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Abstract

A price that excludes some consumers from the market for a status good results in exclusivity and conspicuous consumption. But if rational consumers are not fully aware of the market demand, they may infer from the price signal that such exclusivity can not be too great, because the seller would not otherwise be willing to exclude these consumers at this price. Therefore, a price that supports conspicuous consumption also sends a signal that threatens it by undermining consumers' confidence in exclusivity. This paper demonstrates that when price sends such a signal, a monopoly seller may need to sell more than he wants to at a lower price, which impairs his profitability and even eliminates conspicuous consumption entirely. A firm with a lower profit from conspicuous consumption will be impacted by the price signal more heavily.

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1 Introduction

Exclusivity results when a high price excludes some consumers from the market. If this exclusivity is publicly observable and consumers are willing to pay for the exclusivity, conspicuous consumption occurs. However, this result regarding the market for status goods (also known as conspicuous goods) is based on the assumption that all consumers are well informed about the market demand or the value distribution of all potential consumers. Without this premise, the price may not only change the actual level of exclusivity, but also consumers' beliefs about the level of exclusivity. If the price plays both roles, how would the market for status goods be affected? In this paper, I seek to explore the conditions under which consumers' ignorance of market demand may hinder conspicuous consumption.

When a seller has an information advantage over consumers, such information may be conveyed to consumers through prices that are set by the seller to optimize his profit. When consumers with a higher income place a greater value on status goods, a price that excludes some potential consumers from the market activates conspicuous value for the higher income consumers who remain on the market. However, it also sends the message to those who are uncertain of the exclusivity, that the group of potential consumers being excluded cannot be too large compared to the group of consumers remaining on the market, because otherwise, the loss in sales volume would be too large for this exclusion to be profitable for the seller. Therefore, consumers who observe a price that is significantly higher than the price of a comparable good that is sold to everyone as a daily necessity may think "there must still be a large number of people who will accept the high price, otherwise how can the brand earn enough profit?".

Suppose that consumers are uncertain of the exclusivity but are aware of the price threshold that activates the conspicuous value. Any price exceeding this threshold creates the exclusivity, but also constrains the level of it. Through this constraint, the price signal may cause consumers' beliefs of exclusivity to be lower than the actual exclusivity at this price. Since exclusivity can be measured by the ratio of excluded consumers to consumers remaining on the market, a lower exclusivity suggests that the buyers of status goods rank lower in the income hierarchy, resulting in a lower conspicuous value, which may threaten conspicuous consumption.

For example, suppose there are q_H type H consumers and q_L type L consumers who value a good at $v_H = 5$ and $v_L = 3$ respectively, and let $\alpha = q_L/q_H$ denote the ratio of L to H in the market. Suppose the true value of α is 1 but it is known only to the seller. Also, assume that marginal production cost is 0 and consumer's willingness to pay is characterized by $v_i + E(\alpha)$, $i = H, L$, when the product is sold exclusively to consumer H. If consumers are truthfully informed that $\alpha = 1$, conspicuous consumption is possible, because setting the price at 6 to sell the product only to H is not less profitable than selling it to everyone at 3, because when $\alpha = q_L/q_H = 1$, we have $(5+1)q_H \geq 3(q_H + q_L)$.

However, when consumers do not know $\alpha = 1$, but instead believe that it is uniformly distributed on $[0, 2]$, a price equal to 6 delivers the message that $\alpha \leq 1$, because when $6q_H \geq 3(q_H + q_L)$, it must be that $\alpha \leq 1$. Otherwise, the seller will find $6q_H < 3(q_H + q_L)$ and set the price at 3. With this signal, consumers' beliefs will be updated to $\alpha \in [0, 1]$, resulting in $E(\alpha) = 0.5$. Therefore, the seller can only set the price at 5.5 at maximum if selling the product exclusively to H. Further such iterations cause consumers' beliefs to converge to $\alpha \in [0, 0.8]$ and $E(\alpha)$ to converge to 0.4, eventually resulting in a price reduction to 5.4 when selling exclusively to consumer H.[1] Comparatively, selling to all consumers at a price of 3 is more profitable. In this sense, consumer's uncertainty regarding market demand, or more specifically, exclusivity at a given price, impairs conspicuous consumption, which would have generated higher profit under perfect information assumption.

When there are two types of consumers so that conspicuous consumption is possible only if the good is sold exclusively to one of these types, the target consumer's willingness to pay may decrease as a result of price signaling, which could reduce the seller's profit. If profit loss becomes severe, this mechanism eliminates conspicuous consumption, provided

[1]Specifically, let $\alpha \sim U[a_i, b_i]$ for iteration i, and $E_i = \frac{b_i - a_i}{2}$ be $E(\alpha)$ for iteration i. Then we have $a_i \equiv 0$, $\forall i$, and $b_{i+1} = \frac{b_i/2+5}{3} - 1$. Setting $b_i = b_{i+1}$ yields $b_i \to 0.8$ as $i \to \infty$.

that selling status goods to all consumers becomes more profitable. When the scenario is generalized to include more than two types of potential consumers, the price signal affects the conspicuous value of each type of consumer. As the seller raises the price to enhance exclusivity, the marginal conspicuous value is diminished. This mechanism reduces the marginal profit generated by the price increase. Therefore, the seller may sell the status goods at a lower price to more types of consumers than would be optimal under perfect information assumption, which could result in a lower profit. Since the reduction in profit is caused by insufficient conspicuous value, a status good is more susceptible to the impact of the price signal if high income consumers are primarily interested in the product due to its conspicuous value $E(\alpha)$ rather than the direct value v_H in the above example. Moreover, the magnitude of the price signal effect is determined by the seller's profit associated with conspicuous consumption in comparison to his profit from selling the good as daily necessities. If a firm has a lower profit associated with conspicuous consumption, the negative impact by the price signal on such a profit is greater.

As a managerial implication, when a seller fails to recognize that consumers lack information about the market demand or do not consider the negative effect brought by the price signal, he may set price higher than the target consumers are willing to pay, resulting in a business loss; or he may overestimate the profit and enter the market for status goods mistakenly. Even for firms that remain in the market for status goods, maintaining high prices and exclusivity is sometimes difficult. Affordable luxury brands, such as Coach and Kate Spade, frequently offer substantial discounts on their products and sell them in outlet stores in order to attract more customers.

Although the price signal is unavoidable if consumers are uncertain about the market demand for status goods, the seller should still take measures to protect his profit if he chooses to remain on the market. The price signal functions on the consumer's initial support of possible exclusivity levels, for example, $[0, 2]$ in the introductory example above. If consumers severely underestimate the exclusivity, for example, by having initial support of $[0, 0.5]$, before seeing the price, their decisions are largely determined by this initial underestimation rather than the price signal. A seller may employ multiple strategies to ensure that consumers have an adequate support of possible exclusivity levels prior to seeing the price. As suggested by Krähmer (2006), enhanced advertising coverage enables brand names to reach a broader range of social members and expands the pool of potential consumers, of which many have low incomes and cannot afford the good. It convinces target consumers to be optimistic regarding their positions in the income hierarchy of potential consumers. Furthermore, it is not uncommon for prices to be concealed behind the products in some luxury stores. Some brands obscure or even completely remove price information from their official websites.[2] When price tags are hidden from consumers in the first place, consumers must ask for the price if they are interested in a product. This strategy affords sales representatives the opportunity to shape consumers' beliefs before the price sends a signal that could jeopardize the transaction.

My findings can also yield some broader policy implications. For instance, counterfeits, even if they may threaten the actual exclusivity of the authentic good, could send a signal that may enhance exclusivity in consumer's belief. Specifically, a counterfeiter may choose to make his products distinguishable from authentic goods (such as by setting a lower price) in order to target those who could not afford authentic goods. The existence of these counterfeits may send a signal to the market, indicating that there are a significant number of counterfeit buyers who are excluded from the markets for authentic goods, which may assist in maintaining consumer's belief in the exclusivity of authentic goods. This possibility explains the popularity of certain product lines (such as Louis Vuitton's "Nerverfull handbag" and Dior's "Book Tote handbag") remains unaffected by being counterfeited, and their prices increase year after year.[3] Another example would be the luxury

[2]For example, on the official websites of Gucci and Tiffany & Co., the price is not visible until the mouse cursor is placed over the product. On the official websites of Chaumet and Harry Winston, prices for watches and the majority of high-end jewelry are unavailable. Consumers can only place orders for these products via phone, email, or in person.

[3]Louis Vuitton's "Neverfull" product line was introduced in 2007 at a price of \$645, and the cost of the most recent model is now over \$2,000. In 2018, Dior's "Book Tote" was released at \$1,900; by

designer brands' tolerance of Zara which is famous for borrowing their designs. Zara is rarely sued for copying designs from other brands, especially considering how much and how many of their products are similar to other brands' collections.

According to the findings of my study, the status goods may not be as profitable as is typically conceived. If conspicuous consumption is thriving, counterfeits may contribute to its success. More importantly, the coexistence of counterfeiting and the growing popularity of authentic products may be evidence that reflects the price signaling issue in the status goods market. Though counterfeiting is occasionally perceived as a "problem" rather than a "solution" on the luxury goods market, regulators should understand the role it plays in neutralizing the price signaling effect that may undermine conspicuous consumption, which depends on whether consumers have adequate knowledge of the market demand.

The structure of my paper is as follows: Section 2 discusses the related literature. After establishing the model in Section 3, I discuss the main equilibrium with only two types of consumers in Section 4. This section demonstrates that the price signal may reduce the profitability of conspicuous consumption and may even eliminate it completely. Section 5 extends the scenario to include more than two types of consumers and shows that the main result is robust to this generalization. Finally, Section 6 concludes with remarks.

2 Related Literature

My paper contributes to the topic of price as a signal in transactions. Price as a signal is a well-established discussion supported by voluminous research. In addition to quality (Bagwell and Riordan, 1991; Bagwell, 1992; Linnemer, 2002) and production cost (Milgrom and Roberts, 1982; Bagwell, 1987; Bagwell and Ramey, 1988), the price can also transmit

2022, the price had increased to over $3,500. Both product lines are among the most popular of all time and are counterfeited extensively across the globe. In Entrupy's 2020 report "State of the Fake" (https://www.entrupy.com/state-of-the-fake-2020-report/#market), Louis Vuitton is the brand with the most authentications and "Neverfull" is the most authenticated product line of Louis Vuitton. Even though Entrupy is only one of many anti-counterfeiting companies, this report reflects that the counterfeiting issue surrounding with Louis Vuitton and "Neverfull" is well-known among consumers.

information about market demand (Bagwell and Ramey, 1990; Albaek and Overgaard, 1992). But most previous studies have focused on the supply side (such as retailer and entrant) as the receiver of the signal of market demand because consumers are not concerned with market demand. However, in the market for conspicuous goods, exclusivity, which is closely related to market demand, determines the conspicuous value and is hence the primary issue for consumers. This study investigates how the price could convey a signal of market demand to consumers and affect conspicuous consumption as a result. It complements another paper discussing the price signal in conspicuous consumption, in which conspicuous consumption undermines price signal that conveys the information about the product quality (Zhang, 2022).

