경제학석사학위논문

Screening and Attracting Consumers with Salient-thinking Behavior

2014년 8월

서울대학교 대학원

경제학부 경제학 전공

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Abstract

Screening and Attracting Consumers with Salient-thinking Behavior

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In this paper, we analyze a market with salient-thinking consumers who have different willingness-to-pay for a unit quality of the good. Specifically, we use a utility function recently introduced by Bordalo, Gennaioli, and Shleifer (2013b) to model the salient-thinking consumers. In the first part of the paper, we solve the screening problem of a monopolist facing such consumers. We find that optimal screening results in a market where price is salient rather than quality with or without asymmetric information on the consumers' types. In the second part, we allow the monopolist to offer bundles – 'decoy bundles' – not really intended to sell, but to attract the consumers to some target bundles that the monopolist does intend to sell. This is possible because the consumer's utility depends on the offered menu, or the context, itself and thus the monopolist has an option to add such bundles if profitable. We find that the seller has an incentive to add decoy bundles to make the target bundles quality-salient so that she can extract more profit from the consumers. Doing so results in welfare loss on the consumers' side. The first half and the second half combined provide a characterization of the monopolist's problem in a market with salient-thinking consumers.

Keywords : salient-thinking, decoy bundles, screening, nonlinear pricing, quality differentiation

Student Number : 2012-20144

Contents

1 Introduction

There is abundant evidence showing that the consumers' choice depend not merely on the attributes of a given good but also on the context in which the choice is made. For example, a great number of literature stemming from Huber, Payne, and Puto (1992) provide evidence on the effect of asymmetrically dominated alternatives. That is, suppose there are two goods and that neither good dominates the other. However, adding an alternative dominated by one of the goods but not by the other enhances greatly the sales of the dominating good. Another well-known example is that of Tversky and Simonson (1993), extremeness aversion, which says that consumers are reluctant to choose extreme options. In a market with two alternatives, one with low price, low quality and another with high price, high quality, introducing an additional alternative with extremely high price and quality will boost the sale of the good with high price and quality since now the good seems 'moderate.' Chatterjee and Heath (1995) also provide a large number examples on such context-dependent consumer choice.

In all such examples, there exists a product that does not sell – we call this a decoy product[1] (or decoy bundle) – and/or a product whose sale fall due to the arrival of a new alternative. Hence, it is ambiguous whether exploiting consumers' such behavior is indeed profitable to the seller. However, most of the literature has concentrated on analyzing the

[1]While many use this term referring to the dominated good in the asymmetrically dominated alternative context, in its wide sense it refers to any good that boosts the sale of some other alternative though the good itself does not sell much, if any. See Chatterjee and Heath (1995).

effect on the consumers' side and there has been no formal analysis of such sales' practice that focus on the firms' side. This was partly due to the lack of reasonable and tractable model of consumer preference that is consistent with such context-dependent behavior of the consumers. However, Bordalo, Gennaioli, and Shleifer (2013b, hereafter BGS) proposed a model of consumer preference that reflects the salient-thinking behavior; a specific form of context-dependent behavior of the consumers. We adopt this model to analyze the behavior of a firm selling its product to a pool of consumers that make different choices depending on the context they face.

Of course, BGS is not the first to propose a tractable utility function that incorporates context-dependent behaviors. Depending on how we set the reference point, the reference-dependent preference of Koszegi and Rabin (2006) also incorporate context-dependent behaviors, and numerous research has built on such preference to explain many aspects of the economy that was not possible with only rational preferences. However, the utility function of BGS takes into account the effect of the bundles offered in the market more explicitly, and therefore is more appropriate for analyzing the effect of decoy bundles.

Using the BGS utility function, we first solve the typical screening problem (not allowing decoy bundles) the monopolist faces when encountered with two types of (heterogeneous) consumers. We find that the monopolist must offer a price-salient menu to successfully screen the salient-thinking consumers in both situations with and without asymmetric information on the consumer type. Then, we turn our attention to a relatively new screening problem[2] where we allow for decoy bundles. We find that the monopolist sells quality-salient bundles to the consumers so that they can charge a higher price from them, which results in higher profit for the seller and lower surplus for the consumer compared to when there is no decoy bundle. We also find that the presence of decoy bundle has a greater impact on producer/consumer surplus as consumer are more salient-thinking. Additionally, we compare the profit increment from decoys with the profit loss due to information asymmetry so that we can determine how well the firm performs if decoy bundles are allowed under unfavorable conditions concerning information.

In Section 2, we describe the model. In Section 3, we consider the standard screening problem under such salient-thinking consumers. In Section 4, we consider the possibility of attracting consumers using bundles not intended to sell but to attract other bundles, namely decoy bundles. Section 5 concludes with some discussions.

2 The Model

Let $\mathcal{M}$ be the set of bundles, i.e. the menu. A bundle $(q, p) \in \mathcal{M}$ is composed of quality[3], q, and price, p. We assume that consumers exclude dominated bundles from their choice sets. This amounts to assuming that if (q_1, p_1) and (q_2, p_2) are in $\mathcal{M}$, then $p_1 > p_2$ if and only if $q_1 > q_2$. Also,

[2]Similar research has been conducted based on the reference-dependent preferences of Koszegi and Rabin (2006). For example, Carbajal and Ely (2012) solves optimal contract problem between a monopolist and a continuum of loss-averse buyers; Hahn et al. (2012) solves the screening problem under loss-averse consumers; and Rosato (2013) suggests a model where the seller sells substitute goods to loss-averse consumers.

[3]Another possible interpretation is to see q as quantity rather than quality.

assume $|\mathcal{M}| < \infty$ and write $\mathcal{M} = \{(q_1, p_1), \ldots, (q_M, p_M)\}$. We assume that consumer's preference depends on the salience of price and quality. We use a utility function proposed by Bordalo, Gennaioli, and Shleifer (2013, hereafter BGS). The original version of the utility function introduced by BGS is

$$u(q,p) = \begin{cases} \frac{2}{\delta+1}q - \frac{2\delta}{\delta+1}p & \text{if } \sigma(q,\bar{q}) > \sigma(p,\bar{p}) \\ \frac{2\delta}{\delta+1}q - \frac{2}{\delta+1}p & \text{if } \sigma(q,\bar{q}) < \sigma(p,\bar{p}) \\ q - p & \text{if } \sigma(q,\bar{q}) = \sigma(p,\bar{p}) \end{cases},$$

where $\sigma(\cdot,\cdot) : \mathbb{R}_+ \times \mathbb{R}_+ \to \mathbb{R}_+$, namely the salience function, is a function that satisfies a couple of conditions so that it appropriately measures salience and $\delta \in (0,1]$ decreases in the severity of salient thinking. Following BGS, we assume that the salience function satisfies 1) the *ordering* property and 2) homogeneity of degree zero. The ordering property indicates that if the value of an attribute of a bundle differs more from the average, the attribute becomes more salient. Homogeneity of degree zero implies that salience does not depend solely on the absolute difference from the average. For instance, if the prices of all bundles in a menu rise at the same rate, no difference is caused in terms of the salience of price. Specifically, the salience function we use is

$$\sigma(x,y) = \frac{|x-y|}{x+y},$$

which was also introduced by BGS. To evaluate the relative salience of price and quality for a given bundle (q,p), we compare $\sigma(q,\bar{q})$ with $\sigma(p,\bar{p})$ where $\bar{q}$ and $\bar{p}$ are the arithmetic means of q and p, respectively.

