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Cloak or Flaunt? The Fashion Dilemma

Hema Yoganarasimhan
Graduate School of Management, University of California, Davis, Davis, California 95616,
hyoganarasimhan@ucdavis.edu

There exists a dichotomy in the communication strategies of fashion firms—some firms purposefully cloak information on the tastefulness of their products, whereas others openly flaunt their tasteful or "it" products. This divide in communication strategies cannot be explained by existing wealth signaling models of fashion. In this paper, we offer a model of fashion that explains the above dichotomy. We model fashion as a social device that plays the dual role of allowing people to both fit in with their peers and differentiate themselves by signaling their good taste or access to information. In this context, we show that a fashion firm faces an interesting dilemma—if it restricts information, then only sophisticated consumers buy its products and use them to signal their taste. Cloaking thus preserves the signaling value of its products but reduces the number of social interactions enabled by them. In contrast, flaunting undermines the signaling value of its products but increases the interactions enabled by them. Given these trade-offs, we derive the conditions under which cloaking occurs. We also show that, in equilibrium, the most tasteful product endogenously emerges as the fashion hit or "it" product.

Key words: advertising; analytic models; game theory; marketing strategy; fashion; social interactions; signaling
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1. Introduction

Carpe Diem is an avant-garde fashion label by Altieri, who is known among the fashion cognoscenti for his secretive nature. Altieri does not advertise or promote his products at all and shuns all kinds of publicity (Shoham 2006).[1] In fact, he only sells his products through selective stores such as Atelier New York that serve his agenda of remaining under the radar. This crafted invisibility, although seemingly strange, is not unique to Carpe Diem. Many other chic fashion designers seem equally intent on hiding themselves (Wilson 2008). For instance, according to the trendy fashion guide Refinery29: "Location was everything to Takahiro Miyashita when opening his first store in the States. The extremely popular Japanese designer was looking for a location ... where only people looking for it would find it [he had to move his Tokyo store three times when the locations got too mainstream]" (http://www.refinery29.com/refinery/NYCmen_08.php; last assessed August 17, 2008).

This phenomenon of strategically withholding information in the arena of fashion is not just confined to avant-garde labels. Mainstream fashion houses also routinely withhold information on their fashion products. Labels such as Yves Saint Laurent (YSL), Versace, and Marc Jacobs usually have multiple product lines, of which only one (if any) goes on to become a fashion hit (Rumbold 2007). However, these firms do not aid consumers in identifying the potential fashion hits. Their stores, websites, and ad campaigns tend to be uniformly uninformative (Horyn 2008). In fact, their websites do not even divulge whether a particular product is part of a new line or was continued from the last season.

Consider, for instance, the marketing strategy of YSL in spring 2008. In the fashion shows staged at the beginning of the season, Muse Two emerged as the most critically acclaimed bag from YSL's collection. However, YSL did not explicitly promote this bag in its ad campaign, website, or stores. For instance, YSL ran three advertisements for bags, but only one of them featured Muse Two.[2] Furthermore, all three advertisements were given equal prominence; i.e., from the ad campaign, one could not infer that Muse Two was more tasteful than the other bags. Even YSL's website was not very informative—it simply

[1] As Shoham (2006) puts it, "He [Altieri] doesn't give interviews, doesn't let himself be photographed, doesn't advertise, doesn't have shows, doesn't loan clothes for shoots, doesn't market his wares other than to a handful of stores in the world .... Why in the world would a clothes designer behave like a radical underground artist? What does commerce have to do with anti-commercialism like this?"