Besides, my paper is related to the literature about the Veblen effect or conspicuous consumption. The study of conspicuous consumption originated with the Veblen effect which was first noticed by Veblen (1899). In recent decades, researchers have fitted conspicuous consumption into the framework of signaling game as behavior that signals personal traits or social status (some of the seminal works includes Pesendorf, 1995; Bagwell and Bernheim, 1996; Corneo and Jeanne, 1997). But previous related studies have either assumed that conspicuous value is independent of exclusivity or market demand (Liu et al., 2019), that consumers know market demand (Rao and Schaefer, 2013), or that their expectations regarding it are rational and accurate (Amaldoss and Jain, 2005a, 2005b). This paper, on the other hand, focuses on the scenario in which consumers, who are uncertain of market demand, may form a biased belief about the conspicuous value that is determined by market-demand-related exclusivity. Tereyağoğlu and Veeraraghavan (2012) also discussed the demand uncertainty on the market for conspicuous consumption. However, due to the absence of an asymmetric information structure within their framework, in which both consumers and sellers are uncertain about the market demand, the price signals was not discussed.

Finally, my paper is relevant to the literature discussing the potential contribution of counterfeits in the market.[4] It complements the existing studies stating that counterfeits may result in innovation in general markets (Qian, 2014) or solve the time inconsistency problem in markets for durable goods (Ding, 2014), which supports the empirical evidence by Romani et al. (2012) that counterfeits may increase consumers' willingness to pay for authentic goods. The implication of this paper is consistent with Yildirim et al.(2016), who demonstrate that consumers are willing to purchase more authentic goods to outpace the expansion of counterfeits and enhance the strength of their status signals. In contrast to Yildirim et al. (2016), this paper implies the possibility that counterfeiting itself may enhance exclusivity in consumer's belief, which improves the quality of the status signal and encourages consumers to pay more.

3 Model

In the main model, I consider two representative consumers representing H and L types, which will be relaxed in Section 5. Both consumers are aware of the types existing on the market but do not know the number of consumers belonging to each type. Since the type of a specific consumer is her private information, consumers can only be identified as belonging to a particular type based on their observable separating decisions on purchasing the status good X.

Consumers demand 0 or 1 unit of the status good X. When they consume and are observed to possess one unit of good X, direct and conspicuous value are created, respectively. I assume that H type consumer enjoys greater direct value v_H than L type consumer, who enjoys v_L.[5] On the other hand, conspicuous value $g(\alpha)$ is the same for all consumers who

[4]This strand of studies challenged the conventional wisdom, as represented by Grossman and Shapiro (1988a, 1988b), that counterfeits reduce economic welfare.

[5]This assumption follows the classical ones used in previous studies, such as Rao and Schaefer (2013). Such an assumption reflects that, given a direct utility function with an income effect, the indirect utility of a wealthier consumer is always greater than that of a consumer who is relatively poorer. In general, the richer consumer should have higher direct and conspicuous value. However, without sacrificing generality and in order to simplify the model, we assume that this differentiation applies only to the direct value.

own X, and it is a function of exclusivity $\alpha \in [0, \infty)$. Let q denote the sales volume or number of consumers who actually purchase good X, and M denotes the total number of all potential consumers on the market. Exclusivity is measured by $\alpha = \frac{M-q}{q}$, the population ratio of non-buyers to buyers. Consumer's conspicuous value $g(\alpha)$ is continuous and strictly increasing in α, and $g(0) = 0$.[6]

On the market for status good X, there is a monopoly seller. This monopolist produces X at a publicly known marginal cost $c \in [0, v_L)$, and sets the price at p. He knows that there are two representative consumers whose types are H and L respectively. But since the type of each consumer is her private information, the seller cannot associate each consumer with her type.

Consumers make rational decisions based on their beliefs about the market demand before they see the price, and the information conveyed to them by the price posted by the seller who has information advantage. In each consumer's belief before they see the price, there are at most N consumers on the market and no more than $k-1$ of them are L type, where $N \geq 2$ and $k \in [2, N]$. Therefore, the set of possible values of exclusivity $\hat{\alpha}$ is defined as $\{\hat{\alpha} = \frac{m}{l} | m \in \{1, ..., k-1\}, l \in \{1, ..., N-k+1\}\}$. For tractability, I assume that each distinct possible $\hat{\alpha} = \frac{m}{l}$ has the same probability of being the true value.[7] I also assume that k and N are the same for all consumers, and they are common knowledge shared by all players, including the seller.

Consumer i's expected (indirect) utility $E(u_i|p)$, where $i = H, L$, conditional on the price gives the expectation of total net value she receives when purchasing X. She purchases

[6] Observers know that those who own good X are wealthier than those who do not, under the assumption that wealthier consumers always enjoy greater direct value from good X. With higher exclusivity, an observer recognizes that consumers who purchase goods X are wealthier than more of their peers, and therefore rank higher on the wealth hierarchy. Therefore, $g(\alpha)$ is increasing in exclusivity α. In other words, exclusivity refines the signal about the wealth rank, which is conveyed by conspicuous consumption behavior.

[7] To keep introductory example concise, I implicitly assumed that $N - k + 1 \to \infty$ and a special probability distribution function such that $\alpha \sim U[0, 2]$. But in this more rigorous main model, to make the problem tractable, I apply a describable probability distribution function defined above that has full support on all possible discrete $\hat{\alpha}$ as $N - k + 1 < \infty$. In addition, I used $g(\alpha) = \alpha$ in the introductory example, but a generalized and unspecified $g(\alpha)$ in this main model.

one unit of good X if $E(u_i|p)$ is greater than or equal to zero, and does not if otherwise.

$$E(u_i|p) = v_i + E\left[g(\alpha)|p\right] - p \tag{1}$$

Knowing consumers' distribution of net value, the seller's objective is

$$\max_p (p-c)|\{i|E(u_i|p) \geq 0\}| \tag{2}$$

where cardinality $|\cdot|$ determines the number of consumers i buying the good X.

In the Perfect Bayesian equilibrium of this sequential game, the seller sets p to optimize objective (2) based on his anticipation of consumers' best responses. After observing p, consumers make decisions simultaneously depending on the value of (1). After the purchase is made, consumer i receives $u_i = v_i + g(\alpha) - p$ as the payoff. She gets 0 if deciding not to purchase X.

4 Equilibrium

In my model, because those who do not buy the good receive 0, conspicuous consumption, where consumers pay more than the direct value of a good, is possible only when selling to a part of the consumers.[8] Specifically, in this section, we focus on the condition which makes the seller sell good X exclusively to consumer H.

4.1 Benchmark Condition

Given two representative consumers, H and L on the market, $\alpha = 1$ when only consumer H owns the good X. If both consumers have it, $\alpha = 0$ and conspicuous value vanishes. When consumers have full information about the market demand (the number of H and

[8]Alternately, if consumers who do not purchase good X are recognized and receive a negative net value, they are willing to pay to avoid being excluded. Under this circumstance, conspicuous consumption may be possible even if sold to everyone.

L type consumers on the market), they can precisely determine α from the observed price. Because $u_H > u_L$, consumer H purchases good X as long as consumer L is willing to buy it. This implies that consumer L never enjoys conspicuous value, and that any price above v_L excludes her from the market. Consequently, when $p > v_L$ is observed, consumer H receives $v_H + g(1) - p$ for purchasing good X; when $p \leq v_L$ is observed, consumer H receives $v_H - p$ for purchasing good X.

The seller can choose to set $p = v_H + g(1)$ and sell one unit of good X exclusively to H for a profit of $v_H + g(1) - c$, or he can set $p = v_L$ so that both representative consumers will buy the good. When selling to both representative consumers, the seller earns $2(v_L - c)$. In order to examine the impact of the price signal on conspicuous consumption, $2(v_L - c) \leq v_H + g(1) - c$ is assumed as the benchmark condition for this section. Under this condition, there exists conspicuous consumption as long as consumers have knowledge about the market demand, because selling good X exclusively to consumer H generates a higher profit for the seller. In addition, I assume $v_H - c \leq 2(v_L - c)$ to make the problem meaningful. Otherwise, conspicuous consumption always exists regardless of the value of $E\left[g(\alpha)\right] > 0$.

4.2 Price Signal and Equilibrium

Departing from the benchmark where $\{p^*, q^*\} = \{v_H + g(1), 1\}$, we consider how consumer's lack of complete knowledge of market demand, or specifically, the number of H and L type consumers would change this equilibrium on the market for status good X, mainly through the effect of the price signal.

According to the utility function in (1), consumers with the same direct values have the same $E(u_i|p)$, and they make the same decisions. Therefore, regardless of how many L and H type consumers each representative consumer believes to exist, she believes that the seller sells good X to either all consumers of the same type or none of them.

In the benchmark in Section 4.1, $Pr(\alpha = 0) = 0$ is implied in the equilibrium if the price is set above v_L. As in the benchmark, consumer L never engages in conspicuous consumption and she exits the market as long as $p > v_L$. This is because she believes that her decision to purchase good X implies that all other L type consumers will make the same decision, causing the conspicuous value to vanish. Therefore, consumer H knows that all consumers of type L are excluded from the market whereas all consumers of type H remain on it, when she observes a price that is greater than v_L but does not exceed her willingness to pay. With $Pr(\alpha = 0) = 0$ implied for the equilibrium, exclusivity in this price range is measured by the ratio of consumers of type H to consumers of type L. However, such ratio is unknown to consumer H, as she does not know the number of consumers of each type.

Besides implying that $Pr(\alpha = 0) = 0$, a price greater than v_L also provides information that can be used to eliminate other possible values of exclusivity that are unjustifiably high. Because the information structure of this game is common knowledge, consumer H is aware that the price must reflect the seller's complete knowledge of the market demand. If some of the possible values of exclusivity, $\hat{\alpha}$, could not be justified by such information, they should be eliminated or assigned 0 probability in the consumer's belief. Specifically, if p is set above v_L, consumer H rationally deduces that the seller must observe $(p-c)q \geq (v_L - c)M$, or knows that setting p greater than v_L is more profitable. This condition can be rearranged into $\frac{p-c}{v_L-c} - 1 \geq \frac{M}{q} = \alpha$. Therefore, any $g(\hat{\alpha}) > g\left(\frac{p-c}{v_L-c} - 1\right)$ can not be justified by p, and should be assigned 0 probability when estimating expected conspicuous value.

$Pr(\alpha = 0) = 0$ implies that consumer H would estimate the expected conspicuous value based on $E\left[g(\alpha)\right] = \frac{1}{|\{\frac{m}{l}\}|} \sum_{\hat{\alpha} \in \{\frac{m}{l}\}} g\left(\hat{\alpha}\right) > 0$, where $m = 1, ..., k-1$ and $l = 1, ..., N-k+1$. On this basis, all $\frac{m}{l} > \frac{p-c}{v_L-c} - 1$ are removed from the expectation of conspicuous value, while the remaining ones share the same probability. Therefore, the following expression gives consumer H's expected conspicuous value conditional on the price signal.

$$E\left[g(\alpha)|p\right] = \frac{1}{|\{\frac{m}{l}|\frac{m}{l} \leq \frac{p-c}{v_L-c} - 1\}|} \sum_{\hat{\alpha} \in \{\frac{m}{l}|\frac{m}{l} \leq \frac{p-c}{v_L-c} - 1\}} g\left(\hat{\alpha}\right) \tag{3}$$

Lemma 1. *Suppose* $\frac{1}{N-k+1} \leq \frac{p-c}{v_L-c} - 1$*,* $E\left[g(\alpha)|p\right] \leq E\left[g(\alpha)\right]$*; If* $k > \frac{p-c}{v_1-c}$*,* $E\left[g(\alpha)|p\right] < E\left[g(\alpha)\right]$*.*

$\frac{1}{N-k+1} \leq \frac{v_H-c}{v_L-c} - 1$ ensures that $\{\frac{m}{l}|\frac{m}{l} \leq \frac{p-c}{v_1-c} - 1\}$ is not an empty set. If $k \leq \frac{p-c}{v_1-c}$, $E\left[g(\alpha)\right]$ is unaffected by the price signal and therefore $E\left[g(\alpha)|p\right] = E\left[g(\alpha)\right]$. If $k > \frac{p-c}{v_L-c}$, some $\hat{\alpha} = \frac{m}{l}$ that are greater than $\frac{p-c}{v_L-c}$ and should be assigned 0 probability, while all smaller $\hat{\alpha}$ that are less than $\frac{p-c}{v_L-c} - 1$ are assigned a greater probability. As $g(\alpha)$ is strictly increasing in α, we have $E\left[g(\alpha)|p\right] < E\left[g(\alpha)\right]$.

