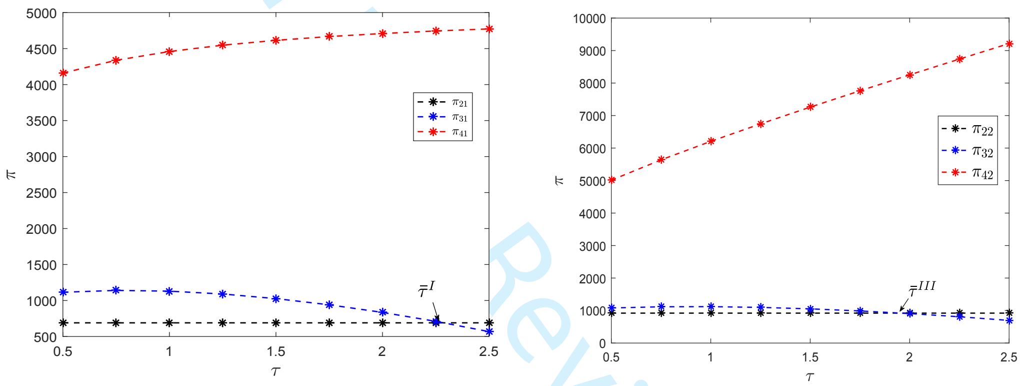
Observation 2:

When the retailer provides both quick response and value-added services, profits decrease with the cost of quick response, but increase with the cost of value-added services.

According to the analysis of model 3, when the retailer only provides value-added services, the profits decrease with the cost of value-added services. However, when both strategies are included, profits increase with the cost of value-added services. The explanation is that in this case the retailer could increase the price and therefore reduce the negative effect of increased costs. Whereas when only value-added services are provided, increasing the price will make more customers wait till the second period to purchase, and therefore resulting in losses. Since the losses are greater than the revenue gained from increasing price, the profit decreases as the cost of value-added services increases. However, when the retailer adopts the quick response at the same time, the quick response enhances the balance between demand and sales in the first period, thereby it reduces the probability of the sales at a discount, and subsequently it reduces losses. Therefore, the revenue from the increase in price at this time will be higher than the sales loss, so that the retailer's profit will increase with the cost of value-added services. In short, quick response can amplify the benefits of value-added services by controlling the probability of the goods to be sold in the second period.

7.4 Comparisons of profits in the same price decision

In this section, we compare the retailer' profits in models 2, 3 and 4. From section 7.2 we know that the optimal pricing strategies of different models are not the same. We use $\alpha = 0.2$ to represent the situation of $\alpha < \alpha_2^*$, where the optimal pricing strategies of above mentioned three models are the low price strategies; and $\alpha = 0.9$ to represent the situation of $\alpha > \alpha_3^*$, where the corresponding optimal pricing strategies are the high price strategies. At the same time, we make $e = 10$ to satisfy the constraints in Theorem 5. The profits comparisons are shown in Figure 11.



(a) Profits comparisons with a low price (b) Profits comparisons with a high price

Figure 11. Profits comparisons of models 2, 3 and 4.

Through the profits comparisons, we find that no matter what pricing strategy is applied, the profit of providing both strategies is always higher than the profits when only one strategy is adopted. This shows that value-added services and quick response can bring an increase in profits when costs are relatively low. Therefore, the retailer is encouraged to combine two strategies at the same time when resources such as funds and personnel are sufficient. At the same time, it can be seen that when the value-added services cost is low, providing only value-added services is more profitable than providing only quick response. The abscissas corresponding to the intersections in Figure 11 (a) and (b) are represent the $\bar{\tau}^I$ and $\bar{\tau}^{III}$ in the Theorem 5 respectively. We can see $\bar{\tau}^{III} < \bar{\tau}^I$ in the figure, which verifies the Theorem 5.