We slightly modify this utility function in two aspects; 1) we add a parameter to incorporate different willingness-to-pay (WTP) among consumers and 2) introduce a valuation function of quality, $v(q)$, instead of using q itself so that the utility function can feature general characteristics of a typical utility function with respect to the quality. Here $v(q)$ can be interpreted as the perceived quality of the bundle. Formally, we use the following utility function:

$$(1)\qquad u(q,p|\theta) = \begin{cases} \frac{2}{\delta+1}\theta v(q) - \frac{2\delta}{\delta+1}p & \text{if } \sigma(v(q),\overline{v(q)}) > \sigma(p,\bar{p}) \\ \frac{2\delta}{\delta+1}\theta v(q) - \frac{2}{\delta+1}p & \text{if } \sigma(v(q),\overline{v(q)}) < \sigma(p,\bar{p}) \\ \theta v(q) - p & \text{if } \sigma(v(q),\overline{v(q)}) = \sigma(p,\bar{p}) \end{cases} \cdot$$

Here, θ captures the consumer's WTP and $v(\cdot)$ is a twice differentiable function satisfying $v(0)=0$, $v'(\cdot)>0$, $v''(\cdot)<0$, $\lim_{q\to 0} v'(q)=\infty$, and $\lim_{q\to\infty} v'(q)=0$. If $\sigma(p,\bar{p}) > \sigma(v(q),\overline{v(q)})$ [4], we say the bundle (q,p) is price-salient; if the inequality holds in the other direction, we say that the bundle is quality-salient. If $\sigma(p,\bar{p}) = \sigma(v(q),\overline{v(q)})$, we say that the bundles is equally salient. To take the notations simple we write $\bar{v}$ instead of $\overline{v(q)}$ throughout the paper. Absent salient thinking, the utility function

[4]Given that $v(q)$ is the perceived quality, it seems more reasonable that consumers are interested in the salience with respect to the average perceived quality $\overline{v(q)}$ rather than the perceived average quality $v(\bar{q})$. Additionally, the assumption that σ is homogeneous of degree 0 ensures that θ does not affect the salience of quality.

would be $u(q,p|\theta) = \theta v(q) - p$ for any $(q,p) \in \mathcal{M}$, which we refer to as the rational case or the rational utility function.

Throughout the paper we consider a monopolistic seller that offers the menu $\mathcal{M} = \{(q_1,p_1),\ldots,(q_k,p_k)\}$ to maximize its profit $\Sigma_{i=1}^{k} r_i(p_i - cq_i)$, where c is the marginal cost of production and r_i is the measure of consumers that buy (q_i,p_i). If a consumer decides to buy nothing and exits the market, she gets zero utility. In all of the following arguments we assume there are two types of consumers differing only in their willingness-to-pay. Specifically, we assume that there are two types of consumers; the high-type consumers, with WTP θ_H, and the low-type consumers, with WTP θ_L. Of course, $\theta_H > \theta_L$ and there are respectively $(1-m)$ and m measure of consumers of each type, where $m \in (0,1)$. An additional assumption is that $\delta\theta_H > \theta_L$, which implies that the high-type consumer has a higher WTP even in case where she gives smaller weight to quality. That is, salient-thinking does not result in type reversals. The consumer-type could be known or unknown to the monopolist, depending on the context. However, each type's WTP, θ_H and θ_L, and the distribution of each type is common knowledge.

The monopolist, at the point of designing her bundle, still faces the usual incentive problems that could rise due to possible asymmetric information problems, but the monopolist must also decide, due to the consumers' salient-thinking behavior, whether or not to add decoy bundles to the menu to attract the consumers to specific bundles. To take all possible aspects into consideration, we analyze and compare four types of menus that the monopolist can provide:

1. A *pooling menu* which consists of exactly one bundle that all types of consumers purchase,

2. A *screening menu* which consists of exactly two different bundles with all high-type consumers buying the same bundle and all low-type consumers buying the other,

3. A *pooling menu with decoy* which consists of more than one bundle with all consumers buying the same bundle, and

4. A *screening menu with decoy* which consists of more than two bundles with all high-type consumers buying the same bundle and all low-type consumers buying another same bundle, distinct from the bundle that high-type consumers buy.

In the general model of monopoly with "rational" heterogeneous consumers, a screening menu is more profitable than a pooling menu whenever providing such a menu is possible. This is because the monopolist can freely differentiate quality and prices of the bundles and extract more from the consumers. However, it turns out that when there are salient-thinking consumers, an additional good in a menu may affect the salience of existing bundles and hence the profit of the monopolist is not monotone in the number of her available product lines. Thus, we explore both pooling and screening menus in the following two sections and compare the resulting profits and consumer welfares.

Also, while we mainly focus on the situation where the WTP of consumers are privately known, we introduce another case where the monopolist can distinguish the types of consumers, namely a symmetric information case, as a benchmark. With information asymmetry, there is information rent to the consumers and the monopolist's profit decreases generally. We also analyze the effect of salient-thinking on such information rent.

3 Optimal Pooling and Screening

In this section, we consider menus that consist of bundles only that are actually purchased by the consumers. That is, the seller does not offer decoy bundles. In such context, there are three possible situations depending on the number of bundles offered and the information structure we can think of: 1) the monopolist offers a single bundle (pooling menu), 2) the monopolist knows the type of each consumer and offers two bundles (screening menu with symmetric information) , or, 3) the monopolist knows the type of each consumer and offers two bundles (screening menu with asymmetric information).

To formally write down the seller's maximization problem, let (q_L, p_L) and (q_H, p_H) denote the bundles that the monopolist desires to sell to the high-type and low-type consumers, respectively, where p_H and p_L are not necessarily different. Write $\mathcal{M} = \{(q_L, p_L), (q_H, p_H)\}$. We consider menus only with $p_H \geq p_L$ (and thus $q_H \geq q_L$). The monopolist maximizes its profit, $m(p_L - cq_L) + (1 - m)(p_H - cq_H)$, subject to some combination of the following conditions:

$$\begin{aligned}
\text{IR(L):} \quad & u(q_L, p_L|\theta_L) \geq 0 \\
\text{IR(H):} \quad & u(q_H, p_H|\theta_H) \geq 0 \\
\text{IC(L):} \quad & u(q_L, p_L|\theta_L) \geq u(q, p|\theta_L) \qquad \forall (q,p) \in \mathcal{M} \\
\text{IC(H):} \quad & u(q_H, p_H|\theta_H) \geq u(q, p|\theta_H) \quad \forall (q,p) \in \mathcal{M} \\
\text{P:} \quad & (q_L, p_L) = (q_H, p_H).
\end{aligned}$$

The first two conditions are the participation constraints of the low-type and high-type consumers; the next two ensure that the consumers indeed buy the intended bundle. Imposing the last constraint means that the seller offers only a single bundle. Imposing condition IR and P corresponds to the pooling menu; IR corresponds to the screening menu with symmetric information; and IR and IC corresponds to the screening menu with asymmetric information.

3.1 Pooling menu

We begin the analysis by considering the pooling menu. In this case, we only have a single bundle in the menu, which we denote by (q^p, p^p). Since only a single bundle is offered, the bundle is neither quality-salient nor price-salient, and thus the maximization becomes exactly same with the rational case. First, note that in optimum IR(L) must bind. If we suppose to the contrary, there exists $\epsilon > 0$ such that the monopolist can raise p^p by a small amount ϵ with the constraints remaining satisfied with higher profits to the seller. Substituting the expression implied by IR(L) into the objective function and differentiating gives $(q^p, p^p) = (v'^{-1}(c/\theta_L), \theta_L v(v'^{-1}(c/\theta_L)))$. Since the LHS of IR(H) is greater than the LHS of IR(L), (q^p, p^p) obviously satisfies IR(H) and thus is indeed the optimal menu. The seller earns a profit of $\pi^p = \theta_L v(v'^{-1}(c/\theta_L)) - cv'^{-1}(c/\theta_L)$. The low-type consumers earn zero utility and the high-type consumers earns strictly positive utility. Note that the monopolist faces only rational consumers and the salient-thinking behavior plays no role here.