[2] The other two bags featured in YSL's ad campaign were Muse and Majorelle. All three advertisements consisted of model Kate Moss posing with the bag. Samples of these three advertisements can be found on page 27 in the March 2008 edition of *Vogue* and pages 17 and 19 in the April 2008 edition of *Vogue*.

portrayed dozens of bags with no information on their relative popularity. In fact, Muse Two did not even appear on the first page of YSL's handbag section. Moreover, YSL's pricing strategy was also uninformative; i.e., it priced all its bags similarly.[3] Nevertheless, Muse Two did eventually emerge as the "it" bag[4] of the season.[5]

YSL is by no means the only fashion label that cloaks information on its fashion products. Recently, Marc Jacobs redid some of its storefronts to resemble generic army/navy stores and sold vintage military coats for $59. It is notable that the coats were marketed such that only those "in the know" could recognize its storefronts and buy them. Nevertheless, the coats went on to become fashion hits and were later featured in the *New York Times* (Colman 2008).

This strategic information restriction is surprising, especially because many other firms, such as the Ralph Lauren Collection (RLC),[6] flaunt information on their fashion hits. For example, consider the marketing strategy of RLC in spring 2008. In contrast to YSL, RLC promoted its popular "Scarf" bag as its most fashionable offering of the season—it was heavily featured in its advertisements and also promoted on its website (see http://www.visit4ads.com/advert/Ralph-Lauren-The-Scarf-Handbag-Ralph-Lauren-Womenswear/58423 for an example of RLC's Scarf handbag ad; last accessed December 30, 2011). In fact, RLC's website is extremely informative and aids consumers in identifying tasteful products through trend reports and style guides (e.g., Ralph Lauren 2008). RLC's website also allows consumers to sort items based on tags such as "Our Favorites," "Best Selling," "Newest Arrivals," etc. This allows consumers to easily identify RLC's fashion hits. RLC also priced the Scarf bag much higher then most of its other bags at $3,185, thereby allowing prices to reveal the identity of its most popular/fashionable bag.[7] Gap is another example of a firm whose advertisements aid consumers in picking fashion hits. In 2006, Gap promoted its popular skinny black pants using a series of memorable advertisements featuring Audrey Hepburn (Goldsmith 2006). Moreover, like RLC, its website also aids consumers in identifying the most fashionable items by providing trend guides and seasonal look books.

We examine this divide in the communication strategies of fashion firms—why do some firms *cloak* information on fashion products while others *flaunt* this information? What is the rationale for cloaking, as more information helps consumers identify potential fashion hits or "it" products and can thereby increase demand? Furthermore, firms that cloak information (e.g., YSL) also cater to consumers from taste-conscious circles—why is that? Finally, the word "fashion" itself seems imprecise—popular products worn by everyone (e.g., skinny pants) are labeled fashionable but so are elusive products worn by few (e.g., Muse Two). What exactly is "fashion" then, and how does the nature of fashion shape a firm's communication strategy?

These questions are particularly important for two reasons. First, as marketing researchers, it is essential that we understand why certain firms in a particular industry systematically withhold information on their most popular products. Second, from a managerial perspective, fashion is an economically important phenomenon. It is responsible for a $300 billion dollar industry (Bellaiche et al. 2010), which makes it the fourth-largest global industry according to some estimates (Helmore 2010). Moreover, fashion, as a phenomenon, is not confined to clothing or accessories. It also plays a prominent role in the success of other conspicuously consumed products such as electronic gadgets, furniture, and cars. (See Gammage and Jones 1974 for a fascinating discussion of tail-fin fashions in car design.) Given the widespread impact of fashion and its economic importance, it is essential that we understand how individuals adopt fashions and the role of firms in this process.

In this paper, we offer a model of fashion that explains the role of information in a market for fashion. We model fashion as a social device that facilitates social interactions by (1) allowing people to signal their good taste or sophistication and (2) enabling them to fit in with peers. We model social interactions as a *dating game*, where players signal their own type and interpret that of others. In this context, we examine how a firm's advertising and pricing strategies affect the value of fashion as a social device and how this in turn affects the firm's incentives to cloak information. Consider the firm's dilemma: If it restricts information on its products, then only sophisticated consumers (those with good taste or those "in the know") can identify the most tasteful or "it" product and buy it; by doing so, they can signal their taste to other consumers. Cloaking thus preserves a product's signaling value. However, it decreases the number of social interactions in which a consumer can use the

[3] For example, a medium-sized Muse Two was priced at $1,895, but so was a medium-sized Majorelle.