Lemma 1 implies that a price greater than v_L that makes conspicuous consumption possible also sends a signal that is not in favor of conspicuous consumption, when consumers are uncertain of the market demand.[9] Particularly, if $\max\{\hat{\alpha}\} = (k-1)/1$ is greater than $\frac{p-c}{v_L-c} - 1 \geq \alpha$, indicating that consumer's estimation of exclusivity before seeing the price is overly high, such estimation would be corrected by the price signal. However, such price signal always undermines consumer i's expected conspicuous value $E\left[g(\alpha)\right]$ as well as her expected indirect utility $E(u_i)$, $i = H, L$.

According to Lemma 1, $E\left[g(\alpha)|p\right]$ is an expectation of $g(\hat{\alpha})$, where $\hat{\alpha} \leq \frac{p^*-c}{v_L-c} - 1$. Therefore, a rational expectation on conspicuous value conditional on a given price should be $E\left[g(\alpha)|\alpha \leq \frac{p^*-c}{v_L-c} - 1\right]$. According to (1), to sell good X to consumer H, such price is constrained by consumer H's willingness to pay, which includes this expectation. Therefore, the equilibrium price is required by

$$p^* \leq v_H + E\left[g(\alpha)|\alpha \leq \frac{p^*-c}{v_L-c} - 1\right] \tag{4}$$

The existence of a $p^* > v_H$ that satisfies condition (4) is necessary for conspicuous equilibrium to exist, where only consumer H purchases good X. Lemma 2 demonstrates the necessary and sufficient condition for such existence.

Lemma 2. *Provided that* $k-1$ *is sufficiently great, there exists* $h \geq 0$ *such that* $v_H +$

[9] Lemma 1 holds true even if $E\left[g(\alpha)|p\right]$ has a different form than (3), as long as the probabilities assigned to the all remaining justifiable $\hat{\alpha} \leq \frac{p-c}{v_L-c} - 1$ are not diminished by the price signal.

$E[g(\alpha)|\alpha \leq h] - c \geq (h - \epsilon + 1)(v_L - c)$ and $\{\hat{\alpha}|\hat{\alpha} \leq h\} \neq \emptyset$, where $\epsilon = \min\{h - \hat{\alpha}|\hat{\alpha} \leq h\}$, is a necessary and sufficient condition for (4) to hold.

Proof. See Appendix A.1 $\square$

h measures the maximum value of exclusivity that is possible. For any given h, if $v_H + E[g(\alpha)|\alpha \leq h] - c < (h - \epsilon + 1)(v_L - c)$, a price $p \leq v_H + E[g(\alpha)|\alpha \leq h]$ that induces consumer H to buy the good causes $\frac{p-c}{v_L-c} - 1 < h - \epsilon$. The definition of ϵ indicates that at least one $\hat{\alpha} \in (0, h]$ that supports $E[g(\alpha)|\alpha \leq h]$ could not be justified by p.[10] Therefore, $E[g(\alpha)|\alpha \leq h]$ could not be a rational expectation.

Lemma 2 translates condition (4) into a more intuitive condition. A price should not exceed the consumer H's willingness to pay $v_H + E[g(\alpha)|\alpha \leq h] - c$. In addition, it must exceed $(h - \epsilon + 1)(v_L - c) + c$ for such a willingness to pay to be supported. Proposition 1 shows that under the assumption $v_H > v_L$, this condition is feasible.

Proposition 1. *Given that $\frac{1}{N-k+1} \leq \frac{v_H-c}{v_L-c} - 1$, there exists a price $p^* > v_H$ such that condition (4) is satisfied so that consumer H is willing to buy good X at $p^* > v_H$.*

Since $v_H > v_L$, even if the price is set at v_H, consumer H believes that some type L consumers are excluded from the market. $p = v_H + E\left[g(\alpha)|\alpha < \frac{v_H-c}{v_L-c} - 1\right] > v_H$ is justified as long as consumer H also believes that $\{\hat{\alpha}|\hat{\alpha} \leq \frac{v_H-c}{v_L-c} - 1\} \neq \emptyset$, which is guaranteed by $\frac{1}{N-k+1} \leq \frac{v_H-c}{v_L-c} - 1$. Therefore, $v_H + E[g(\alpha)|\alpha \leq h] - c \geq (h - \epsilon + 1)(v_L - c)$ is satisfied when $h = \frac{v_H-c}{v_L-c} - 1 > 0$. The shaded region in Figure 1 indicates the area where conspicuous consumption is feasible when the price signal is present given that $\epsilon \to 0$. It is evident that such a region exists so long as $v_H > v_L$.

Proposition 1 demonstrates that consumer H's conspicuous value can be activated even if she does not know the exact number of consumers of a particular type on the market. Thus, the seller can still charge consumer H a price higher than the direct value she receives

[10] $\epsilon \in [0, \min\{\frac{1}{l}|\frac{k-1}{l} > h\})$ and the possibility that $\epsilon > 0$ exists because $\hat{\alpha}$ is discrete. As $k - 1 \to \infty$ and $N + k - 1 \to \infty$, $\epsilon \to 0$.

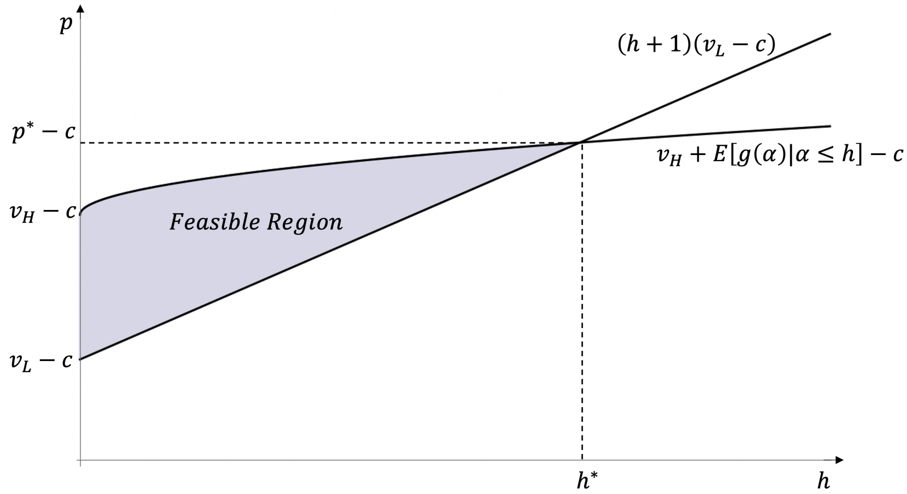

Figure 1: Feasible Region and Optimal Price of Conspicuous Consumption ($\epsilon \to 0$)

from consuming the good. This conclusion is consistent with the simple example presented in the Introduction where the effect of the price signal causes the upper bound of the uniform distribution to converge to 0.8 rather than 0.

The existence of $p > v_H$ satisfying condition (4) is only a necessary condition for conspicuous consumption. A seller is willing to sell good X exclusively to consumer H only when doing so will generate a greater profit than selling to both representative consumers.

Proposition 2. *(Equilibrium) Given that $k-1$ is finite, and $g''(\alpha) < 0$, there exists a finite h^* such that*

$$v_H + E\left[g(\alpha)|\alpha \leq h^*\right] - c = (h^* + 1)(v_L - c) \tag{5}$$

And $p^* = v_H + E\left[g(\alpha)|\alpha \leq h^*\right]$ is the equilibrium price on the market for status good X if $h^* \geq 1$. In this equilibrium, good X is sold exclusively to consumer H and equilibrium sales volume is $q^* = 1$.

Proof. See Appendix A.2 □

According to the definition of ϵ, $\epsilon = 0$ if $h \in \{\hat{\alpha}\}$. Let $\hat{\alpha}_{i^*}$ be the maximum $\hat{\alpha}$ that satisfies $v_H + E[g(\alpha)|\alpha \leq \hat{\alpha}] - c \geq (\hat{\alpha}+1)(v_L - c)$, and $\hat{\alpha}_{i^*+1}$ be the smallest $\hat{\alpha}$ that satisfies $v_H + E[g(\alpha)|\alpha \leq \hat{\alpha}] - c < (\hat{\alpha}+1)(v_L - c)$. Intuitively, since $(h+1)(v_L - c)$ is continuous in h, there must exist an $h^* \in [\hat{\alpha}_{i^*}, \hat{\alpha}_{i^*+1})$ that satisfies (5) as $(h+1)(v_L - c)$ bypasses $v_H + E[g(\alpha)|\alpha \leq h] - c$ from below. And $E[g(\alpha)|\alpha \leq h^*] = E[g(\alpha)|\alpha \leq \hat{\alpha}_{i^*}]$.

As reflected by Figure 1, with $\epsilon \to 0$, the intersection between $p = v_H + E[g(\alpha)|\alpha \leq h] - c$ and $p = (h+1)(v_L - c)$ uniquely determines h^*, and $p^* = v_H + E[g(\alpha)|\alpha \leq h^*]$ is the maximum p within the feasible region that allows for conspicuous consumption.[11] At this price, the profit $p^* - c$ is equal to $(h^*+1)(v_L - c)$. Only when $(h^*+1)(v_L - c) \geq 2(v_L - c)$ or $h^* \geq 1$ will the seller choose to sell good X to only consumer H instead of both representative consumers.

Proposition 2 is consistent with the example in the Introduction and yields the same result with the same numerical parameters.[12] Moreover, it implies a same convergence process as the introductory example. Even if consumer H's willingness to pay $v_H + E[g(\alpha)]$ is high before she sees the price, when the seller sets $p_1 = v_H + E[g(\alpha)]$, p_1 implies that some possible values $\hat{\alpha}$ that comprise $E[g(\alpha)]$ are too high and should be eliminated. Consequently, $E[g(\alpha)]$ would depreciate to $E[g(\alpha)|p_1]$. However, when the seller updates a lower price p_2 that fits $E[g(\alpha)|p_1]$, this lower price sends a signal that depreciate $E[g(\alpha)|p_1]$ into $E[g(\alpha)|p_2] < E[g(\alpha)|p_1]$. The seller then has to lower the price once again, and enter another loop. This feedback loop terminates until (5) is met.

Despite this feedback loop, conspicuous equilibrium, in which good X is sold exclusively to consumer H, is still possible so long as $h^* \geq 1$. However, it requires higher v_H compared to the benchmark. In the benchmark, $2(v_L - c) \leq v_H + g(1) - c$ is sufficient to sustain a conspicuous equilibrium. This condition changes to $2(v_L - c) \leq v_H + E[g(\alpha)|\alpha \leq 1] - c$ when the price signal is present, per Proposition 2 and Figure 1. Hence, a greater v_H is

[11] $\epsilon \to 0$ is a sufficient but not necessary condition for h^* to be uniquely determined. See Appendix A.3 for detailed discussion.