3.2 Screening menu under symmetric information

Suppose the consumers observes both bundles offered in the market, but her choice of purchase is restricted to only one of the two which is designated by the seller. Then, the consumer, having observed both goods, evaluates both bundles according to the salient-thinking utility but can actually buy only the designated bundle. Such situation gives rise to the screening problem with salient-thinking consumers under symmetric information. We analyze this symmetric information case as a benchmark before we proceed to the analysis of screening menus with unknown consumer types. Now, since the monopolist knows each consumer's type, she can designate the good the each of the consumers and thus the IC constraints can be dropped.

It is obvious that with an optimal bundle both of the IR constraints bind. Then, the optimal menu $\{(q^s_L, p^s_L), (q^s_H, p^s_H)\}$ satisfies

$$\frac{v(q^s_H)}{p^s_H} < \frac{v(q^s_L)}{p^s_L}.$$

Thus, the two bundles are both price-salient. This is because the high-type consumers are willing to pay a relatively larger amount than the increase in quality due to its high WTP. As a result, the monopolist prefers rather to discriminate price than to discriminate quality and thus the market becomes price-salient. Now, by substituting the two binding constraints into the objective function, we obtain the following optimal bundles and maximized profit:

$$(q_L^s, p_L^s) = \Big(v'^{-1}(\frac{c}{\delta\theta_L})\,,\ \delta\theta_L v\Big(v'^{-1}(\frac{c}{\delta\theta_L})\Big)\Big)\,, (q_H^s, p_H^s) = \Big(v'^{-1}(\frac{c}{\delta\theta_H})\,,\ \delta\theta_H v\Big(v'^{-1}(\frac{c}{\delta\theta_H})\Big)\Big)$$

$$\pi^s = m\big[\delta\theta_L v\big(v'^{-1}(\frac{c}{\delta\theta_L})\big) - cv'^{-1}(\frac{c}{\delta\theta_L})\big] + (1-m)\big[\delta\theta_H v\big(v'^{-1}(\frac{c}{\delta\theta_H})\big) - cv'^{-1}(\frac{c}{\delta\theta_H})\big]\,.$$

Note that a low type consumer buys a bundle with lower quality and price than she does in the pooling case; a high type consumer buys a bundle with higher quality and price.

3.3 Screening menu under asymmetric information

A more realistic situation is one where the monopolist does not know each consumer's type so that she must consider the consumers' incentive compatibility constraints. Since the menu consists of only two bundles, (q_L, p_L) and (q_H, p_H), it is straightforward that $\sigma(v_L, \bar{v}) \geq \sigma(p_L, \bar{p})$ if and only if $\sigma(v_H, \bar{v}) \geq \sigma(p_H, \bar{p})$. Thus, we only need to consider the cases in which the salient attributes of both bundles are the same, and in each case the IC constraint becomes

$$\begin{aligned} \text{IC(L):} \quad & \theta_L v_L - \delta p_L \geq \theta_L v_H - \delta p_H \\ \text{IC(H):} \quad & \theta_H v_H - \delta p_H \geq \theta_H v_L - \delta p_L \end{aligned}$$

when the bundles are quality-salient,

$$\begin{aligned} \text{IC(L):} \quad & \delta\theta_L v_L - p_L \geq \delta\theta_L v_H - p_H \\ \text{IC(H):} \quad & \delta\theta_H v_H - p_H \geq \delta\theta_H v_L - p_L \end{aligned}$$

when the bundles are price-salient, and

$$\begin{aligned} \text{IC(L):} \quad & \theta_L v_L - p_L \geq \theta_L v_H - p_H \\ \text{IC(H):} \quad & \theta_H v_H - p_H \geq \theta_H v_L - p_L \end{aligned}$$

when neither of the attributes are salient. In all three cases, it is straightforward to show that IC(H) and IR(H) imply IR(L).

Proposition 1. *If $m > 1 - \theta_L/\theta_H$*[5]*, a solution menu of the screening problem with asymmetric information always exists, and has the form*

$$q_L^a = v'^{-1}\Big(\frac{mc}{\delta\theta_L - \delta\theta_H(1-m)}\Big),\ p_L^a = \delta\theta_L v_L^a,\ q_H^a = v'^{-1}\Big(\frac{c}{\delta\theta_H}\Big),\ p_H^a = p_L^a + \delta\theta_H(v_H^a - v_L^a)\,.$$

Moreover, both bundles in the menu are price salient and the optimal

[5]The higher quality the low-type consumers are provided with, the more incentive exists for the high-type consumers to deviate from their target bundle. Thus, if there are few low-type consumers, then the monopolist will give up making a profit from them and set both quality and price to zero, which is not an interesting case.

screening menu does not necessarily yield higher profits than the optimal pooling menu.

Proof. Appendix A.1

If the monopolist can compose a menu which separates the consumers according to their types, it necessarily consists of the bundles that are price-salient. In contrast with the standard result of a screening model, the optimal pooling menu can be more profitable to the monopolist than the screening menu. This is because when δ is sufficiently small and the consumers' utility from quality is minute with price-salient bundles, the benefit from the separation will be outweighed by the loss from consumers' insensitivity to the quality of products. To be concrete, as is shown in the proof of Proposition 1, by composing a pooling menu the monopolist can extract more especially from the low-type consumers.

4 Optimal Menus with Decoy Bundles

While we have considered menus that consist only of bundles that will actually be sold in equilibrium, including additional bundles to the menu, even though it may not sell, may affect consumer choice due to the salient-thinking behavior of the consumers. Hence, there could be a possibility that the seller adds decoy bundles – those included in the menu not intended to sell but to attract consumers to the target bundles – in pursuit of higher profit. In this section, we derive the optimal menus that include decoy bundles a monopolist offers under the three situations of the earlier sector. Throughout the section, we refer to bundles intended to sell as target bundles, and the all other bundles are referred to as decoy bundles.

4.1 Pooling menu with decoy

First, we begin with the simpler case where the monopolist can offer a single target bundle with some additional $k > 0$ bundles of decoy. To write down the maximization problem formally, again let (q_s, p_s) be the target bundle, and let $\mathcal{M}\backslash\{(q_s, p_s)\} = \{(q_1, p_1), \ldots, (q_k, p_k)\}$. Then, the maximization problem can be written as

$$
\begin{aligned}
& \max_{(q_s,p_s),(q_1,p_1),\ldots,(q_k,p_k),k} p_s - cq_s \\
\text{s.t.} \quad & \text{IR(L): } u(q_s, p_s|\theta_L) \geq 0 \\
& \text{IR(H): } u(q_s, p_s|\theta_H) \geq 0 \\
& \text{IC(L): } u(q_s, p_s|\theta_L) \geq u(q_i, p_i|\theta_L) \quad \forall i \\
& \text{IC(H): } u(q_s, p_s|\theta_H) \geq u(q_i, p_i|\theta_H) \quad \forall i.
\end{aligned}
\tag{2}
$$

Since we are considering a pooling menu, only one bundle will be sold in the equilibrium. However, with the additional bundles in the menu, the monopolist may be able to sell a bundle that was previously not possible to do so or also it can get higher prices relative to quality by distracting the consumers from price and making them focus on quality (i.e. by making the target bundle quality-salient.) A quick guess is that making the target bundle quality-salient would give more profit to the monopolist because then the consumer does not care much about the price so making it possible for the monopolist to extract a higher price from the consumer. The following lemma shows that this is indeed the case.