[4] An "it" bag is a sought-after bag that is carried by the fashion elite, is in great demand, and sells out soon after its launch.

[5] At the end of the season, the leading fashion website Style.com took stock of the fashion hits of spring 2008 and identified YSL's Muse Two as one of the most wait-listed accessories of the season.

[6] RLC is Ralph Lauren's highest-end women's wear label that retails exclusively at specialty boutiques and stores similar to Neiman Marcus. It should not to be confused with the low-end Polo brand from Ralph Lauren.

[7] Additional details on YSL's and RLC's advertising campaigns are available from the author.

product as a signaling device because of the decreased demand. On the other hand, if the firm flaunts information, then everyone can identify the most tasteful product and buy it. Although this increases the number of interactions enabled by the product, it undermines the product's signaling value. That is, people infer that the owner of the fashion good received help from the firm in discerning its tastefulness and hence do not credit its purchase to the owner's superior taste. Thus, information revealed by the firm affects the signaling game between consumers, their willingness to pay, and by extension, the firm's profits. Given these trade-offs, we derive the conditions under which cloaking occurs.

The rest of this paper is organized as follows: In §2, we develop a theory of fashion and discuss the related literature. In §§3 and 4, we present the model and analysis. In §5, we present three extensions of the main model. Finally, in §6, we conclude with a discussion of the main findings, limitations, and suggestions for future research.

2. Background and Theory Development

The word *fashion* is semantically ambiguous, so we start by examining the broad underpinnings of what constitutes fashion. One of the defining attributes of fashion is that it is consumed conspicuously—most if not all fashion products such as clothes and bags are external accessories meant for public display. This suggests that fashion products are social devices that are consumed for more than just their inherent utility. In fact, in a seminal essay on fashion, the prominent sociologist Simmel (1904, p. 133) argues that fashion satisfies two paradoxical social needs—the need for group cohesion and the need for differentiation:

> It [fashion] satisfies the demand for social adaptation; it leads the individual upon the road which all travel. ... At the same time, it satisfies in no less degree the need for differentiation ... .

This idea also relates to the concept of *optimal distinctiveness* in psychology (Brewer 1991). Brewer suggests that although people want to be similar to their social counterparts (group cohesion), they also want to portray distinctive positive qualities (distinction). The dual concepts of emulation and distinction serve as the basis for consumer utility in this paper.

First, consider the concept of group cohesion. In an influential experiment, Asch (1955) shows that people often conform to erroneous opinions in unambiguous situations to avoid the discomfort of being isolated in their choices or being the odd one out; i.e., people conform for social approval. (See Jones 1984 for an overview of the experimental evidence on conformity.) Furthermore, they may use external accessories as a means to this end; i.e., they may use fashion goods as social devices to fit in with the society (Berger and Heath 2007).

In their other role, fashion products allow people to differentiate themselves from others by signaling distinctive positive qualities. Specifically, we argue that fashion is a signal of taste. Indeed, the word "fashionable" is often used synonymously with tastefulness. Bourdieu (1984), a renowned sociologist who has written extensively on fashion and social distinction, proposes that cultural capital or knowledge manifests itself in individual taste, which in turn is reflected in fashion choices. Moreover, cultural capital or taste is often a manifestation of access to information. According to Donath (2007), "Fashion is a signal of one's position in a mobile, information-based hierarchy." Blumer (1969, p. 279) studies the cultivation of taste in the context of fashion and suggests that those with extensive access to similar information go on to develop "common sensitivities and similar appreciations." Simply put, those "in the know" develop a similar appreciation, termed as taste. For example, Suzuki and Best (2003) attribute the rise of high-school girls, or *kogyaru*, as fashion leaders in 1990s Japan to their communication networks.