[12] Specifically, let $v_H = 5$, $v_L = 3$, $c = 0$ and $\alpha \sim U[0, h]$, (5) becomes $5 + \frac{h^*}{2} = 3(h^*+1)$, as the set of $\hat{\alpha}$ is compact and $\epsilon \equiv 0$. This equation yields $h^* = 0.8$, as predicted by the approximation performed on the example. As h^* fails to meet the threshold that supports conspicuous consumption $h^* \geq 1$, the price signal eliminates conspicuous consumption entirely.

required compared to the benchmark, since all possible values of exclusivity that could be justified by p in $E\left[g(\alpha)|\alpha \leq 1\right]$ are less than 1. For instance, if conspicuous equilibrium is barely maintained in the benchmark by having $v_H = 2v_L - c - g(1)$, it will be eliminated when the price signal exists, because the seller will find $2(v_L - c) > v_H + E\left[g(\alpha)|\alpha \leq 1\right] - c$ and choose to sell to both representative consumers, where conspicuous value vanishes.

Even if v_H is significantly greater than $2v_L - c - g(1)$ so that conspicuous equilibrium survives the impact of the price signal, the price signal may still reduce consumer's expected conspicuous value, thereby reducing the seller's profit in conspicuous equilibrium.

Proposition 3. *Given that $N-k \geq 1$ and $g^{''}(\alpha) < 0$, if $h^* < 2$, $p^* = v_H + E\left[g(\alpha)|\alpha \leq h^*\right]$ is smaller than $v_H + g(1)$.*

Let $E(\alpha|\alpha < 2) = \frac{1}{|\hat{\alpha}|\hat{\alpha}<2|}\sum_{\hat{\alpha}<2}\hat{\alpha}$, where $\hat{\alpha} = \frac{m}{l}$, and $\Gamma_2(l) = \frac{1}{\min\{2l-1,k-1\}}[\frac{1}{l} + ... + \frac{\min\{2l-1,k-1\}}{l}]$. Evidently, $E(\alpha|\alpha < 2)$ is a weighted sum of $\Gamma_2(l) \leq 1$ on $l = 1, ..., N-k+1$, with the weights adding up to 1. Hence, $E(\alpha|\alpha < 2) \leq 1$. Since $g^{''}(\alpha) < 0$, and $|\hat{\alpha}|\hat{\alpha} < 2| \geq 2$ due to $N-k \geq 1$, Jensen's inequality implies that $E\left[g(\alpha)|\alpha < 2\right] < g\left[E(\alpha|\alpha < 2)\right] \leq g(1)$. Therefore, if $h^* < 2$, $p^* = v_H + E\left[g(\alpha)|\alpha \leq h^*\right] < v_H + g(1)$.

As the upper bound of the possible exclusivity in the equilibrium, h^* determines the magnitude of the signaling effect. According to Lemma 2, $h^* - \epsilon \leq \frac{p^*-c}{v_L-c} - 1$ must hold to support consumer's willingness to pay, showing that the price constrains this magnitude. Specifically, when consumer H's willingness to pay $v_H + g(\cdot)$ is too small for a given v_L, a sufficiently high p^* cannot be supported when selling exclusively to consumer H, resulting in a decrease in h^* and the amplification of the signaling effect. In this case, a signal is sent to the market implying a smaller exclusivity, which could lead to a significant depreciation of the expected conspicuous value. The following corollary from Proposition 3 makes this mechanism clearer.

Corollary 1. *Given that ϵ and $g^{'}(\alpha)$ are sufficiently small, $g^{''}(\alpha) < 0$, and $N - k \geq 1$, $p^* = v_H + E\left[g(\alpha)|\alpha \leq h^*\right] < v_H + g(1)$ if $v_H + g(1) < 3(v_L - c) + c$.*

According to Proposition 3, $v_H + E[g(\alpha)|\alpha \leq h] < v_H + g(1)$, $\forall h < 2$. If $v_H + g(1) < 3(v_L - c) + c$, there exist a $\tilde{h} < 2$ such that $v_H + g(1) = (\tilde{h}+1)(v_L - c) + c$, implying that $v_H + E[g(\alpha)|\alpha \leq h] < (h+1)(v_L - c) + c$ at $\tilde{h} < 2$. When ϵ and $g^{'}(\alpha) < 0$ are sufficiently small that guarantee h^* that satisfies (5) is unique, $h^* < 2$ is resulted, as also shown by Figure 1. Because $h^* < 2$, Proposition 3 implies that $E[g(\alpha)|\alpha \leq h^*]$ is smaller than $g(1)$.

If consumer's willingness to pay is insufficient to support a high enough p^*, testified by $v_H + g(1)$ being significantly smaller than $3(v_1 - c) + c$, consumers are not convinced by the price signal that half of the potential consumers have been excluded from the market and $\alpha = 1$ is resulted. Therefore, even if conspicuous equilibrium exists with $h^* \geq 1$, the profit it generates may still be less than the benchmark. In particular, when $h^* \in [1, 2)$, the seller sells good X only to consumer H but only at a price lower than $v_H + g(1)$. This lower price results in a lower profit than the benchmark would have generated.

Nevertheless, consumer's uncertainty regarding exclusivity does not always lower the seller's profit in the conspicuous equilibrium. Because $g(\cdot)$ is concave, without specifying its concrete format, it is difficult to precisely characterize the condition for $E[g(\alpha)|\alpha \leq h^*] > g(1)$. But generally, it requires $k - 1 \geq h^*$ and that h^* is sufficiently large. The first requirement implies that consumers should overestimate the exclusivity prior to the price signal, while the second one suggests that the price signal should not be intense. With these two requirements being met, the seller could take advantage of the uncertainty to charge consumer H a higher price for a higher profit than the benchmark.

4.3 Discussion

If consumers on the market for status goods lack knowledge about the size of consumers belonging to each type, they also lack precise information about the exclusivity, even if the price indicates that certain types of consumers have been excluded. Although this may allow consumers to overestimate the exclusivity prior to observing the price, the price may convey the information that impact consumers' estimations, potentially leading to an underestimation of exclusivity, as indicated by Lemma 1.

A threshold consumer would believe "there are much more rich people than what I originally thought" and consequently reduce their willingness to pay when observing the price of status goods, particularly if they purchase these status goods primarily to satisfy their conspicuous needs. Proposition 1 implies that consumer's conspicuous value $E\left[g(\alpha)|p\right]$ will not be entirely eliminated by price signal. However, if the price signal is intense enough, the final $E\left[g(\alpha)|p^*\right]$ may be lower than $g(\alpha)$, which impairs the seller's profitability in conspicuous equilibrium, according to Proposition 3. In extreme case, if $v_H + g(\alpha)$ is not significantly higher than $2(v_L - c)$, such a depreciation may cause the profit to drop below $2(v_L - c)$, where conspicuous consumption that could have been possible in benchmark disappears.

Market for status goods is famous for high markup. To maintain a high price and sell only to a small portion of high income consumers, some luxury brands may even burn unsold stocks that worth millions of dollars each year.[13] However, this strategy is practiced only by a small number of high-end luxury brands and can not be sustained by majority of others. Because it is ubiquitous that consumers have little knowledge of the market demand and are therefore affected by the price signal to underestimate the conspicuous value when considering engaging in conspicuous consumption, the strategy of high price and high exclusivity is sometimes hard to be sustained. Some affordable luxury brands, such as Coach, Michael Kors, and Kate Spade, may place their products in outlet stores or offer substantial discounts in order to appeal to more consumers.

This implication is more significant when considering that certain firms may attempt to enter the market for status goods and induce their customers to engage in conspicuous consumption. So that they can charge consumers higher price based on the conspicuous value, especially when the direct value is low. When consumers are well aware of the market

[13]Burberry, for example, is famous for this practice. According to a BBC report, the total value of the stock destroyed in the five years before this practice was discontinued in 2018 may have reached £90 million (https://www.bbc.com/news/business-44885983).

demand, this strategy may help increase consumers' willingness to pay if $g(\alpha)$ is high. For example, in the benchmark of this section, $g(1)$ could raise consumer H's willingness to pay above $2v_L - c$, making selling exclusively to consumer H more profitable. However, when consumers have limited knowledge of the market demand, their estimated conspicuous value upon which they base their decisions becomes $E\left[g(\alpha)|\alpha \leq h^*\right]$. As suggested by Corollary 1, the magnitude of the price signal effect h^* is limited by the difference between the seller's profit from selling exclusively to consumer H versus selling to both consumers. Therefore, exceptional firms that are capable of making a high profit from conspicuous consumption are less susceptible to the negative effect of the price signal and have a greater chance of surviving in the market for status goods. On the contrary, it is extremely difficult for new entrants to survive in this market, as achieving superior quality and establishing a solid reputation and customer base are challenging. Conspicuous value is more of a reward for firms with high profits than a solution for those that require sufficient profits to survive. Therefore, although the high profit in the market for status goods is tempting, it has a high entry barrier that is significantly contributed by the lack of market demand knowledge among consumers. A seller could incur significant losses by entering the market of status good without considering the potential price signal issue associated to consumer's ignorance of market demand.

The reason for the existence of the price signal is that consumers are uncertain about the exclusivity. Due to this uncertainty, a consumer's initial belief is formed before the price signal modifies it. A scenario could be worse than the price signal constraining conspicuous consumption is one in which the equilibrium price is determined by the consumer's underestimated exclusivity rather than the price signal, represented by $k - 1 < h^*$. Figure 2 illustrates this circumstance.

By definition, $\epsilon = h - (k - 1)$ at $h \geq k - 1$. In contrast to Figure 1, the optimal price in Figure 2 is determined not by the constraint $(h - \epsilon + 1)(v_L - c)$ representing the effect of the price signal, but by the maximum possible exclusivity in the consumer's belief, $k - 1$.

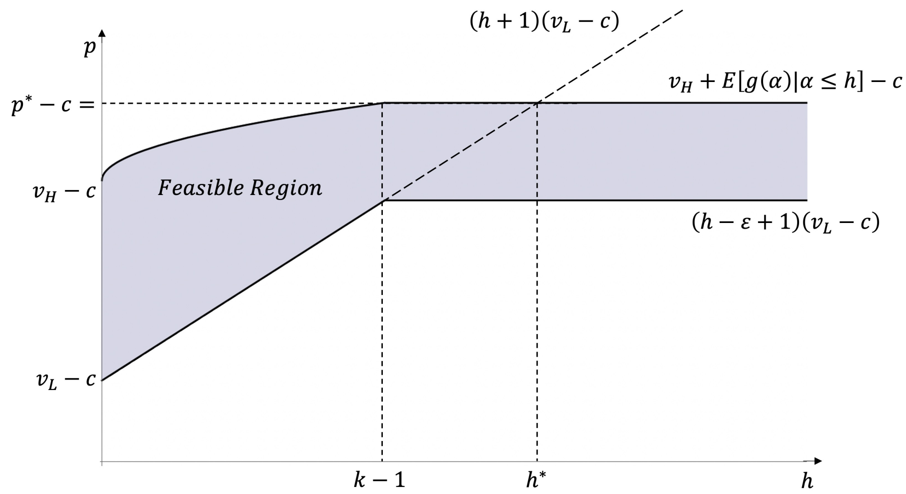

Figure 2: Feasible Region and Optimal Price of Conspicuous Consumption ($k-1 < h^*$)

According to Proposition 3, if $k - 1 < 2$, the seller's profit loss results from the initial underestimation of exclusivity by the consumer rather than the price signal.