Lemma 1. *Suppose* $(q_s^*, p_s^*), (q_1^*, p_1^*), \ldots, (q_k^*, p_k^*)$ *is a solution to the maximization problem* (2)*. Then,* (q_s^*, p_s^*) *is quality-salient.*

Proof. Appendix A.2

Lemma 1 ensures that it is sufficient to consider only menus that render the target bundle quality-salient. Now, first consider the relatively simple case with $k = 1$. We write (q_d, p_d) instead of (q_1, p_1) to emphasize that this bundle is a decoy. What the monopolist wants to do is to make the target bundle quality-salient using the decoy bundle. However, the monopolist will provide a decoy bundle if doing so gives more profit than just offering a single bundle. The following proposition shows that an appropriate decoy bundle exists and adding it to the menu increases the firm's profit.

Proposition 2. *Consider the monopolist's maximization problem* (2) *with* $k = 1$*. Then, a solution menu exists, and has the form*

$$(\tilde{q}^p, \tilde{p}^p) = (v'^{-1}(\delta c/\theta_L), \theta_L v(v'^{-1}(\delta c/\theta_L))/\delta).$$

Moreover, the monopolist's profit is higher than that from the pooling menu without decoys.

Proof. Appendix A.3

Now we know that the monopolist can make an improvement on its profit by using a single decoy. Then, a natural question rises in mind: can the monopolist improve even more by using multiple decoys? However, the following remark shows that this is not the case; one decoy bundle is sufficient to attain the maximal profit in giving a pooling menu.

Remark. *The monopolist has no incentive to offer more than one decoy bundle.*

Proof. The bundle $(\tilde{q}^p, \tilde{p}^p)$ in Proposition 2 maximizes the monopolist's profit with IC excluded from the constraint and thus gives (weakly) greater profit than any other solution of the maximization problem (2). However, we have shown that $(\tilde{q}^p, \tilde{p}^p)$ can be supported as the target bundle of a solution with a single appropriate decoy bundle. Hence, there is no additional gain from using more than one decoy bundles. $\square$

In the proof of Proposition 2, we have seen that the optimal decoy bundle features lower price and quality than the target bundle. However, this does not mean that bundles with higher price and quality than the target bundle cannot be used as decoy bundles. What it means is that if we are to attain the maximum profit under pooling menus with a single decoy, we must use bundles with lower price and quality. However, if we use more than one decoy bundle, we can also include bundles with high price and quality in the menu.

4.2 Screening menu with decoy under symmetric information

When the monopolist provides two different bundles for each type of consumers, her profit can be improved by adding a decoy bundle as in the pooling menu case. The maximization problem is

$$\begin{aligned} &\max_{(p_L,q_L),(p_H,q_H),(p_1,q_1),\ldots,(p_k,q_k),k} && m(p_L - cq_L) + (1-m)(p_H - cq_H) \\ &\text{s.t.} && \text{IR(L): } u(p_L, q_L|\theta_L) \geq 0 \\ & && \text{IR(H): } u(p_H, q_H|\theta_H) \geq 0 \end{aligned} \tag{3}$$

The absence of the IC constraints enables the monopolist to extract surplus as if there are two separate markets. Thus, Lemma 1 implies that the profit is maximized only if the target bundles to sell are both quality-salient. The optimal target bundles, denoted by $(\tilde{q}^s_L, \tilde{p}^s_L)$ and $(\tilde{q}^s_H, \tilde{p}^s_H)$, are readily derived in a similar way as in subsection 3.2. The only difference is that the participation constraints for the consumers are $\theta_i v(q_i) = \delta p_i$ for $i = L, H$ instead of $\delta\theta_i v(q_i) = p_i$, reflecting the quality-salience of the target bundles in this case. Thus, we obtain

$$(\tilde{q}^s_L, \tilde{p}^s_L) = \Big(v'^{-1}\big(\frac{\delta c}{\theta_L}\big)\,,\, \frac{\theta_L}{\delta} v\Big(v'^{-1}\big(\frac{\delta c}{\theta_L}\big)\Big)\Big)\,, (\tilde{q}^s_H, \tilde{p}^s_H) = \Big(v'^{-1}\big(\frac{\delta c}{\theta_H}\big)\,,\, \frac{\theta_H}{\delta} v\Big(v'^{-1}\big(\frac{\delta c}{\theta_H}\big)\Big)\Big)\,.$$

Making the consumers pay more attention to the quality, the monopolist is able to sell the goods of higher quality at even higher prices. In this case, too, a single decoy bundle is enough and the construction of it is as follows. First, we take $\bar{v} > \delta \tilde{p}_H^s/\theta_L$ and $\bar{p} = \tilde{p}_H^s$. The bundle $(\tilde{q}_H^s, \tilde{p}_H^s)$ has the same price as the average price, so it is clearly quality-salient. Also, the quality-price ratio of the bundle for the low-type consumers is lower than that of the average bundle, i.e., $(\bar{q}, \bar{p})$, and thus the quality becomes salient. Moreover, such average quality and price can be always attained by introducing a product which features higher quality and price than those of the target bundles.

4.3 Screening menu with decoy under asymmetric information

Now, we finally turn to the most complicated case where there is asymmetric information on consumer types and also the monopolist can add decoy bundles to the menu. Since the monopolist does not know each consumer's type, she must consider two additional incentive constraints:

$$\text{IC(L)}: u(q_L, p_L|\theta_L) \geq u(q_i, p_i|\theta_L) \quad \forall i$$
$$\text{IC(H)}: u(q_H, p_H|\theta_H) \geq u(q_i, p_i|\theta_H) \quad \forall i.$$

We refer to the maximization problem resulting from adding the two IC constraints to (3) as (3)$'$. Before the monopolist sets the quality and the price of additional bundles, she has to decide which attribute of her target bundles to be salient. Again, due to the following Lemma, a menu with quality-salient target bundles is most profitable to the monopolist.

Lemma 2. *When offering a menu, suppose that the monopolist can decide which attributes of the target bundles to be salient regardless of their actual* *salience. Under such situation, let $\mathcal{M}$ be a menu that satisfies both IR and IC and maximizes the monopolist's profit. Then, the target bundles of $\mathcal{M}$ must be quality salient.*

Proof. Appendix A.4

Before composing a full menu including decoy bundles, the monopolist determines the target bundles to sell by solving the following maximization problem:

$$
\begin{aligned}
&\max_{(p_L,q_L),(p_H,q_H)} \quad m(p_L - cq_L) + (1-m)(p_H - cq_H) \\
(4) \qquad &\text{s.t.} \quad \theta_i v(q_i) - \delta p_i \geq 0 \quad \text{for } i = L, H \\
&\qquad\quad \theta_i v(q_i) - \delta p_i \geq \theta_i v(q_j) - \delta p_j \quad \text{for } i,j = L,H,\ i \neq j\,.
\end{aligned}
$$

As long as $m > 1 - \theta_L/\theta_H$, the solution for the problem (4) is given by

$$
\tilde{q}^a_L = v'^{-1}\Big(\frac{m\delta c}{\theta_L - (1-m)\theta_H}\Big),\ \tilde{p}^a_L = \theta_L \tilde{v}^a_L/\delta,\ \tilde{q}^a_H = v'^{-1}\Big(\frac{\delta c}{\theta_H}\Big),\ \tilde{p}^a_H = \tilde{p}^a_L + \frac{\theta_H}{\delta}(\tilde{v}^a_H - \tilde{v}^a_L)\,.
$$

Both target bundles are price-salient if the monopolist gives a menu comprised of them only as shown in section 3.3, which implies that the actual incentive constraints are different from those specified in (4). Hence, it is impossible for the monopolist to sell the optimal target bundles by offering a menu consisting of only the two. To be concrete, the bundle $(\tilde{q}^a_L, \tilde{p}^a_L)$ makes the low-type consumers break even if it is quality-salient, but the consumers will leave the market with buying nothing if they pay more attention to the price than the quality. However, if proper decoy bundles are added to the menu, the target bundles become quality-salient and thus the monopolist can achieve the desired maximum profit. The following Proposition ensures that it is always possible to design such a menu.