8 Conclusion and management insights

8.1 Main conclusions

This paper studies the retailers' optimal pricing decisions with regard to conspicuous customers in the luxury industry when the retailer can provide quick response or value-added services. The main conclusions of this paper are as follows. First, the proportion of conspicuous customers plays an important role in determining the pricing strategy in a luxury market. When the proportion of conspicuous customers is lower than a threshold, the retailer should adopt a low price strategy, otherwise a high price strategy. Besides, the quick response could induce the retailer to adopt high price while value-added services inhibit it. Second, the customer conspicuous behavior can motivate the retailer to provide quick response. Therefore, when the proportion of conspicuous customers in the market is higher, the retailer tends to adopt a combination of high price and quick response strategies. Third, in the model extension, we find that providing two strategies together can bring greater profits to the retailer when costs permit and the existence of quick response can amplify the benefits of value-added services. Specifically, the retailer's profits increase with the cost of value-added services when both strategies are provided, but the profits will decrease with the cost when only value-added services strategy is provided.

8.2 Management insights

The main conclusions of this paper include practical references for retailers who need to make decisions concerning conspicuous customers in a luxury market. First, the retailers should investigate the types of customers in the market, so as to form better pricing decisions and therefore maximize the profit according to the mix of customers. Second, considering more conspicuous customers in the market, the retailers should provide quick response, timely replenish products according to market demand, in order to reduce the possibility of goods being sold at a reduced price and obtain higher profits. Third, for the retailers with sufficient resources such as capital and manpower to adopt quick response and value-added services at the same time, both strategies should be included to maximize their profits. Moreover, when adopting a value-added services strategy, the company's out-of-stock probability in the second period should be controlled to amplify the benefits of value-added services.

8.3 Limitations and future study

Although this paper analyzes the pricing decisions and service strategy decision for the retailers facing conspicuous customers in the luxury market, there are still some shortcomings in this paper. First, the supply chain structure considered in this paper only involves the retailer and customers; it does not consider the behavior of the supply side such as a manufacturer. In practice, the supplier's decision will also affect the retailer's pricing, and quick response also requires the support and cooperation of the supplier. Therefore, future research should extend to such supply chain structure. In addition, for the mode choices of luxury company, this paper considers the high-end luxury route and the phenomenon of transforming to “accessible luxury”. The parameters are relatively simple in the two models. The future research should collect more data to elaborate the choice behavior of the retailer and the customers, in particular the conspicuous customers, to further improve the retailer's decisions.

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Appendix A: Optimal equilibriums of the three models

Table A-1. Summary of the optimal equilibriums of the three models.

Model	variables	Case 1 (all customers purchase in the first period)	Case 2 (only conspicuous customers purchase in the first period)
Model 1	price	$p_{11}^{*}=\sqrt{(w-s)(v-s)}+s$	$p_{12}^{*}=\sqrt{(w-s)(v+k-s)}+s$
	Order quantity	$Q_{11}^{*}=\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v-s}}\right)$	$Q_{12}^{*}=\alpha\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v+k-s}}\right)$
	profit	$\pi_{11}(Q)=\sqrt{(w-s)(v-s)}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v-s}}\right)}xf(x)dx$	$\pi_{12}(Q)=\alpha\sqrt{(w-s)(v+k-s)}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v+k-s}}\right)}xf(x)dx$
Model 2	price	$p_{21}^{*}=\frac{w-s}{w+w_q-s}(v-s)+s$	$p_{22}^{*}=\frac{w-s}{w+w_q-s}(v+k-s)+s$
	order quantity	$Q_{21}^{*}=\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)$	$Q_{22}^{*}=\alpha F^{-1}\left(\frac{w-s}{w+w_q-s}\right)$
	profit	$\pi_{21}(Q)=(w+w_q-s)\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)}xf(x)dx+\left(\frac{w-s}{w+w_q-s}(v-s)+s-w-w_q\right)\mu$	$\pi_{22}(Q)=\alpha\left[(w+w_q-s)\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)}xf(x)dx+\left(\frac{w-s}{w+w_q-s}(v+k-s)+s-w_q-w\right)\mu\right]$
Model 3	price	$p_{31}^{*}=\sqrt{(w+\tau e-s)(v+\theta e-s)}+s$	$p_{32}^{*}=\sqrt{(w+\tau e-s)(v+\theta e+k-s)}+s$
	order quantity	$Q_{31}^{*}=\bar{F}^{-1}\left(\sqrt{\frac{w+\tau e-s}{v+\theta e-s}}\right)$	$Q_{32}^{*}=\alpha\bar{F}^{-1}\left(\sqrt{\frac{w+\tau e-s}{v+\theta e+k-s}}\right)$
	profit	$\pi_{31}(Q)=\sqrt{(v+\theta e-s)(w+\tau e-s)}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\tau e-s}{v+\theta e-s}}\right)}xf(x)dx$	$\pi_{32}(Q)=\alpha\sqrt{(v+\theta e+k-s)(w+\tau e-s)}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\tau e-s}{v+\theta e+k-s}}\right)}xf(x)dx$