Therefore, even if the price signal is unavoidable and constrains the level of exclusivity in consumers' beliefs, the seller must still persuade consumers and present them with a picture of high exclusivity associated with the good before they meet the price signal and update their beliefs accordingly. It is common for luxury brands to prevent consumers from seeing the price or making a purchase decision without being persuaded. For instance, luxury brands are reluctant to sell high-end products online. Customers can only place orders for these items via phone, email, or in stores where they can be persuaded to believe that owning these products gives them high exclusivity and conspicuous value. Ricard Mille, Harry Winston and Chuamet are examples of such luxury brands. For more luxury brands, price tags are frequently hidden behind or inside the products even in stores, allowing the sales representatives to engage in conversations with customers who are attracted to the products and curious about their prices. Through these conversations, the seller may be able to convince consumers that $k - 1$ is substantial, thereby preserving the seller's profit to the greatest extent possible, despite the negative impact of the price signal.

5 Multiple-type Consumers

Section 4 derived and analyzed the main equilibrium with consumers who represent two different types H and L. In this section, the model is generalized to include $M \geq 2$ consumers representing M different types. With this change, the actual distribution of direct value on the market becomes $\{v_1, ..., v_M\}$, where $v_i \geq v_j$ as long as $i > j$. For tractability, I assume that $v_i = v_1 + (i-1)\Delta v$, where $i = 1, ..., M$ and $\Delta v > 0$, which makes $\{v_1, ..., v_M\} = \{v_1 + (i-1)\Delta v | i \in \{1, ..., M\}\}$. Marginal cost of production $c = 0$ is assumed without sacrificing generality.

With this modification to the model, it is necessary to also generalize player's information structure. In this structure, each consumer knows her own direct value, and believes that it ranks k^{th} on the market before she observes the price. Besides, she also knows the lowest direct value on the market v_1, or the price at which conspicuous value vanishes.[14] To reflect this generalization, consumer i's belief about the direct value distribution prior to observing the price can be denoted as $\{\hat{v}_1, ..., \hat{v}_N\}$, where $\hat{v}_1 = v_1$ and $\hat{v}_k = v_i$. Except for $\hat{v}_1$ and $\hat{v}_k$, other values in $\{\hat{v}_1, ..., \hat{v}_N\}$ may differ from those in the actual distribution $\{v_1, ..., v_M\}$. For the consumer who has the lowest direct value, $k = 1$ and $v_k = v_1$. And for the other consumers, k could be any number from 2 to N in $\{\hat{v}_1, ..., \hat{v}_N\}$. I assume that all consumers $i \neq 1$ on the market have the same k and N and that the seller knows them as common knowledge.

[14] This assumption is generally equivalent to the scenario where consumers have in mind a price (v_1) at and below which they have no incentive to engage in conspicuous consumption. A consumer is only willing to pay for conspicuous value when doing so distinguishes her from those who are indistinguishable from her in the absence of conspicuous consumption. This group of her peers has willingness to pay exceeding v_1, because those unwilling to pay more than v_1 are so poor that their wealth can be distinguished from that of the targeted consumer even without conspicuous consumption. Therefore, if $p \leq v_1$, conspicuous value for targeted consumers vanishes.

5.1 Benchmark

When consumers are well aware of $\{v_1, ..., v_M\}$, given the price, they can rationally deduce how many consumers out of M are excluded from the market in the subgame equilibrium and can characterize α at this price unambiguously. As there is no uncertainty regarding α, consumer i buys one unit of good X only when $p \leq v_i + g(\alpha)$. Anticipating their best responses, the seller will set the price at $v_i + g(\frac{i-1}{M-i+1})$ if he desires to optimally exclude consumers with direct values smaller than v_i.

When the seller increases the exclusivity from $\frac{i-1}{M-i+1}$ to $\frac{i}{M-i}$, he is able to increase the price by $\Delta v + \frac{M}{(M-i+1)(M-i)} g'(\alpha)|_{\alpha \in (\frac{i-1}{M-i+1}, \frac{i}{M-i})}$ while losing one unit of sales volume. B_i, $i \in \{1, ..., M-1\}$ below gives the marginal benefit of such change.

$$B_i = (M-i) \left[\Delta v + \frac{M g'(\alpha)|_{\alpha \in (\frac{i-1}{M-i+1}, \frac{i}{M-i})}}{(M-i)(M-i+1)} \right] - v_i - g(\frac{i-1}{M-i+1}) \tag{6}$$

An equilibrium, in which sales volume is $M - i^*$ and price is $v_{i^*} + g(\frac{i^*}{M-i^*})$, is possible only when $B_{i^*} \geq 0$ and $B_{i^*+1} < 0$. The following lemma shows that there is an unique i^* that satisfies this condition.

Lemma 3. *As long as M is sufficiently great and $|g''(\alpha)|$ is sufficiently small, if $g\left(\frac{1}{M-1}\right) \geq \frac{v_1}{M-1}$, and $g''(\alpha) < 0$, there exists an unique $i^* \in \{1, ..., M\}$ such that $B_{i^*} \geq 0$ and $B_{i^*+1} < 0$.*

If M is sufficiently great and $|g''(\alpha)|$ is sufficiently small, $\left[\frac{M g'(\alpha)|_{\alpha \in (\frac{i-1}{M-i+1}, \frac{i}{M-i})}}{(M-i+1)}\right] - g(\frac{i-1}{M-i+1})$ approximates $g'(\frac{i-1}{M-i+1}) + \frac{i-1}{M-i+1} g'(\frac{i-1}{M-i+1}) - g(\frac{i-1}{M-i+1})$, which is decreasing in i as $g''(\alpha) < 0$. Because $\Delta v(M-i) - v_i = \Delta v(M - 2i + 1) - v_1$ is also decreasing in i, B_i is decreasing in i. $g\left(\frac{1}{M-1}\right) \geq \frac{v_1}{M-1}$ ensures that $B_1 > 0$ for any $\Delta v_i > 0$. Therefore, if $B_M < 0$, there exists an unique $i^* \in \{1, ..., M-1\}$ such that $B_{i^*} \geq 0$ and $B_{i^*+1} < 0$. If $B_M > 0$, $i^* = M$ because $B_M = -v_M - g(M-1) < 0$.

Lemma 3 implies that this equilibrium, as it is unique, can serve as a benchmark when characterizing the effect of the price signal on conspicuous consumption in a multi-type consumer context. To characterize this effect, I examine the deviation of the equilibrium from this benchmark. Specifically, let B_i^S denote the marginal benefit in the price signaling case when decreasing the sales volume from $M-i+1$ to $M-i$. If B_i^S decreases in i and be smaller than 0 at i^*, price signal causes the seller to sell good X to more types of consumers compared to the benchmark, which lowers the degree of conspicuous consumption.

5.2 Price Signal Effect

When consumers do not have full information about the direct value distribution $\{v_1, ..., v_M\}$, they need to process the price signal with the belief $\{\hat{v}_1, ..., \hat{v}_N\}$ to estimate the exclusivity and conspicuous value. To ensure that her decision is rational, each consumer $i \neq 1$ assumes that all consumers in her belief with a direct value greater than her will buy the good, whereas other consumers with a direct value less than her will not.[15] The seller always sets the price at the threshold consumer's willingness to pay, making the threshold consumer receives zero expected payoff when purchasing the good. With this anticipation, each consumer understands that when buying good X, her expected payoff will be negative if her direct value is less than the threshold consumer's direct value and positive if her direct value is greater. Using this as a decision criterion, she always receives a non-negative expected payoff.

In anticipation of consumers' best responses, condition (4) is still required for the price p_i to sell the good to consumer i whose direct value is v_i, with v_H replaced by v_i and v_L replaced by v_1. According to Proposition 2 and similar to condition (5), for $i \geq 2$, $p_i = v_i + E\left[g(\alpha)|\alpha \leq h_i\right]$ where h_i is given by

$$(i-1)\Delta v + E\left[g(\alpha)|\alpha \leq h_i\right] = h_i v_1 \tag{7}$$

[15] With this assumption, a consumer with a direct value lower than the threshold consumer will underestimate the exclusivity and her expected payoff of buying good X compared to assuming that only a portion of consumers with a direct value higher than her will purchase the good. Nevertheless, since a consumer with a direct value lower than the threshold consumer should choose not to buy good X, this underestimation does not change her decision of not buying the good. Similar reasoning applies to consumers whose direct value exceeds the threshold consumer.

I assume that ϵ is negligible in this section to simplify the problem. Under this assumption, h_i is uniquely determined by (7) according to Lemma 5 in Appendix A.3. Condition (7) also suggests that hi increases as i increases.

Let f_i denote $\frac{E[g(\alpha)|\alpha \leq h_{i+1}]-E[g(\alpha)|\alpha \leq h_i]}{h_{i+1}-h_i}$, condition (7) implies that $E\left[g(\alpha)|\alpha \leq h_{i+1}\right] - E\left[g(\alpha)|\alpha \leq h_i\right]$ is represented by $\frac{f_i}{v_1-f_i}\Delta v$. According to Lemma 4 in Appendix A.2, if $g''(\alpha) < 0$, f_i is decreasing in i with ϵ being negligible.

When decreasing the sales volume from $M-i+1$ to $M-i$, the seller can increase the price to extract the extra direct and expected conspicuous value from the remaining consumers, while losing one unit of sales volume. Thus, the seller's marginal benefit of making such a change, B_i^S can be expressed as (8) below.

$$B_i^S = (M-i)\left[\left(1+\frac{f_i}{v_1-f_i}\right)\Delta v\right] - v_i - E\left[g(\alpha)|\alpha \leq h_i\right] \tag{8}$$

As f_i decreases in i and $v_i + E\left[g(\alpha)|\alpha \leq h_i\right]$ increases in i, B_i^S decreases in i. Therefore, as long as $B_{i^*+1}^S < B_{i^*+1} < 0$, we have $B_i^S \geq 0$ at $i \leq i^*$, which implies that the price signal may increase the equilibrium sales volume in multi-type consumer context. This condition is realized if Δv is sufficiently low.

Proposition 4. *Given that $g\left(\frac{1}{M-1}\right) \geq \frac{v_1}{M-1}$ and $g''(\alpha) < 0$, there exists a $\Delta > 0$ such that as long as $\Delta v \in (0, \Delta)$, there exists an $i^* \in \{1, ..., M-1\}$ such that $B_{i^*+1}^S < B_{i^*+1} < 0$.*

Proof. See Appendix A.4 $\square$

$\left[(M-i)\frac{f_i}{v_1-f_i} - \sum_{j=1}^{i-1}\frac{f_j}{v_1-f_j}\right] > 0$ if i is below a certain threshold. Within this range of i, $(M-i)\left(\frac{f_i}{v_1-f_i}\right)\Delta v - E\left[g(\alpha)|\alpha \leq h_i\right]$ in (8) increases in Δv because $E\left[g(\alpha)|\alpha \leq h_i\right]$ can be rewritten as $\left[\sum_{j=1}^{i-1}\frac{f_j}{v_1-f_j}\right]\Delta v$. In contrast, $(M-i)\frac{Mg'}{M-i+1} - g(\frac{i-1}{M-i+1})$ in (6) is unaffected by Δv. Therefore, while both B_i^S and B_i decrease as Δv decreases, this variation is more substantially on B_i^S than B_i. When Δv is sufficiently small, $B_{i+1}^S < B_{i+1}$ holds for i below a certain threshold. If $B_i \geq 0$ and $B_{i+1} < 0$ at any of these i, i becomes i^*, and

$B^S_{i^*+1} < B_{i^*+1} < 0$ is resulted. This is possible also if Δv is sufficiently small, because B_i decreases as Δv decreases.