Proposition 3. *There always exists a finite set of decoy bundles that composes a solution of the maximization problem (3)′ when combined with* $\{(\tilde{q}^a_L, \tilde{p}^a_L), (\tilde{q}^a_H, \tilde{p}^a_H)\}$.

Proof. Appendix A.5

While it was sufficient to include a single decoy bundle in the menu to achieve maximum profit in pooling or screening with symmetric information cases, the proof of Proposition 3 shows that a single decoy bundle may not be enough for some values of the parameters δ, c, and m. However, since providing an additional bundle that will not be sold still incurs some cost in reality, such menus that include numerous decoy bundles may not be profitable. Nonetheless, the monopolist can earn higher profits than the no-decoy screening case even by including only a single decoy bundle due to the following Proposition.

Proposition 4. *There always exists a screening menu with only a single decoy that yields more profit to the monopolist than the optimal screening menu with no decoys does.*

Proof. Appendix A.6

5 Discussions and Concluding Remarks

In this section, we compare the menus we have solved in the former sections in two aspects. Specifically, we compare the monopolist's profit between the resulting menus, and then also the consumers' utility under the menus. Moreover, we conclude with some suggestions on possible extensions of the paper.

5.1 Monopolist profit

In Sections 3 and 4, we have shown that adding decoys generally increases the monopolist's profit. Here, we show how such difference depends on the salience parameter, δ. Also, by comparing the optimal profits when a monopolist uses decoys under asymmetric information with the optimal profits when she is not allowed to use decoys under symmetric information, we examine whether the gains from exploiting consumers' salient-thinking behavior can outweigh the information rent.

An intuitive explanation for our results is that when consumers are significantly concerned with the salience of attributes, the monopolist can manipulate the consumers' perception of items by diversifying their products. In fact, when such salient-thinking is more severe, the value of manipulation increases. In the case of screening under information asymmetry, the monopolist considers the maximization problem

$$\max_{q_L,q_H} \ \alpha(\theta_L - (1-m)\theta_H)v(q_L) - mcq_L + \alpha(1-m)\theta_H v(q_H) - (1-m)cq_H \,,$$

where α is δ if a decoy bundle is not allowed and hence the bundles are price-salient, and α is $1/\delta$ if the monopolist intends to compose a menu with quality-salient target bundles. Clearly, the difference between profits is bigger when δ is small, which implies little attention of consumers to the less salient attribute. In such a case, the consumers who face quality salient bundles will think that how much they pay is insignificant. This kind of behavior may harm the consumers and we will discuss this aspect in subsection 5.2.

It also turns out that by using decoy bundles the monopolist is able to overcome her disadvantage due to information asymmetry. It is easily verified that the profit of the monopolist is higher under symmetric information than when the types of consumers are not known to her. A more interesting issue is how much the monopolist can extract from consumers' salient-thinking, especially in comparison with the magnitude of the information rent. The comparison of two profits, π^s and $\tilde{\pi}^a$, leads us to the conclusion that the benefit from using decoys, if δ is small, may override the value of acquiring information. The effect of the salient-thinking is twofold. First, without consumers' consideration of salience, the monopolist should provide lower quality for the low-type consumers to resolve the incentive problem between two types of consumers. In contrast, if salient-thinking is prevalent, the seller provides more quality and sets higher price so that she can yield more profit from the low-type consumers. But then again, an increased provision of quality to the low-type forces the monopolist to cut the price for the high-type to the extent that the incentive constraints remain satisfied. However, the monopolist's ability to skim money out of the consumers who are obsessed with quality dominates the pressure of the incentive problem, and more profit can be attained from the high-type consumers, too.

5.2 Consumer utility

Now, we turn our attention to the consumers and evaluate their utility under the menus in interest. However, since the utility itself depends on the offered menu, it is meaningless to directly compare the consumer utilities evaluated under the distinct menus. Note that an identical bundle can be price salient under some menu and quality salient in some other menu so that the utility is different under each menu. If we simply compare the utilities resulting from each situation, we would arrive at a awkward conclusion that such bundle is strictly better than itself. Hence, what we compare here is the rational case utility of the bundles the consumer buys in each of the cases. Considering salient-thinking as some biased behavior a consumer exhibits in the market at the timing of purchasing, we could think of the rational utility as the actual realized utility after the bias is resolved at some point after the purchase.

It is rather obvious that low-type consumers are worse off when the monopolist introduces decoy bundles to make the target bundle quality-salient. Regardless of whether a consumer is given a pooling or a screening menu, she gets zero utility if she buys the quality-salient bundle. This implies that she would never buy it if she had put the same weight on the two attributes, or considered rational utility. On the contrary, the change in the high-type consumer's utility is indeterminate. If we compare the screening cases with and without decoy bundles, we have

$$u(\tilde{q}_H^a, \tilde{p}_H^a|\theta_H) - u(q_H^a, p_H^a|\theta_H) = \theta_H\big[\big(1-\frac{1}{\delta}\big)v(\tilde{q}_H^a) - (1-\delta)v(q_H^a)\big] + (\theta_H - \theta_L)\big(\frac{v(\tilde{q}_H^a)}{\delta} - \delta v(q_L^a)\big).$$

The first term is negative, where the first term in the bracket represents the loss from paying excessively for a quality-salient good and the second term in the bracket represents foregone benefit from caring much about prices when there is no decoy. However, the second term which is related to the high-type consumer's benefit from information asymmetry is strictly positive. Thus, the direction of change in the high-type consumer's utility will be determined depending on the relative magnitude of the two effects. Nevertheless, by examining the difference of her utilities in symmetric information cases with and without decoys, we can explicitly see the negative pure effect of decoy bundles on the welfare of high-type consumers, as is the case with the low-type ones.

5.3 Possible extensions

In this paper, we have analyzed the behavior of a monopolist facing two types of salient-thinking consumers. However, there are still many interesting research questions pending regarding the market with salient-thinking consumer types. First of all, while we only briefly discuss the effect of cost that may incur due to adding new bundles to the menu, it would be more interesting if such cost is explicitly modelled in to the monopolist's problem. Secondly, competition could be introduced instead of assuming a monopolistic seller. It would be interesting to see whether competing firms also have an incentive to offer decoy bundles or whether a firm with the option to offer decoy bundles wins the market. Bordalo, Gennaioli and Shleifer (2013b) introduced competition in a market with homogeneous salient-thinking consumers with firms offering only target bundles, which would be a nice starting point. Lastly, assuming that the consumers' type space is a continuum may provide us with new intuitions which were not apparent with only two types of consumers.

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A Proofs

A.1 Proof of Proposition 1

Case 1: When quality is the salient attribute, we have

$$\frac{\delta}{\theta_H} \leq \frac{v_H - v_L}{p_H - p_L} \leq \frac{\delta}{\theta_L} \leq \frac{v_L}{p_L}.$$

The first two inequalities come from the IC constraints and the last one from the IR(L) constraint. However, it is implied by the inequalities above that $v_L/p_L \geq v_H/p_H$ and hence that quality is not salient. Thus, if the monopolist provides quality-salient bundles, then the incentive constraints fail to hold and the desired screening cannot occur.