We now show the proofs of optimal equilibriums. Taking Model 1 as an example, the retailer's expected profit when all customers buy in the first period can be simplified into $\pi_{11}(Q)=(p-s)E\min(d,Q)-(w-s)Q$. Because $\xi=\overline{F}(Q)$, the price $p=v-(v-s)(1-\xi)=\overline{F}(Q)(v-s)+s$. By substituting p into $\pi_{11}(Q)$ and finding the first derivative of the profit function, we obtain $\bar{F}(Q)=\sqrt{\frac{w-s}{v-s}}$ and $Q_{11}^{*}=\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v-s}}\right)$. To ensure Q_{11}^{*} to be positive, we should have $w>s$, which is often true in reality, especially in the garment industry. For example, during the product promotion season, companies will sell at a loss to reduce inventory and regain cashes. Substituting the Q_{11}^{*} into p, we have $p_{11}^{*}=\sqrt{(w-s)(v-s)}+s$. Substituting the Q_{11}^{*} and p_{11}^{*} into $\pi_{11}(Q)$, we have $\pi_{11}(Q)=\sqrt{(w-s)(v-s)}\int_{0}^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v-s}}\right)}xf(x)dx$.

Similarly, the retailer's expected profit when only conspicuous customers buy in the first period can be simplified as $\pi_{12}(Q)=\alpha(p-s)E\min\left(d,\frac{Q}{\alpha}\right)-\alpha(w-s)\frac{Q}{\alpha}$. The price $p=v+k\xi-(v-s)(1-\xi)=\bar{F}\left(\frac{Q}{\alpha}\right)(v+k-s)+s$. By substituting p into $\pi_{12}(Q)$ and finding the first derivative of the profit function, we obtain $Q_{12}^{*}=\alpha\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v+k-s}}\right)$ and $p_{12}^{*}=\sqrt{(w-s)(v+k-s)}+s$, $\pi_{12}(Q)=\alpha\sqrt{(w-s)(v-s+k)}\int_{0}^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v+k-s}}\right)}f(x)dx$. The similar processes are applied to the calculation of models 2 and 3. Thus, we complete the proofs of optimal equilibriums.

Appendix B: Proof of Theorem 1

It is intuitive to see that the π_{12}, π_{22} and π_{32} are strictly monotonically increasing in α.

Let $\pi_{i2}=\pi_{i1}$, $i=1,2,3$, then we have $\alpha_{1}^{*}=\dfrac{\sqrt{v-s}\int_{0}^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v-s}}\right)}xf(x)dx}{\sqrt{v+k-s}\int_{0}^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v+k-s}}\right)}xf(x)dx}$,

$$\alpha_2^* = \frac{\left(w+w_q-s\right)\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf\left(x\right)dx + \left(\frac{w-s}{w+w_q-s}\left(v-s\right)+s-w-w_q\right)\mu}{\left(w+w_q-s\right)\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf\left(x\right)dx + \left(\frac{w-s}{w+w_q-s}\left(v+k-s\right)+s-w_q-w\right)\mu}$$ and

$$\alpha_3^* = \frac{\sqrt{v+\theta e-s}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\tau e-s}{v+\theta e-s}}\right)} xf\left(x\right)dx}{\sqrt{v+\theta e+k-s}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\tau e-s}{v+\theta e+k-s}}\right)} xf\left(x\right)dx},$$ making when $\alpha \in (0,\ \alpha_i^*]$, $\pi_{i2} \le \pi_{i1}$; and when $\alpha \in (\alpha_i^*, 1)$, $\pi_{i2}\left(Q\right) > \pi_{i1}\left(Q\right)$.

Then we complete the proof of Theorem 1.