As long as $g\left(\frac{1}{M-1}\right) \geq \frac{v_1}{M-1}$, $B_1 \geq 0$ for any positive Δv. And there exists some sufficiently small Δv that hold $B^S_2 < B_2 < 0$, which shows the existence of Δ such that Δv is considered sufficiently small if $\Delta v < \Delta$. Within this range, for i such that $B_i \geq 0$, $B_{i+1} < 0$ are satisfied, $B^S_{i+1} < B_{i+1}$ also holds.

Proposition 4 shows that with the existence of the price signal, optimal sales volume is not less than the benchmark. In fact, this conclusion could be extended, because if a positive B_{i^*} is close enough to 0 at some $\Delta v < \Delta$, $B^S_{i^*}$ can be smaller than 0 as it is smaller than B_{i^*}. It implies that $B^S_i \geq 0$ while $B^S_{i+1} < 0$ may appear at $i < i^*$, and that the seller may sell to more types of consumers than in the optimal benchmark.

The mechanism of this result is similar to that of Section 4. If consumers are aware of the actual distribution of direct value on the market, when the price increases by $\Delta v + g(\frac{i}{M-i}) - g(\frac{i-1}{M-i+1})$, those with direct values greater than or equal to v_{i+1} realize precisely that one extra consumer is excluded from the market. Being certain that the exclusivity will increase from $\frac{i-1}{M-i+1}$ to $\frac{i}{M-i}$, they are willing to pay such extra price. However, if consumers do not have full information about the distribution of direct value, they can only estimate the number of excluded consumers based on the price relative to v_1. Δv is the additional direct value that the seller is able to extract when he abandons one consumer with lower direct value from the market. To convince consumers that one consumer has been excluded from the market, a sufficient price increase is necessary to justify this sacrifice in sales volume. But if Δv is too low, such an increase in price cannot be supported. When consumers are not convinced, they underestimate the increase in expected conspicuous value resulting from this price change. As the seller excludes one extra consumer from the market, this mechanism allows him to only increase prices by less than $\Delta v + g(\frac{i}{M-i}) - g(\frac{i-1}{M-i+1})$ when consumers need to estimate the exclusivity with the help of price signal. Therefore, while it is beneficial to exclude the consumer with direct value v_{i^*} from the market in benchmark, this may not be the case if the price signal is present, causing the seller to sell more than the benchmark scenario.

This deviation in level of conspicuous consumption led by price signal may eventually result in a lower profit in the equilibrium due to a lower conspicuous value, making it less optimal than benchmark for the seller. Similar to Corollary 1, the following corollary implies a sufficient condition for the profit to be lower in the case of price signaling than in the benchmark.

Corollary 2. *Given that $g^{''}(\alpha) < 0$, $g(\frac{i-1}{M-i+1}) > E\left[g(\alpha)|\alpha \leq h_i\right]$, as long as $v_i + g(\frac{i-1}{M-i+1}) < (2\frac{i-1}{M-i+1} + 1)v_1$.*

Corollary 2 is a generalized version of Corollary 1 in Section 4, with $\alpha = 1$ and $v = v_H$ replaced by $\frac{i-1}{M-i+1}$ and v_i, respectively, and c set to 0. It relies on the same mechanism as Corollary 1: $v_i + g(\frac{i-1}{M-i+1}) < (2\frac{i-1}{M-i+1} + 1)v_1$ implies $v_i + E\left[g(\alpha)|\alpha \leq h\right] < (h+1)v_1$ at $h = 2\frac{i-1}{M-i+1}$. Therefore, as in Corollary 1, $h_i < 2\frac{i-1}{M-i+1}$ is resulted, which makes $E\left[g(\alpha)|\alpha \leq h_i\right]$ smaller than $g(\frac{i-1}{M-i+1})$.

$v_i + g(\frac{i-1}{M-i+1})$ being smaller than $(2\frac{i-1}{M-i+1} + 1)v_1$ at given i is more likely if Δv is small enough, because a smaller Δv lowers $v_i + g(\frac{i-1}{M-i+1})$. On the basis of Proposition 4, if Δv is small enough to make $E\left[g(\alpha)|\alpha \leq h_i\right] < g(\frac{i-1}{M-i+1})$ at $i = i^{S*}$ such that $B^S_{i^{S*}} \geq 0$ and $B^S_{i^{S*}+1} < 0$, the price signal lowers the seller's profit in the equilibrium. Given $B^S_{i^{S*}} \geq 0$ and $B^S_{i^{S*}+1} < 0$, the optimal profit is achieved at a sales volume of $M - i^{S*}$ when the price signal affects the market. However, this optimal profit is even smaller than the seller's profit in the benchmark at the same sales volume $q = M - i^{S*}$. Since the seller's profit in the benchmark case may be further optimized by deviating the sales volume from $M - i^{S*}$ to $M - i^*$, the equilibrium profit is unambiguously greater in the benchmark than in the case where the price signal exists.

5.3 Discussion

As indicated by Proposition 4 and Corollary 2, the conclusion that price signal may reduce the level of conspicuous consumption and impair seller's profit is robust in generalized scenario with multiple types of consumers. And sufficiently small Δv serves as the supporting factor for these results.

In addition to serving as a robustness check, the model of this section establishes a more flexible framework that may accommodate more implications. Relaxing the assumption that $\Delta v > 0$ is constant for all i and setting $\Delta v = 0$ for some i results in $h_i = h_{i-1}$ for these i, according to (7). It implies that if the seller wishes to sell the good to threshold consumers with direct value v_i, he must sell to all of these consumers. Nevertheless, this issue does not exist if consumers know the market demand and can relate the price to the exclusivity precisely. With consumers' full knowledge, the seller can control the price to sell the good to a subset of threshold consumers with same direct values, because any extra ownership reduces the current conspicuous value. For those threshold consumers who are intended to be excluded, buying the good causes their net payoff to be negative, which makes them to voluntarily abstain from doing so. Therefore, if selling to a part of the threshold consumers is more beneficial, the existence of the price signal due to consumers lacking knowledge about market demand may further reduce the seller's profit compared to the benchmark.

In the real world, it is difficult for consumers to determine not only the size of each type of their peers, but also the number of types and their associated direct values on the market. Nevertheless, the generalization of consumer's belief prior to the price signal shows that the result of this paper is unaffected by this fact. With this generalization, consumers are allowed to hold either a more complicated belief which includes types that do not exist in society with a simple income structure, as discussed above, or a simpler belief which omits some types that do exist, as in this generalized section when $N < M$.[16] If exclusivity is the

[16] Specifically, in this generalized actual distribution $\{v_1, ..., v_M\}$ where $v_{i+1} - vi = \Delta v > 0$ for $i =$

only factor that determines conspicuous value, different beliefs $\{\hat{v}_1, ..., \hat{v}_k, ..., \hat{v}_N\}$, whether identical or distinct to the actual distribution $\{v_1, ..., v_M\}$, produce the same payoff for consumers in the equilibrium, so long as they do not know $\{v_1, ..., v_M\}$, and k and N are fixed. Although $\hat{v}_1 = v_1$ is still necessary, this only requirement on the information structure that restricts $\{\hat{v}_1, ..., \hat{v}_N\}$ has been significantly relaxed compared to the majority of previous studies, which assumed that consumers must know the entire actual distribution $\{v_1, ..., v_M\}$.

6 Concluding Remarks

Most previous studies of conspicuous consumption have assumed that consumers are fully aware or could rationally deduce an unbiased exclusivity as the determinant of their conspicuous value. My paper demonstrates that conspicuous consumption is still possible even when consumers lack complete information about market demand and can therefore infer a biased exclusivity. However, this conspicuous consumption is constrained by the price signal, which may correct consumers' overestimation of exclusivity but could also lead to a final underestimation of it.

Besides excluding some consumers from the market to create exclusivity and conspicuous value, a high price may also convey information about this exclusivity if consumers on the market for status goods are uncertain of the market demand. If the group of excluded consumers is too large, it would not in the seller's best interest to set such a high price. Therefore, a price that enables conspicuous consumption undermines consumers' beliefs in exclusivity and constrains their willingness to pay for the conspicuous value. In an investigation into how price signal affects the conspicuous consumption, I showed that the price signal may reduce the seller's profit and even eliminate conspicuous consumption

$1, ..., M-1$, all consumers can even hold the prior belief same as the one in Section 4 where $\hat{v}_j = v_L$ for $i = 1, ..., k$ and $\hat{v}_j = v_H$ for $i = k+1, ..., N$. And the result in this section is unaffected with this change in assumption.

completely if the reduction is substantial. This result is applicable in the context where consumers are aware of the consumer types on the market but do not know the number of consumers belonging to each type, and it is robust even when consumers are not fully aware of these consumer types.

This result suggests that it is difficult to maintain a high profit in the market for status goods by selling exclusively to a select group of consumers and charging them a premium for exclusivity. Furthermore, because firms with low profits are more susceptible to the negative impact of the price signal, only firms with high profits can survive in the status goods market. Therefore, although the market for status goods is tempting because firms in the market earn high profits, a firm that wishes to enter the market must take into account the effect of the price signal in order to accurately estimate its prospective profit in order to avoid business loss.

Even if the price signal is unavoidable due to consumers' ignorance of market demand, its effect may be neutralized by another signal if it helps restore consumers' beliefs about the exclusivity. The presence of counterfeits may facilitate such a signal. Some consumers who cannot afford expensive authentic goods may turn to purchase counterfeits if the counterfeit is hardly distinguishable from the authentic product and satisfies the buyer's conspicuous need, and is sold at an affordable price. As long as the consumers of authentic brands know that counterfeiting is prevalent, they can deduce that a large group of consumers are interested in authentic goods but are excluded from the market because they cannot afford those goods. This estimate may restore their faith in the exclusivity. Consequently, some product lines are more popular despite the spread of counterfeiting, and some authentic brands demonstrate considerable tolerance toward their imitators.

Realizing the significance of such a neutralized signal is also meaningful for the policy maker. Since selling exclusively to a group of consumers induces their conspicuous values, the dead-weight loss may result if the price signal eliminates conspicuous consumption and causes conspicuous values to vanish. If this loss outweighs the loss of transactions with excluded consumers, preserving conspicuous consumption is beneficial for social welfare. In this sense, regulating counterfeiting may result in inefficiencies that were not previously considered. Even though a growing number of studies suggest that counterfeiting may not necessarily be detrimental to social welfare, the majority of society continue to view it as a "problem" rather than a potential "solution" to other problems. My research necessitates future empirical studies to estimate consumers' knowledge of market demand in the market for status goods and to comprehensively characterize the effect of the price signal on this market, which may call for a reevaluation of certain policies in the real world.

References

Albák, Svend and Per Baltzer Overgaard, "Upstream Pricing and Advertising Signal Downstream Demand," *Journal of Economics & Management Strategy*, 1992, *1* (4), 677–698.