Case 2: In the case where the bundles are price-salient, the two IC constraints are summarized as follows:

$$\frac{1}{\delta\theta_H} \leq \frac{v_H - v_L}{p_H - p_L} \leq \frac{1}{\delta\theta_L}.$$

Since the IR(L) is binding at the solution, $p_L = \delta\theta_L v_L$. Also, the constraint IC(H), which is represented by the first inequality above, must bind since, otherwise, the monopolist is able to raise the price p_H without varying q_H and extract more money from the high-type consumers. Thus, the maximization problem of the monopolist becomes

$$\max_{(q_L, q_H)} \; m(\delta\theta_L v(q_L) - cq_L) + (1-m)(\delta\theta_L v(q_L) + \delta\theta_H(v(q_H) - v(q_L)) - cq_H).$$

If $m > 1 - \theta_L/\theta_H$, or there are sufficiently many low-type consumers, the screening solution is

$$q_L^a = v'^{-1}\Big(\frac{mc}{\delta\theta_L - \delta\theta_H(1-m)}\Big)$$
$$q_H^a = v'^{-1}\Big(\frac{c}{\delta\theta_H}\Big).$$

Case 3: When both attributes are equally salient, it holds that $v_H/p_H = v_L/p_L = (v_H - v_L)/(p_H - p_L)$. Since the IC constraints become

$$\frac{1}{\theta_H} \leq \frac{v_H - v_L}{p_H - p_L} \leq \frac{1}{\theta_L},$$

and $\theta_L v_L \geq p_L$ from IR(L), we obtain $p_L = \theta_L v_L$ and $p_H = \theta_L v_H$. Thus, the maximization problem is

$$\max_{(q_L, q_H)} \; m(\theta_L v(q_L) - cq_L) + (1-m)(\theta_L v(q_H) - cq_H),$$

and the optimal quality provision is $v'^{-1}(c/\theta_L)$ for both types, which is equivalent to that of the optimal pooling menu.

Hence, q_L^a and q_H^a with the corresponding prices consist the optimal screening menu. However, the profit from this menu is not necessarily higher than that from the optimal pooling menu. The difference between the profits from the two menus are

$$\begin{aligned}\pi^p - \pi^a = m\Big[&\theta_L v\big(v'^{-1}(\frac{c}{\theta_L})\big) - cv'^{-1}(\frac{c}{\theta_L}) \\ &- \big\{\delta\theta_L v\big(v'^{-1}(\frac{mc}{\delta\theta_L - \delta\theta_H(1-m)})\big) - cv'^{-1}(\frac{mc}{\delta\theta_L - \delta\theta_H(1-m)})\big\}\Big] \\ &+ (1-m)\Big[\theta_L v\big(v'^{-1}(\frac{c}{\theta_L})\big) - cv'^{-1}(\frac{c}{\theta_L}) - \big\{\delta\theta_H v\big(v'^{-1}(\frac{c}{\delta\theta_H})\big) - cv'^{-1}(\frac{c}{\delta\theta_H})\big\}\Big].\end{aligned}$$

Let $f(x,y) := v(v'^{-1}(x)) - yv'^{-1}(x)$ and $g(x) := f(x,x) = v(v'^{-1}(x)) - xv'^{-1}(x)$. Then, we can rewrite the difference as follows:

$$\pi^p - \pi^a = m\big[\theta_L g(\frac{c}{\theta_L}) - \theta_L f(\frac{mc}{\delta\theta_L - \delta\theta_H(1-m)}, \frac{c}{\theta_L}) + (1-\delta)\theta_L v(q_L^a)\big] \\ + (1-m)\big[\theta_L g(\frac{c}{\theta_L}) - \delta\theta_H g(\frac{c}{\delta\theta_H})\big] \,.$$

Since $\partial f/\partial x(x,y) = (x-y)(v'^{-1})'(x)$, $f(x,y)$ is maximized at $x = y$, given y. Thus, the first part of the difference is positive. On the contrary, $g'(x) = -v'^{-1}(x) < 0$ and the second part is positive by the assumption that $\delta\theta_H > \theta_L$. Thus, if m is near 1 or if δ is sufficiently small, then π^p is greater than π^a. $\square$

A.2 Proof of Lemma 1

First, we argue that IR(L) must bind. Suppose otherwise. Observing that the LHS of IC(H) is always greater than the LHS of IC(L), these exists a positive number $\epsilon > 0$ such that the new set of bundles obtained by raising all p_s^* and p_i^* $(i = 1, \ldots, k)$ by the same amount ϵ violate none of the constraints. However, the monopolist's profit increases in this case, which contradicts with the fact that the given bundle was optimal. Therefore, IR(L) must bind. Now, let

$$\pi(\alpha) := \max_q \Big(1 - \frac{1-\delta}{1+\delta}\alpha\Big)^{-1}\Big(1 + \frac{1-\delta}{1+\delta}\alpha\Big)\theta_L v(q) - cq, \text{ for } \alpha \in [-1,1] \,.$$

Then, $\pi(-1)$ and $\pi(1)$ are the maximized profits of the seller when the solution (q_s^*, p_s^*) is price-salient and quality-salient, respectively. By the envelope theorem, we have

$$\pi'(\alpha) = \frac{2(1-\delta)(1+\delta)}{\big((1+\delta)-(1-\delta)\alpha\big)^2}\theta_L v(q_s^*(\alpha)) > 0\,.$$

Therefore, (q_s^*, p_s^*) is quality-salient. $\square$

A.3 Proof of Proposition 2

By Lemma 1, we know that quality must be the salient attribute under the optimal menu and thus we may include $\sigma(v(q_s),\bar{v}) > \sigma(p_s,\bar{p})$ as an additional constraint. Under such additional constraint, IR and IC conditions boil down to the following simpler conditions:

$$\begin{aligned}
\text{IR(L)}: &\quad \theta_L v(q_s) = \delta p_s \\
\text{IR(H)}: &\quad \theta_H v(q_s) \geq \delta p_s \\
\text{IC(L)}: &\quad \theta_L v(q_s) - \delta p_s \geq \theta_L v(q_d) - \delta p_d \\
\text{IC(H)}: &\quad \theta_H v(q_s) - \delta p_s \geq \theta_H v(q_d) - \delta p_d
\end{aligned}$$

Since IR(L) implies IR(H), we need not consider the latter. From IR(L) we obtain an expression of p_s as a function of q_s. Substituting this expression in the objective function and differentiating with respect to q_s, we obtain the first-order condition for the maximization problem without the IC constraints: $\tilde{q}^p = v'^{-1}(\delta c/\theta_L)$. Denoting $\tilde{p}^p = (\theta_L/\delta)v(v'^{-1}(\delta c/\theta_L))$, $(\tilde{q}_s, \tilde{p}_s)$ is the solution to the maximization without the IC constraint. Hence, if we find (q_d, p_d) such that $\{(\tilde{q}^p, \tilde{p}^p), (q_d, p_d)\}$ satisfies IC and quality-salience of $(\tilde{q}^p, \tilde{p}^p)$, then $\{(\tilde{q}^p, \tilde{p}^p), (q_d, p_d)\}$ would be a solution to the given maximization problem.

Suppose $\tilde{p}^p > p_d$. In this case, the IC conditions become

$$\frac{\delta}{\theta_H} \le \frac{\delta}{\theta_L} \le \frac{v(\tilde{q}^p) - v(q_d)}{\tilde{p}^p - p_d}.$$

If this condition holds, we can verify that $v(\tilde{q}^p)/\tilde{p}^p > v(q_d)/p_d$ and that $(\tilde{q}^p, \tilde{p}^p)$ is quality-salient. Thus, for any q_d with $v(q_d) < v(\tilde{q}^p)p_d/\tilde{p}^p$, (q_d, p_d) is a decoy bundle which supports $(\tilde{q}^p, \tilde{p}^p)$ as a target bundle.