Appendix C: Proof of Theorem 2

(1) We first compare the α_1^* and α_2^*.

$$\frac{\alpha_2^*}{\alpha_1^*} = \frac{\left(w+w_q-s\right)\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf\left(x\right)dx + \left(\frac{w-s}{w+w_q-s}\left(v-s\right)+s-w-w_q\right)\mu}{\left(w+w_q-s\right)\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf\left(x\right)dx + \left(\frac{w-s}{w+w_q-s}\left(v+k-s\right)+s-w_q-w\right)\mu} * \frac{\sqrt{v+k-s}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v+k-s}}\right)} xf\left(x\right)dx}{\sqrt{v-s}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v-s}}\right)} xf\left(x\right)dx}$$

$$< \frac{\left(w+w_q-s\right)\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf\left(x\right)dx + \left(\frac{w-s}{w+w_q-s}\left(v-s\right)+s-w-w_q\right)\mu}{\left(w+w_q-s\right)\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf\left(x\right)dx + \left(\frac{w-s}{w+w_q-s}\left(v+k-s\right)+s-w_q-w\right)\mu} * \frac{\sqrt{v+k-s}}{\sqrt{v-s}}$$

$$= \frac{\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf\left(x\right)dx + \left(\frac{w-s}{\left(w+w_q-s\right)^2}\left(v-s\right)-1\right)\mu}{\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf\left(x\right)dx + \left(\frac{w-s}{\left(w+w_q-s\right)^2}\left(v+k-s\right)-1\right)\mu} * \frac{\sqrt{v+k-s}}{\sqrt{v-s}}$$

Using the magnifying or reducing method, when $c > b > a > 0$, $\frac{b}{c} > \frac{b-a}{c-a}$

$$\frac{\alpha_2^*}{\alpha_1^*} < \frac{\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf(x)dx + \frac{w-s}{\left(w+w_q-s\right)^2}(v-s)\mu}{\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf(x)dx + \frac{w-s}{\left(w+w_q-s\right)^2}(v+k-s)\mu} * \frac{\sqrt{v+k-s}}{\sqrt{v-s}}$$

$$= \frac{\frac{\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf(x)dx}{\sqrt{v-s}} + \frac{w-s}{\left(w+w_q-s\right)^2}\mu\sqrt{v-s}}{\frac{\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf(x)dx}{\sqrt{v+k-s}} + \frac{w-s}{\left(w+w_q-s\right)^2}\mu\sqrt{v+k-s}}$$

Comparing the numerator and denominator, that is $\frac{\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf(x)dx}{\sqrt{v-s}} + \frac{w-s}{\left(w+w_q-s\right)^2}\mu\sqrt{v-s}$ and $\frac{\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf(x)dx}{\sqrt{v+k-s}} + \frac{w-s}{\left(w+w_q-s\right)^2}\mu\sqrt{v+k-s}$, can be considered the size of $\frac{1}{\sqrt{v-s}} + \sqrt{v-s}$ and $\frac{1}{\sqrt{v+k-s}} + \sqrt{v+k-s}$, calculate the square of the two, we can get $\left(\frac{1}{\sqrt{v-s}} + \sqrt{v-s}\right)^2 = \frac{1}{v-s} + v - s + 2$, $\left(\frac{1}{\sqrt{v+k-s}} + \sqrt{v+k-s}\right)^2 = \frac{1}{v+k-s} + v + k - s + 2$,

So we find: $\left(\frac{1}{v+k-s} + v + k - s + 2\right) - \left(\frac{1}{v-s} + v - s + 2\right)$. Therefore,
$= k + \frac{1}{v+k-s} - \frac{1}{v-s} > 0$

$$\frac{\alpha_2^*}{\alpha_1^*} < \frac{\frac{\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf(x)dx}{\sqrt{v-s}} + \frac{w-s}{\left(w+w_q-s\right)^2}\mu\sqrt{v-s}}{\frac{\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf(x)dx}{\sqrt{v+k-s}} + \frac{w-s}{\left(w+w_q-s\right)^2}\mu\sqrt{v+k-s}} < 1, \alpha_1^* > \alpha_2^*.$$

(2) we then compare α_1^* and α_3^*.