Amaldoss, Wilfred and Sanjay Jain, "Conspicuous Consumption and Sophisticated Thinking," *Management Science*, 2005a, *51* (10), 1449–1466.

_ **and** _ , "Pricing of Conspicuous Goods: A Competitive Analysis of Social Effects," *Journal of Marketing Research*, 2005b, *42* (1), 30–42.

Bagwell, Kyle, "Introductory Price as a Signal of Cost in a Model of Repeat Business," *The Review of Economic Studies*, 1987, *54* (3), 365–384.

_ , "Pricing to Signal Product Line Quality," *Journal of Economics & Management Strategy*, 1992, *1* (1), 151–174.

_ **and Garey Ramey**, "Advertising and Limit Pricing," *The Rand Journal of Economics*, 1988, pp. 59–71.

_ **and** _ , "Advertising and Pricing to Deter or Accommodate Entry When Demand is Unknown," *International Journal of Industrial Organization*, 1990, *8* (1), 93–113.

_ **and Michael H Riordan**, "High and Declining Prices Signal Product Quality," *The American Economic Review*, 1991, pp. 224–239.

Bagwell, Laurie Simon and B Douglas Bernheim, "Veblen Effects in a Theory of Conspicuous Consumption," *The American Economic Review*, 1996, pp. 349–373.

Corneo, Giacomo and Olivier Jeanne, "Conspicuous Consumption, Snobbism and Conformism," *Journal of Public Economics*, 1997, *66* (1), 55–71.

Ding, Yucheng, "Why Branded Firm may Benefit from Counterfeit Competition," *Working Paper*, 2014.

Grossman, Gene M and Carl Shapiro, "Counterfeit-product Trade," 1988a.

_ **and** _ , "Foreign Counterfeiting of Status Goods," *The Quarterly Journal of Economics*, 1988b, *103* (1), 79–100.

Krähmer, Daniel, "Advertising and Conspicuous Consumption," *Journal of Institutional and Theoretical Economics (JITE) / Zeitschrift für die gesamte Staatswissenschaft*, 2006, *162* (4), 661–682.

Linnemer, Laurent, "Price and Advertising as Signals of Quality When Some Consumers are Informed," *International Journal of Industrial Organization*, 2002, *20* (7), 931–947.

Liu, Zhenqi Jessie, Pinar Yildirim, and Jogn Zhang, "A Theory of Minimalist Luxury," *Preprint available at SSRN: https://ssrn. com/abstract*, 2019, *324672* (9).

Milgrom, Paul and John Roberts, "Limit Pricing and Entry under Incomplete Information: An Equilibrium Analysis," *Econometrica: Journal of the Econometric Society*, 1982, pp. 443–459.

Pesendorfer, Wolfgang, "Design Innovation and Fashion Cycles," *The American Economic Review*, 1995, pp. 771–792.

Qian, Yi, "Counterfeiters: Foes or Friends? How Counterfeits Affect Sales by Product quality tier," *Management Science*, 2014, *60* (10), 2381–2400.

Rao, Raghunath Singh and Richard Schaefer, "Conspicuous Consumption and Dynamic Pricing," *Marketing Science*, 2013, *32* (5), 786–804.

Romani, Simona, Giacomo Gistri, and Stefano Pace, "When Counterfeits Raise the Appeal of Luxury Brands," *Marketing Letters*, 2012, *23* (3), 807–824.

Tereyağoğlu, Necati and Senthil Veeraraghavan, "Selling to Conspicuous Consumers: Pricing, Production, and Sourcing Decisions," *Management Science*, 2012, *58* (12), 2168–2189.

Veblen, Thorstein, *The Theory of the Leisure Class: An Economic Study of Institutions*, Oxford University Press; Reissue edition 2009, 1899.

Yildirim, Pinar, Zhenqi Liu, and Z John Zhang, "Conspicuous Consumption on the Long Tail: How can Luxury Brands Benefit from Counterfeits?," *Working Paper*, 2016.

Zhang, Mengqi, "Income Effect and Product Quality in Conspicuous Consumption," *Working Paper*, 2022.

Appendix

A.1 Proof of Lemma 2

As $\hat{\alpha} = \frac{m}{l}$, $\{\hat{\alpha}|\hat{\alpha} \leq h\} \neq \emptyset$ ensures that $E\left[g(\alpha)|\alpha \leq h\right]$ is meaningful according to (3). For h that satisfies this condition, if $v_H + E\left[g(\alpha)|\alpha \leq h\right] - c < (h - \epsilon + 1)(v_L - c)$, any $p^* \leq v_H + E\left[g(\alpha)|\alpha \leq h\right]$ that induces consumer H to buy the good would cause $\frac{p-c}{v_L-c} - 1 < h - \epsilon$. When $k - 1 \geq h$, we must have $\{\hat{\alpha}|h - \epsilon < \hat{\alpha} \leq h\} \neq \emptyset$ for some $\epsilon \in [0, \frac{1}{N-k+1})$. Therefore, $E\left[g(\alpha)|\alpha \leq h, \alpha \leq \frac{p^*-c}{v_L-c} - 1\right] < E\left[g(\alpha)|\alpha \leq h\right]$, which fails to support $E\left[g(\alpha)|\alpha \leq h\right]$ as a rational expectation of the conspicuous value and shows the necessity of Lemma 2. With the $\epsilon = \min\{h - \hat{\alpha}|\hat{\alpha} \leq h\}$ that supports this necessity, it is also easy to show the sufficiency. When $p = v_H + E\left[g(\alpha)|\alpha \leq h\right] \geq (h - \epsilon + 1)(v_L - c)$, $\frac{p-c}{v_L-c} - 1 \geq h - \epsilon$ is resulted. The definition of ϵ implies that $\{\hat{\alpha}|\hat{\alpha} > \frac{p-c}{v_L-c} - 1, \hat{\alpha} \leq h\} = \emptyset$. Therefore, we have $E\left[g(\alpha)|\alpha \leq h\right] = E\left[g(\alpha)|\alpha \leq h, \alpha \leq \frac{p-c}{v_L-c} - 1\right]$, which causes $p \leq v_H + E\left[g(\alpha)|\alpha \leq \frac{p-c}{v_L-c} - 1\right]$ that satisfies (4). Once a $E\left[g(\alpha)|\alpha \leq h\right] > 0$ is a rational expectation where $\{\hat{\alpha}|\hat{\alpha} \leq h\} \neq \emptyset$, we have $p = v_H + E\left[g(\alpha)|\alpha \leq h\right] > v_H$ that is feasible.

A.2 Proof of Proposition 2

Let the elements in $\{\hat{\alpha}\}$ be ordered and denoted as $\hat{\alpha}_i$, $i \in \mathbb{Z}^{++}$, where $\hat{\alpha}_r > \hat{\alpha}_j$ as long as $r > j$. Considering only the value of $E[g(\alpha)|\alpha \leq h]$, where $h \in \{\hat{\alpha}\}$, we have the following lemma.

Lemma 4. $\frac{E[g(\alpha)|\alpha \leq \hat{\alpha}_{i+1}] - E[g(\alpha)|\alpha \leq \hat{\alpha}_i]}{\hat{\alpha}_{i+1} - \hat{\alpha}_i}$ *is decreasing in* $i \geq 1$*, if* $g''(\alpha) < 0$.

Proof. $E[g(\alpha)|\alpha \leq \hat{\alpha}_i] = \frac{\sum_{j=1}^{i} g(\hat{\alpha}_j)}{i}$, therefore, $\frac{E[g(\alpha)|\alpha \leq \hat{\alpha}_{i+1}] - E[g(\alpha)|\alpha \leq \hat{\alpha}_i]}{\hat{\alpha}_{i+1} - \hat{\alpha}_i}$ can be expressed as $\frac{ig(\hat{\alpha}_{i+1}) - \sum_{j=1}^{i} g(\hat{\alpha}_i)}{[i(i+1)](\hat{\alpha}_{i+1} - \hat{\alpha}_i)}$. After rearrangement, we have

$$\frac{ig(\hat{\alpha}_{i+1}) - \sum_{j=1}^{i} g(\hat{\alpha}_i)}{[i(i+1)](\hat{\alpha}_{i+1} - \hat{\alpha}_i)} = \frac{g(\hat{\alpha}_{i+1}) - g(\hat{\alpha}_i)}{(i+1)(\hat{\alpha}_{i+1} - \hat{\alpha}_i)} + \frac{(i-1)g(\hat{\alpha}_i) - \sum_{j=1}^{i-1} g(\hat{\alpha}_j)}{[i(i+1)](\hat{\alpha}_{i+1} - \hat{\alpha}_i)}$$

Let θ_{i+1} denotes $\frac{ig(\hat{\alpha}_{i+1})-\sum_{j=1}^{i} g(\hat{\alpha}_i)}{[i(i+1)](\hat{\alpha}_{i+1}-\hat{\alpha}_i)}$, the above equation can be expressed as

$$\theta_{i+1} = \frac{g(\hat{\alpha}_{i+1}) - g(\hat{\alpha}_i)}{(i+1)(\hat{\alpha}_{i+1} - \hat{\alpha}_i)} + \theta_i \left(\frac{i-1}{i+1}\right)\left(\frac{\hat{\alpha}_i - \hat{\alpha}_{i-1}}{\hat{\alpha}_{i+1} - \hat{\alpha}_i}\right) \tag{9}$$

Consider that $\hat{\alpha}_{i+1} - \hat{\alpha}_i = \hat{\alpha}_i - \hat{\alpha}_{i-1}$, the dynamic system (9) approximates $(i+1)\theta_{i+1} = g'(\alpha) + (i-1)\theta_i$, which implies that system (9) converge to a static status where the growth rate of θ_{i+1} converges to $\frac{g''(\alpha)}{2} < 0$. The definition of $\hat{\alpha}$ implies that $\hat{\alpha}_{i+1} - \hat{\alpha}_i$ is increasing in i, which preserves the trend that θ_{i+1} decreases in i. Therefore, $\theta_{i+1} = \frac{E[g(\alpha)|\alpha \le \hat{\alpha}_{i+1}] - E[g(\alpha)|\alpha \le \hat{\alpha}_i]}{\hat{\alpha}_{i+1} - \hat{\alpha}_i}$ is decreasing with the increase of i. $\square$

Given that $\frac{1}{N-k+1} \le \frac{v_H - c}{v_L - c}$, $v_H + E[g(\alpha)|\alpha \le h] - c > (h+1)(v_L - c)$ at $h = \hat{\alpha}_1 = \frac{1}{N-k+1}$. A finite $\max\{\hat{\alpha}\} = k-1$ guarantees that $\hat{\alpha}_{i+1}$ for any i is finite. Therefore, suppose there exist an $\hat{\alpha}_{i+1}$ such that $v_H + E[g(\alpha)|\alpha \le \hat{\alpha}_{i+1}] - c < (\hat{\alpha}_{i+1} + 1)(v_L - c)$, we must have $\frac{E[g(\alpha)|\alpha \le \hat{\alpha}_{i+1}] - E[g(\alpha)|\alpha \le \hat{\alpha}_i]}{\hat{\alpha}_{i+1} - \hat{\alpha}_i} < v_L - c$. According to Lemma 4, $v_H + E[g(\alpha)|\alpha \le h] - c < (h+1)(v_L - c)$ holds for all $h \ge \hat{\alpha}_{i+1}$.