Note that when $\tilde{p}^p < p_d$, the IC conditions become

$$\frac{\delta}{\theta_L} \ge \frac{\delta}{\theta_H} \ge \frac{v(\tilde{q}^p) - v(q_d)}{\tilde{p}^p - p_d},$$

which implies $v(\tilde{q}^p)/\tilde{p}^p = \delta/\theta_L > v(q_d)/p_d$ and that the bundle $(\tilde{q}^p, \tilde{p}^p)$ is price-salient. It is immidiate from Lemma 1 that the menu $\{(\tilde{q}^p, \tilde{p}^p), (q_d, p_d)\}$ makes more profit than the menu $\{(q^p, p^p)\}$. $\square$

A.4 Proof of Lemma 2

Note that, for any given salience imposed on bundles, if a menu $\{(\hat{q}_L, \hat{p}_L), (\hat{q}_H, \hat{p}_H)\}$ with $\hat{q}_H > \hat{q}_L > 0$ and $\hat{p}_H > \hat{p}_L$ maximizes the profit, then the constraints IR(L) and IC(H) must be binding at $\{(\hat{q}_L, \hat{p}_L), (\hat{q}_H, \hat{p}_H)\}$.

Case 1: Suppose that the salient attributes of both bundles in the menu are the same, but that they are not quality-salient. Due to the two binding incentive constraints, we have the following maximization problems:

$$\max_{q_L, q_H} \ \alpha(\theta_L - (1-m)\theta_H)v(q_L) - mcq_L + \alpha(1-m)\theta_H v(q_H) - (1-m)cq_H\,,$$

where $\alpha = \delta$ or 1. The problem is for the case where the bundles are price-salient, if $\alpha = \delta$, and for the case where the attributes are equally salient, if $\alpha = 1$. In any case, the maximized value is smaller than that in the case where $\alpha = 1/\delta$, that is, the case where the bundles are quality-salient, since the coefficients of $v(q_L)$ and $v(q_H)$ are both positive and increasing in α.

In the case 2 and 3, we use proofs by contradiction. Suppose that $\{(\hat{q}_L, \hat{p}_L), (\hat{q}_H, \hat{p}_H)\}$ is the menu which maximizes the monopolist's profit.

Case 2: Consider the three cases where the quality of $(\hat{q}_H, \hat{p}_H)$ is relatively more salient than the quality of $(\hat{q}_L, \hat{p}_L)$ is. Without loss of generality [6], we assume that $(\hat{q}_H, \hat{p}_H)$ is quality-salient while $(\hat{q}_L, \hat{p}_L)$ is price-salient. Then, we have

$$\begin{aligned} \theta_H \hat{v}_H - \delta \hat{p}_H &= \delta \theta_H \hat{v}_L - \hat{p}_L \\ \theta_L \hat{v}_H - \delta \hat{p}_H &< 0 \\ \delta \theta_L \hat{v}_L - \hat{p}_L &= 0\,. \end{aligned}$$

Each of the conditions comes from IC(H), IC(L), and IR(L). Let the price-salient bundle $(\hat{q}_L, \hat{p}_L)$ be replaced by a quality-salient bundle (q'_L, p'_L) which satisfies

$$\theta_L v'_L - \delta p'_L = 0, \quad \text{and} \quad \theta_H v'_L - \delta p'_L = \delta \theta_H \hat{v}_L - \hat{p}_L\,.$$

[6] If $(\hat{q}_H, \hat{p}_H)$ is equally-salient and $(\hat{q}_L, \hat{p}_L)$ is price-salient, then, we can first make both of them equally-salient and then apply the argument in the case 1 to show that the profit can be increased further.

Thus, the low-type consumers prefer the new bundle to $(\hat{q}_H, \hat{p}_H)$, while the high-type buyers are indifferent between them. Also, we have from the equations above that

$$v'_L = \delta \hat{v}_L < \hat{v}_L, \quad \text{and} \quad p'_L = \theta_L \hat{v}_L > \delta \theta_L \hat{v}_L = \hat{p}_L\,.$$

Thus, the monopolist can increase her profit by substituting a quality-salient bundle with lower quality and higher price.

Case 3: Consider the three cases where the price of $(\hat{q}_H, \hat{p}_H)$ is relatively more salient than the price of $(\hat{q}_L, \hat{p}_L)$ is. Without loss of generality, we assume that $(\hat{q}_H, \hat{p}_H)$ is price-salient while $(\hat{q}_L, \hat{p}_L)$ is quality-salient. Then, as in the case 2, from the incentive constraints we have

$$\begin{aligned}
\delta\theta_H \hat{v}_H - \hat{p}_H &= \theta_H \hat{v}_L - \delta \hat{p}_L \\
\delta\theta_L \hat{v}_H - \hat{p}_H &< 0 \\
\theta_L \hat{v}_L - \delta \hat{p}_L &= 0\,.
\end{aligned}$$

We raise the price of the bundle for the high-type consumers. So, replace the bundle $(\hat{q}_H, \hat{p}_H)$ by a quality-salient bundle $(\hat{q}_H, p''_H)$, where p''_H satisfies

$$\theta_H \hat{v}_H - \delta p''_H = \theta_H \hat{v}_L - \delta \hat{p}_L.$$

Thus, the high-type consumers are indifferent between the new bundle and the existing bundle for the low-type buyers. Also, the low-type consumers never choose the new bundle since

$$\begin{aligned} p''_H &= \frac{\theta_H}{\delta}\hat{v}_H - \frac{\theta_H}{\delta}\hat{v}_L + \hat{p}_L = \frac{\theta_H}{\delta}\hat{v}_H - \frac{\theta_H}{\delta}\hat{v}_L + \frac{\theta_L}{\delta}\hat{v}_L \\ &= \frac{\theta_L}{\delta}\hat{v}_H + \frac{\theta_H - \theta_L}{\delta}(\hat{v}_H - \hat{v}_L) > \frac{\theta_L}{\delta}\hat{v}_H\,, \end{aligned}$$

and

$$u(\hat{q}_H, p''_H \,|\, \theta_L) = \theta_L\hat{v}_H - \delta p''_H < \theta_L\hat{v}_H - \delta\big(\frac{\theta_L}{\delta}\hat{v}_H\big) = 0\,.$$

In other words, the monopolist's profit can be increased by substituting a quality salient bundle for the high-type consumers with a higher price and the same quality. $\square$