We use a sub-item comparison method, first we compare the size of $\frac{\sqrt{v-s}}{\sqrt{v+k-s}}$ and $\frac{\sqrt{v+\theta e-s}}{\sqrt{v+\theta e+k-s}}$, can be considered the size of $\frac{v-s}{v+k-s}$ and $\frac{v+\theta e-s}{v+\theta e+k-s}$, when $a,b,c>0$ and

$b < c$, $\frac{a+b}{a+c} > \frac{b}{c}$, so $\frac{v+\theta e-s}{v+\theta e+k-s} > \frac{v-s}{v+k-s}$.

Then we compare the size of $\frac{\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\tau e-s}{v+\theta e-s}}\right)} xf(x)dx}{\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\tau e-s}{v+\theta e+k-s}}\right)} xf(x)dx}$ and $\frac{\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v-s}}\right)} xf(x)dx}{\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v+k-s}}\right)} xf(x)dx}$. Because of $\int_0^A xf(x)dx$ is a monotonically increasing function, the monotonicity of $\frac{\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\tau e-s}{v+\theta e-s}}\right)} xf(x)dx}{\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\tau e-s}{v+\theta e+k-s}}\right)} xf(x)dx}$ is same with $\frac{\sqrt{\frac{w+\tau e-s}{v+\theta e-s}}}{\sqrt{\frac{w+\tau e-s}{v+\theta e+k-s}}}$, we can compare the size of $\frac{\sqrt{\frac{w+\tau e-s}{v+\theta e-s}}}{\sqrt{\frac{w+\tau e-s}{v+\theta e+k-s}}}$ and $\frac{\sqrt{\frac{w-s}{v-s}}}{\sqrt{\frac{w-s}{v+k-s}}}$ directly, $\frac{\sqrt{\frac{w+\tau e-s}{v+\theta e-s}}}{\sqrt{\frac{w+\tau e-s}{v+\theta e+k-s}}}$ can be simplified as $\sqrt{\frac{v+\theta e+k-s}{v+\theta e-s}}$, $\frac{\sqrt{\frac{w-s}{v-s}}}{\sqrt{\frac{w-s}{v+k-s}}}$ can be simplified as $\sqrt{\frac{v+k-s}{v-s}}$.

Using the magnifying or reducing method, when a、b、$c > 0$ and $b < c$, $\frac{a+b}{a+c} > \frac{b}{c}$, so $\sqrt{\frac{v+\theta e+k-s}{v+\theta e-s}} > \sqrt{\frac{v+k-s}{v-s}}$. So $\frac{\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\tau e-s}{v+\theta e-s}}\right)} xf(x)dx}{\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\tau e-s}{v+\theta e+k-s}}\right)} xf(x)dx} > \frac{\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v-s}}\right)} xf(x)dx}{\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v+k-s}}\right)} xf(x)dx}$.

So $\alpha_3^* = \frac{\sqrt{v+\theta e-s}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\tau e-s}{v+\theta e-s}}\right)} xf(x)dx}{\sqrt{v+\theta e+k-s}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\tau e-s}{v+\theta e+k-s}}\right)} xf(x)dx} > \alpha_1^* = \frac{\sqrt{v-s}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v-s}}\right)} xf(x)dx}{\sqrt{v+k-s}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v+k-s}}\right)} xf(x)dx}$,

$\alpha_1^* < \alpha_3^*$ is established. Therefore, we have $\alpha_2^* < \alpha_1^* < \alpha_3^*$.

Then we complete the proof of Theorem 2.

Appendix D: Proof of Theorem 3.

1) The proof of the first part of Theorem 3: when $0<\alpha\le\alpha_2^*$:

Under this range of α, the best pricing strategies of model 1 and 2 are both low price strategies. So we only need to compare the $\pi_{11}(Q)$ and $\pi_{21}(Q)$. Making $\pi_{11}(Q)=\pi_{21}(Q)$, we have $w_q^I=\sqrt{(w-s)(v-s)}-(w-s)$.