If such a $\hat{\alpha}_{i+1}$ exists for some i, there is an unique i^* such that $v_H + E[g(\alpha)|\alpha \le \hat{\alpha}_{i^*}] - c \ge (\hat{\alpha}_{i^*} + 1)(v_L - c)$ and $v_H + E[g(\alpha)|\alpha \le \hat{\alpha}_{i^*+1}] - c < (\hat{\alpha}_{i^*+1} + 1)(v_L - c)$. According to the definition of ϵ, $E[g(\alpha)|\alpha \le \hat{\alpha}_{i^*}]$ is the maximum $E[g(\alpha)|\alpha \le h]$ that supports $v_H + E[g(\alpha)|\alpha \le h] - c \ge (h - \epsilon + 1)(v_L - c)$. Since $(h+1)(v_L - c)$ is continuous in h, and $\epsilon = 0$ at all possible $\hat{\alpha}$ by definition, there must exist an h^* such that $E[g(\alpha)|\alpha \le \hat{\alpha}_{i^*}] = v_H + E[g(\alpha)|\alpha < h^*] - c = (h^* + 1)(v_L - c)$, where $h^* \in [\hat{\alpha}_{i^*}, \hat{\alpha}_{i^*+1})$, as shown on Figure 3.[17]

If $v_H + E[g(\alpha)|\alpha \le h] - c < (h+1)(v_L - c)$ holds at $\max\{\hat{\alpha}\}$, as long as $\max\{\hat{\alpha}\} = k-1$ is finite, $v_H + E[g(\alpha)|\alpha \le k-1] - c$ is finite. Because $(h+1)(v_L - c) \to \infty$ as $h \to \infty$, there also exist a finite h^* such that $v_H + E[g(\alpha)|\alpha \le k-1] - c = v_H + E[g(\alpha)|\alpha \le h^*] - c = (h^* + 1)(v_L - c)$.

In either of the aforementioned cases, $p^* = v_H + E\left[g(\alpha)|\alpha \le h^*\right] > v_H$ is the maximum

[17] Figure 3 is a local feature of Figure 1 at intersection and when $\epsilon \neq 0$.

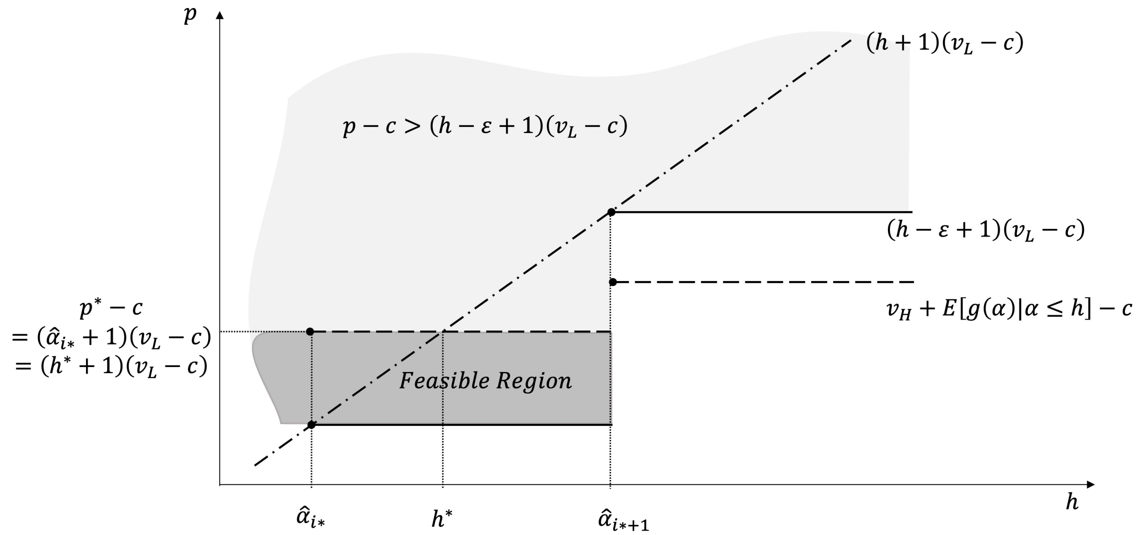

Figure 3: Determining h^* and the Optimal Price in Conspicuous Equilibrium

price p that satisfies condition (4) and it is also finite. Since $p^* - c = (h^* + 1)(v_L - c)$ measures maximum profit the seller can collect when selling good X exclusively to consumer H, p^* is an equilibrium price only if it generates a greater profit than the alternative profit $2(v_L - c)$ where good X is sold to all consumers, which requires $h^* + 1 \geq 2$ or $h^* \geq 1$. The proof is now complete.

A.3 Uniqueness of h^*

Proposition 2 shows that condition (5) is a necessary condition that determines h^* and its associated optimal price p^*. Appendix A.2 demonstrates that there is a unique i^* such that $v_H + E[g(\alpha)|\alpha \leq \hat{\alpha}_{i^*}] - c \geq (\hat{\alpha}_{i^*} + 1)(v_L - c)$ and $v_H + E[g(\alpha)|\alpha \leq \hat{\alpha}_{i^*+1}] - c < (\hat{\alpha}_{i^*+1} + 1)(v_L - c)$, provided that $\hat{\alpha}_{i^*+1} < \max\{\hat{\alpha}\}$.

Lemma 4 implies that (5) is impossible to hold for any $h \geq \hat{\alpha}_{i^*+1}$. To ensure that h^* determined by (5) is unique, we only need to ensure that $v_H + E[g(\alpha)|\alpha \leq h] - c > (h+1)(v_L - c)$ holds for all $h \in [\hat{\alpha}_i, \hat{\alpha}_{i+1})$ and for all $i < i^*$.

Lemma 5. *Given that $i < i^*$, if $v_H + E[g(\alpha)|\alpha \leq \hat{\alpha}_i] - c > (\hat{\alpha}_{i+1} + 1)(v_L - c)$, $v_H +$*

$E[g(\alpha)|\alpha \leq h] - c > (h+1)(v_L - c)$ *holds for all* $h \in [\hat{\alpha}_i, \hat{\alpha}_{i+1})$.

Lemma 5 is straightforward since if $v_H + E[g(\alpha)|\alpha \leq \hat{\alpha}_i] - c > (\hat{\alpha}_{i+1} + 1)(v_L - c)$ is satisfied, $(h+1)(v_L - c) < \min\{v_H + E[g(\alpha)|\alpha \leq h]\}$ for all $h \in [\hat{\alpha}_i, \hat{\alpha}_{i+1})$ if $i < i^*$.

Since $E[g(\alpha)|\alpha \leq \hat{\alpha}_i] < E[g(\alpha)|\alpha \leq \hat{\alpha}_{i+1}]$, Lemma 5 is satisfied if $\frac{E[g(\alpha)|\alpha \leq \hat{\alpha}_i] - E[g(\alpha)|\alpha \leq \hat{\alpha}_{i-1}]}{\hat{\alpha}_i - \hat{\alpha}_{i-1}}$ and $\hat{\alpha}_i - \hat{\alpha}_{i-1}$ are small for $i < i^*$ close enough to i^*. Therefore, a sufficiently small ϵ and $g'(\alpha)$ are both necessary to ensure the uniqueness of h^*. When $\{\hat{\alpha}\}$ is a compact set with full support, h^* is uniquely determined as shown on Figure 1.

A.4 Proof of Proposition 4

Since according to (7), $E[g(\alpha)|\alpha \leq h_{i+1}] - E[g(\alpha)|\alpha \leq h_i] = \frac{f_i}{v_1 - f_i}\Delta v$, $E[g(\alpha)|\alpha \leq h_i]$ can be expressed as $\left[\sum_{j=1}^{i-1} \frac{f_j}{v_1 - f_j}\right]\Delta v$. Therefore, $(M-i)\left(\frac{f_i}{v_1 - f_i}\right)\Delta v - E\left[g(\alpha)|\alpha \leq h_i\right]$ in (8) can also be rewritten as $\left[(M-i)\frac{f_i}{v_1 - f_i} - \sum_{j=1}^{i-1} \frac{f_j}{v_1 - f_j}\right]\Delta v$ for $i \in \{2, ..., M-1\}$. And for $i = 1$, $(M-i)\left(\frac{f_i}{v_1 - f_i}\right)\Delta v - E\left[g(\alpha)|\alpha \leq h_i\right] = (M-1)\left(\frac{f_1}{v_1 - f_1}\right)\Delta v > 0$ because conspicuous value is 0 at $i = 1$.

According to Lemma 4, when ϵ is negligible, f_i is decreasing in i. Therefore, as $M-i$ also decreases in $i \in \{2, ..., M-1\}$, $\left[(M-i)\frac{f_i}{v_1 - f_i} - \sum_{j=1}^{i-1} \frac{f_j}{v_1 - f_j}\right]$ decreases with the increase of i. Hence, $\left[(M-i)\frac{f_i}{v_1 - f_i} - \sum_{j=1}^{i-1} \frac{f_j}{v_1 - f_j}\right] > 0$ for some $i \geq 1$, and there exists an $\iota^S \geq 1$ such that $(M-i)\left(\frac{f_i}{v_1 - f_i}\right)\Delta v - E\left[g(\alpha)|\alpha \leq h_i\right] = \left[(M-i)\frac{f_i}{v_1 - f_i} - \sum_{j=1}^{i-1} \frac{f_j}{v_1 - f_j}\right]\Delta v$ is increasing in Δv as long as $i \leq \iota$.

In (6), $(M-i)\frac{Mg'(\alpha)}{(M-i)(M-i+1)} - g(\frac{i-1}{M-i+1})$ does not vary with Δv. Since $(M-i)\Delta v - v_i$ is a component existing in both B_i and B_i^S, the decrease of Δv decreases B_i^S more than B_i. Therefore, there is a $\lambda_g(\hat{i}) > 0$ such that $B_{i+1}^S < B_{i+1}$ for all $i \leq \hat{i} \leq \iota$ if $\Delta v < \lambda_g(\hat{i})$. $B_1 > 0$ guarantees the existence of $\lambda_g(\hat{i})$. It is easy to know that $\lambda_g(\hat{i})$ is non-increasing in $\hat{i}$.

(6) implies that B_i is monotonically increasing in Δv when $i \leq \lfloor\frac{M+1}{2}\rfloor$ and decreasing in i. Hence, for each $\hat{i} \leq \lfloor\frac{M+1}{2}\rfloor - 1$ defined above, there exists a $\lambda_q(\hat{i}) > 0$ such that

$B_{i+1} < 0$ at $i = \hat{i}$ when $\Delta v < \lambda_q(\hat{i})$. Lemma 3 shows that B_i is decreasing in i, therefore, $\lambda_q(\hat{i})$ is increasing in $\hat{i}$.

To ensure the possibility that $B_i \geq 0$ and $B_{i+1} < 0$ at i such that $B_i^S < B_i$, $\lambda_q(\hat{i}) \leq \lambda_g(\hat{i})$ must hold. Let $\tilde{i}$ be $\max\{\hat{i} \leq \lfloor \frac{M+1}{2} \rfloor - 1 | \lambda_q(\hat{i}) \leq \lambda_g(\hat{i})\}$, Δ in Proposition 4 can be defined as $\lambda_q(\tilde{i})$. As long as $\Delta v < \Delta$, $B_i^S < B_i$ holds for all $i \leq \tilde{i}$. Also, such a Δv makes $B_i \geq 0$ and $B_{i+1} < 0$ at some $i^* \leq \tilde{i}$. Therefore, we have $B_{i^*+1}^S < B_{i^*+1} < 0$, which finishes the proof.