A.5 Proof of Proposition 3

This proof is by construction. Let $\{(q_1, p_1), \ldots, (q_k, p_k)\}$ be the set of decoy bundles where k, the number of bundles, will be fixed later. Let $\bar{p} = \tilde{p}^a_L + \tilde{p}^a_H + \sum_{i=1}^k p_i$ and $\bar{v} = \tilde{v}^a_L + \tilde{v}^a_H + \sum_{i=1}^k v_i$. We must find the values of $\bar{p}$ and $\bar{v}$ such that the target bundles become quality-salient and at the same time they are preferred to all the decoy bundles by the corresponding types of buyers. We will find $\bar{p}$ and $\bar{v}$ with $\bar{p} < \tilde{p}^a_L$ and $\bar{v} < \tilde{v}^a_L$. Since $\sigma(v, \bar{v}) > \sigma(p, \bar{p})$ if and only if $v/p > \bar{v}/\bar{p}$ when $v > \bar{v}$ and $p > \bar{p}$, both of the target bundles are quality-salient if $\tilde{v}^a_i/\tilde{p}^a_i > \bar{v}/\bar{p}$ for $i = L, H$, which is equivalent to

$$\bar{p} > \frac{\tilde{p}^a_H}{\tilde{v}^a_H}\bar{v}\,.$$

Fix $(\bar{v}, \bar{p}) \in D \equiv \{(v, p) : p > \tilde{p}^a_H v / \tilde{v}^a_H\,, 0 < p < \tilde{p}^a_L\,, v > 0\}$. Then it is always possible to take sufficiently many points $(v_1, p_1), \ldots, (v_k, p_k)$ near $(\bar{v}, \bar{p})$ to set the actual average quality and price equal to $(\bar{v}, \bar{p})$. The bundles $(q_1, p_1), \ldots, (q_k, p_k)$ corresponding to the points are the desired decoy bundles. Now it remains to check if there is no incentive for buyers to select the decoy bundles rather than the target bundles. Since the consumers' indifference curves at their target bundles are $\theta_H v - \delta p = \theta_H \tilde{v}^a_L - \delta \tilde{p}^a_L (> 0)$ and $\theta_L v - \delta p = 0$, respectively, every point in D lies above both of the two curves. Thus, it is straightforward that the decoy bundles are inferior to the target bundles, regardless of whether they are quality-salient or price-salient. $\square$

A.6 Proof of Proposition 4

Consider the optimal screening menu $\{(q^a_L, p^a_L), (q^a_H, p^a_H)\}$ without a decoy bundle which is derived in section 3.3. We will design a new menu $\{(q^a_L, p^a_L), (q^a_H, p'_H), (q_d, p_d)\}$ which satisfies the incentive constraints for consumers and that increases the monopolist's profit. Suppose $\theta_L v^a_H / \delta > p^a_H$. Then, let $p'_H = \theta_L v^a_H / \delta$. Also, it is possible to take a point $(\bar{v}, \bar{p})$ such that

$$(5) \quad p'_H > \bar{p}, \quad v^a_H < \bar{v}, \quad v^a_H p'_H < \bar{v}\bar{p}, \text{ and } \frac{2\bar{v} - (v^a_L + v^a_H)}{2\bar{p} - (p^a_L + p'_H)} < \frac{1}{\delta \theta_H}.$$

We select (q_d, p_d) so that the average quality and salient of the desired menu become $\bar{v}$ and $\bar{p}$. The first three conditions ensure that (q^a_H, p'_H) is quality-salient, and the fourth that (q^a_L, p^a_L) and (q_d, p_d) are price-salient.

Now we verify that the incentive constraints hold. First, (q_H^a, p'_H) is strictly preferred to (q_L^a, p_L^a) by the high-type consumers since

$$\begin{aligned}
&u(q_H^a, p'_H |\, \theta_H) - u(q_L^a, p_L^a |\, \theta_H) \\
&= (\theta_H v_H^a - \delta\theta_L v_H^a/\delta) - (\delta\theta_H v_L^a - p_L^a) \\
&= (\theta_H - \theta_L) v_H^a - (\delta\theta_H v_L^a - \delta\theta_L v_L^a) \qquad (\because \text{IR(L) is binding at } (q_L^a, p_L^a)) \\
&= (\theta_H - \theta_L)(v_H^a - \delta v_L^a) > 0\,.
\end{aligned}$$

Also, the fourth condition in (5) ensures that the high-type consumers strictly prefer (q_L^a, p_L^a) to (q_d, p_d). When it comes to the incentive compatibility constraints for the low-type consumers, it should be noted that

$$u(q_L^a, p_L^a |\, \theta_L) = u(q_H^a, p'_H |\, \theta_L) = 0\,,$$

and hence the consumers are indifferent between the two bundles. Moreover, the fourth condition in (5) again guarantees that the decoy bundle (q_d, p_d) will not be chosen by the low-type buyers.

Now suppose $\theta_L v_H/\delta \leq p_H^a$. Then, it is sufficient for the monopolist to raise the price of the high-type bundle slightly. So, let $p'_H = p_H^a + \epsilon$ for some small $\epsilon > 0$. Similarly, we can take a point $(\bar{v}, \bar{p})$ which satisfies the condition (5). Then, for each of the three bundles, the salient attribute is given as before. Now we check if the incentive constraints hold. Note that the decoy bundle is less preferred to the target bundles for each type by the corresponding consumers due to the last condition in (5). The high-type consumers will select (q_H^a, p'_H) since

$$u(q_H^a, p'_H | \theta_H) - u(q_L^a, p_L^a | \theta_H)$$
$$= u(q_H^a, p'_H | \theta_H) - u(q_H^a, p_H^a | \theta_H) \quad (\because \text{IC(H) is binding at } (q_L^a, p_L^a) \text{ and } (q_H^a, p_H^a).)$$
$$= (\theta_H v_H^a - \delta(p_H^a + \epsilon)) - (\delta\theta_H v_H^a - p_H^a) > 0 \quad \text{for sufficiently small } \epsilon\,.$$

Also, the target bundle (q_L^a, p_L^a) will be sold to the low-type consumers since

$$u(q_H^a, p'_H | \theta_H) = \theta_L v_H^a - \delta p'_H < \theta_L v_H^a - \delta(\theta_L v_H^a/\delta) = 0 = u(q_L^a, p_L^a | \theta_L)\,. \quad \square$$

국문초록

본고에서는 주어진 상품의 여러 성질 중 특히 도드라지는 성질에 더욱 주목하는 소비자들이 산재해 있는 시장에서 독점 공급자가 상품군을 어떻게 구성할 것인가의 문제에 대해 이론적으로 분석한다. 위와 같은 경향을 갖는 소비자들을 'salient-thinking하다'고 일컫는데, 구체적으로 Bordalo, Gennaioli, and Shleifer (2013b)에서 소개한 효용함수를 차용함으로써 소비자들의 이러한 행동을 모형에 반영한다. 또한, 지불의사가 다른 소비자의 존재를 가정함으로써 전통적인 정보 비대칭의 문제도 함께 다룬다. 본고에서는 먼저 이러한 시장에서 독점 공급자가 직면하는 선별(screening) 문제를 풂으로써 최적 선별 (optimal screening)을 위해 독점 공급자는 가격보다는 질을 더욱 도드라져 보이게 하는 상품군을 구성한다는 것을 보인다. 다음으로, 독점 공급자가 실제로 팔 의도는 없지만 실제로 팔려는 상품의 특정 특성(여기서는 가격 또는 품질)을 도드라지게 하기 위해 시장에 상품을 낼 수 있는 경우를 분석하는데, 이와 같은 상품을 미끼상품 (decoy bundle)이라 일컫는다. 전통적인 합리적 소비자 모형 하에서는 이러한 미끼상품이 아무런 역할을 하지 못하지만, 본고의 모형에서는 소비자들이 본인이 구매하는 상품뿐만 아니라 구매하지 않는 다른 상품들 역시 효용에 영향을 끼치므로 이러한 미끼상품을 적절히 구성할 유인을 독점 공급자가 가질 것으로 생각해 볼 있다. 실제 모형을 풀어보면, 독점

공급자는 미끼상품들을 적절히 구성해서 실제로 팔려는 상품의 품질을 가격보다 더욱 도드라지게 만듦으로써 소비자들에게서 높은 가격을 받아내고 실제로 더 높은 이윤을 누릴 수 있음을 알 수 있고, 더 나아가 소비자는 이로 인해 후생감소를 겪는 것 역시 보일 수 있다.

주요어: salient-thinking, 미끼상품, 선별, 비선형 가격 설정, 품질 차별

학번: 2012-20144