We take the first derivative of $\pi_{21}(Q)$ with respect to w_q, then we get $\frac{\partial\pi_{21}(Q)}{\partial w_q}=E\min(d,Q)-\frac{(v-s)(w-s)\mu}{(w+w_q-s)^2}-\mu<0$, which shows that $\pi_{21}(Q)$ decreases in w_q. So, we have $w_q=w_q^I$, When $w_q<w_q^I$, we have $\pi_{21}(Q)>\pi_{11}(Q)$; when $w_q>w_q^I, \pi_{21}(Q)<\pi_{11}(Q)$; and when $w_q=w_q^I$, $\pi_{21}(Q)=\pi_{11}(Q)$.

2) The proof of the third part of Theorem 3: when $\alpha_1^*<\alpha<1$:

Similarly, let $\pi_{12}(Q)=\pi_{22}(Q)$, we have $w_q^{III}=\sqrt{(w-s)(v+k-s)}-(w-s)$. And $\frac{\partial\pi_{22}(Q)}{\partial w_q}=E\min(d,Q)-\frac{(v+k-s)(w-s)\mu}{(w+w_q-s)^2}-\mu<0$, which shows $\pi_{22}(Q)$ decreases in w_q. So, we have $w_q=w_q^{III}$, When $w_q<w_q^{III}$, we have $\pi_{22}(Q)>\pi_{12}(Q)$; when $w_q>w_q^{III}, \pi_{22}(Q)<\pi_{12}(Q)$; and when $w_q=w_q^{III}$, $\pi_{22}(Q)=\pi_{12}(Q)$.

3) The proof of the second part of Theorem 3: when $\alpha_2^*<\alpha<\alpha_1^*$:

When $\alpha_2^*<\alpha<\alpha_1^*$, we have $\pi_{21}<\pi_{22}$ and $\pi_{11}<\pi_{12}$. And According to the first two parts we know, regardless of α, when $w_q=w_q^I$, we have $\pi_{21}(Q)=\pi_{11}(Q)$ and $\pi_{21}=\pi_{11}<\pi_{22}$. When $w_q=w_q^{III}$, we have $\pi_{11}<\pi_{22}=\pi_{12}$. Recall that $\pi_{22}(Q)$ decrease in w_q and $w_q^I<w_q^{III}$, so there must be $w_q=w_q^{II}$ and $w_q^I<w_q^{II}<w_q^{III}$, making when $w_q<w_q^{II}$, we have $\pi_{22}(Q)>\pi_{11}(Q)$; when $w_q>w_q^{II}$, we have $\pi_{22}(Q)<\pi_{11}(Q)$ and when $w_q=w_q^{II}$, $\pi_{22}(Q)=\pi_{11}(Q)$. w_q^{II} satisfies the equation

$$\alpha\left[\left(w+w_q^{II}-s\right)\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q^{II}-s}\right)} xf\left(x\right)dx+\left(\frac{w-s}{w+w_q^{II}-s}\left(v+k-s\right)+s-w_q^{II}-w\right)\mu\right]=\sqrt{v-s}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v-s}}\right)} xf\left(x\right)dx\cdot$$

Then we complete the proof of Theorem 3.

Appendix E: Proof of Theorem 4

1) The proof of the first part of Theorem 4: when $0<\alpha\le\alpha_1^*$:

According to Table 2, we have $\pi_{11}\left(Q\right)=\sqrt{(w-s)(v-s)}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v-s}}\right)} xf\left(x\right)dx$, $\pi_{31}\left(Q\right)=\sqrt{(v+\theta e-s)(w+\tau e-s)}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\tau e-s}{v+\theta e-s}}\right)} xf\left(x\right)dx$. It can be seen that π_{31} decreases in τ. Therefore, let $\pi_{31}=\pi_{11}$, there is τ^I satisfy $\frac{\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\tau^I e-s}{v+\theta e-s}}\right)} xf\left(x\right)dx}{\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v-s}}\right)} xf\left(x\right)dx}=\frac{\sqrt{v-s}}{\sqrt{v+\theta e-s}}$.

Making when $\tau<\tau^I$, we have $\pi_{31}>\pi_{11}$, vice versa.

2) The proof of the third part of Theorem 4: when $\alpha_3^*\le\alpha<1$:

Similarly, π_{32} decreases in τ. So, let $\pi_{32}=\pi_{12}$, we have and only have $\tau=\tau^{III}$, which satisfies $\frac{\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\tau^{III} e-s}{v+\theta e+k-s}}\right)} xf\left(x\right)dx}{\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v+k-s}}\right)} xf\left(x\right)dx}=\frac{\sqrt{v+k-s}}{\sqrt{v+\theta e+k-s}}$. Making when $\tau<\tau^{III}$, we have $\pi_{32}>\pi_{12}$, vice versa.

3) The proof of the second part of Theorem 4: when $\alpha_1^*<\alpha<\alpha_3^*$:

When $\tau=\tau^I$, we have $\pi_{31}(\tau^I)=\pi_{11}<\pi_{12}$. And when $\tau=\tau^{III}$,we have $\pi_{31}(\tau^{III})>\pi_{32}(\tau^{III})=\pi_{12}$. Therefore, we know $\pi_{31}(\tau^I)<\pi_{31}(\tau^{III})$. Recall that π_{31} decreases in τ, and π_{12} is changeless in τ. Therefore, we have $\tau^I>\tau^{III}$, and there must have $\tau^{II}\in(\tau^I,\tau^{III})$, making $\pi_{31}=\pi_{12}$. And when $\tau<\tau^{II}$, we have $\pi_{31}>\pi_{12}$, vice versa. τ^{II}

satisfies $\dfrac{\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\tau^{III}e-s}{v+\theta e+k-s}}\right)} xf(x)\,dx}{\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w-s}{v+k-s}}\right)} xf(x)\,dx} = \dfrac{\sqrt{v+k-s}}{\sqrt{v+\theta e+k-s}}$.

Then we complete the proof of Theorem 4.

Appendix F: Proof of Theorem 5

The proof process is similar to Appendix E. and the $\bar{\tau}^{I}$, $\bar{\tau}^{II}$ and $\bar{\tau}^{III}$ satisfy the following equations, respectively:

$$\sqrt{(v+\theta e-s)(w+\bar{\tau}^{I}e-s)}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\bar{\tau}^{I}e-s}{v+\theta e-s}}\right)} xf(x)\,dx = (w+w_q-s)\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf(x)\,dx + \left(\frac{w-s}{w+w_q-s}(v-s)+s-w-w_q\right)\mu$$

$$\sqrt{(v+\theta e-s)(w+\bar{\tau}^{II}e-s)}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\bar{\tau}^{II}e-s}{v+\theta e-s}}\right)} xf(x)\,dx = \alpha\left[(w+w_q-s)\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf(x)\,dx + \left(\frac{w-s}{w+w_q-s}(v+k-s)+s-w_q-w\right)\mu\right]$$

$$\alpha\sqrt{v+\theta e+k-s}\int_0^{\bar{F}^{-1}\left(\sqrt{\frac{w+\bar{\tau}^{III}e-s}{v+\theta e+k-s}}\right)} xf(x)\,dx = \alpha\left[(w+w_q-s)\int_0^{\bar{F}^{-1}\left(\frac{w-s}{w+w_q-s}\right)} xf(x)\,dx + \left(\frac{w-s}{w+w_q-s}(v+k-s)+s-w_q-w\right)\mu\right]$$

Appendix G: Analysis and proof of model 4

Model extension analyzes the retailer's optimal pricing strategy when adopting quick response and value-added services at the same time. Similar in model 3, the retailer has two pricing options: (1) Set a low price as $v+\theta e-(v+\theta e-s)(1-\xi)$, with which, both the conspicuous customers and ordinary customers will buy in the first period; (2) Set a high price as $v+\theta e+k\xi-(v+\theta e-s)(1-\xi)$, with which, the conspicuous customers will purchase in the first period and the ordinary customers will wait until the second period. The retailer has two ordering opportunities in the first period. The unit cost of the first order is w, whereas the unit cost of the secondary order is $w+w_q$, where w_q refers to the extra cost due to quick response.

When the retailer wants all customers to buy in the first period, the expected profit of the retailer can be simplified as: $\pi_{41}(Q)=(w+w_q+\tau e-s)\min(d,Q)-(w+\tau e-s)Q+(p-w-\tau e-w_q)\mu$. Subsituting the $p=v+\theta e-(v+\theta e-s)(1-\bar{F}(Q))$ into it and finding the first derivative of the profit function, we obtain: $\bar{F}(Q)=\dfrac{w+\tau e-s}{w+\tau e+w_q-s}$. Thus, $Q_{41}^*=\bar{F}^{-1}\left(\dfrac{w+\tau e-s}{w+\tau e+w_q-s}\right)$ and $p_{41}^*=\dfrac{(w+\tau e-s)(v-s+\theta e)}{w+\tau e+w_q-s}+s$.

When only the conspicuous customers purchase in the first period, the profit function of the retailer is:

$$\pi_{42}(Q)=\alpha\left(w+w_q+\tau e-s\right)\min\left(d,\frac{Q}{\alpha}\right)-\alpha\left(w+\tau e-s\right)\frac{Q}{\alpha}+\alpha\left(p-w-\tau e-w_q\right)\mu.$$

Substituting $p=v+\theta e+k\xi-\left(v+\theta e-s\right)\left(1-\xi\right)=\bar{F}\left(\dfrac{Q}{\alpha}\right)\left(v+\theta e+k-s\right)+s$ into it and finding the first derivative of the profit function, we obtain: $Q_{42}^*=\alpha\bar{F}^{-1}\left(\dfrac{w+\tau e-s}{w+\tau e+w_q-s}\right)$ and $p_{42}^*=\dfrac{(w+\tau e-s)(v+k-s+\theta e)}{w+\tau e+w_q-s}+s$.

We then obtain the profit when all customers purchase in the first period and the profit when only conspicuous customers purchase in the first period:

$$\pi_{41}=\left(w+w_q-s+\tau e\right)\int_0^{\bar{F}^{-1}\left(\frac{w+\tau e-s}{w+\tau e+w_q-s}\right)}xf\left(x\right)dx+\left(\frac{(w-s+\tau e)(v-s+\theta e)}{w+w_q-s+\tau e}+s-w-\tau e-w_q\right)\mu$$

,

$$\pi_{42}=\alpha\left(w+w_q-s+\tau e\right)\int_0^{\bar{F}^{-1}\left(\frac{w+\tau e-s}{w+\tau e+w_q-s}\right)}xf\left(x\right)dx+\alpha\left(\frac{(w-s+\tau e)(v-s+k+\theta e)}{w+w_q-s+\tau e}+s-w-\tau e-w_q\right)\mu.$$

Comparing the profits under low and high price strategy, we propose Theorem A-1:

Theorem A-1: There exists a conspicuous customer proportion α_4^****, when*** $\alpha\in(0,\ \alpha_4^*]$ ***, we have*** $\pi_{42}(Q)\le\pi_{41}(Q)$ ***and the retailer should set a low price to let all customers purchase in the first period; when*** $\alpha\in(\alpha_4^*,1)$ ***, we have*** $\pi_{42}(Q)>\pi_{41}(Q)$ ***and the retailer should set a high price to let only conspicuous customers purchase in the first period.***

The proof of Theorem A-1 is as follows. We can easily know that the $\pi_{42}(Q)$ is strictly monotonically increasing in α. Let $\pi_{42}(Q)=\pi_{41}(Q)$, than we have

$$\alpha_4^*=\frac{\left(w+w_q-s+\tau e\right)\int_0^{\bar{F}^{-1}\left(\frac{w+\tau e-s}{w+\tau e+w_q-s}\right)}xf\left(x\right)dx+\left(\frac{(w-s+\tau e)(v-s+\theta e)}{w+w_q-s+\tau e}+s-w-\tau e-w_q\right)\mu}{\left(w+w_q-s+\tau e\right)\int_0^{\bar{F}^{-1}\left(\frac{w+\tau e-s}{w+\tau e+w_q-s}\right)}xf\left(x\right)dx+\left(\frac{(w-s+\tau e)(v-s+k+\theta e)}{w+w_q-s+\tau e}+s-w-\tau e-w_q\right)\mu},$$

making when $\alpha\in(0,\ \alpha_4^*]$, $\pi_{42}\left(Q\right)<\pi_{41}\left(Q\right)$; and when $\alpha\in(\alpha_4^*,1)$, $\pi_{42}\left(Q\right)>\pi_{41}\left(Q\right)$.