However, fashion goods may also be a signal of other positive qualities such as wealth (as proposed by Veblen 1899, who also coined the term *conspicuous consumption*). Although wealth signaling certainly explains the demand for expensive luxury goods, it does not provide a rationale for concealing information. Indeed, if fashion were synonymous with wealth alone, then concealment is far from ideal because it reduces the number of people to whom a consumer can signal her wealth, thereby reducing its value. Moreover, the dichotomy in firms' communication does not follow along the lines of prices; the inexpensive Marc Jacobs coats were not advertised as fashionable but neither were the expensive Muse Two bags.

In fact, the idea that fashion is always initiated by the upper classes is often contested (Bourdieu 1984, Benvenuto 2000) because many fashions have humble origins; jeans originated from cowboys and miners, and the western-style male dress owes its origins to Quakers, not aristocracy. More recently, fashions such as the hip-hop style have originated in youth subcultures and inner cities, the antithesis of rich elite. Hence, fashion is not always a signal of wealth.

In sum, in this paper, we focus on two roles of fashion: (1) as a vehicle for conforming and (2) as a signal of taste or access to information. Together, they form the basis of consumer utility in our model.

Next, we discuss existing analytical models of fashion. Karni and Schmeidler (1990) present one of the earliest models of fashion. They consider two social groups, high and low, where both types value products used by high types but not those used by low types, and they show that fashion cycles can arise in equilibrium. Similarly, Corneo and Jeanne (1994) show that fashion cycles may arise out of information asymmetry. Pesendorfer (1995) adds a firm to the mix and adopts Veblen's wealth signaling idea to show that a monopolist produces fashion in cycles to allow high types to signal their wealth. However, none of these papers provides a rationale for concealing information. In contrast, by modeling fashion as a signal of taste and as a vehicle for conforming, we are able to explain why firms often cloak information on their fashion products.

In a more general context, this paper adds to the body of literature that explores the role of social influence on consumption. For example, Wernerfelt (1990) shows that "cheap talk" advertising by a firm can serve as a coordinating cue for consumers wishing to signal group affiliations. Similarly, Kuksov (2007) explores the value of brand image in social communication over and above cheap talk conversation. Whereas he focuses on a scenario where consumers have horizontal preferences in their matches, we focus on one where there is a vertical difference in consumer's abilities and everyone prefers to match with high types. On a related front, Amaldoss and Jain (2005) study the pricing of conspicuous goods. However, they do not model the social interactions between consumers as a signaling game. So their setup cannot explain the role of information in the market for fashion; i.e., they cannot explain why cloaking can be profitable from a firm's perspective.

Finally, our paper also relates to the literature on best sellers (see Sorensen 2007, Tucker and Zhang 2011). However, these papers do not focus on the social externalities associated with conspicuous consumption and its impact on the firm's communication strategy.

3. Model

3.1. Setup

Consider a monopolistic firm that produces two products, A and B. There is a unit mass of risk-neutral consumers who consume A, B, or nothing. Utility from a product is modeled as the sum of consumption utility CU and social utility SU:

$$U = CU + SU. \tag{1}$$

CU is the utility from the qualitative and utilitarian aspects of the product. For instance, the consumption utility of a bag may depend on factors such as its size, quality of leather, and workmanship. We assume that both A and B are of the same quality; i.e., they both provide the same consumption utility, $CU = V$. However, we allow for differences in the tastefulness of the two products. For example, even if two bags are similar in quality, one may be tasteful in its cut and color while the other may be garish. We capture this through state θ, where $\theta = A$ denotes that A is more tasteful than B, and $\theta = B$ denotes that B is more tasteful than A. A priori, both states are equally likely; i.e., $\Pr(\theta = A) = \Pr(\theta = B) = 1/2$.

Consumers are heterogeneous in their ability to recognize the most tasteful product. Some consumers are sophisticated or have a naturally good eye, whereas others lack these attributes. This heterogeneity is operationalized by assuming that consumers are uniformly distributed on a unit line signifying type, where consumer i's sophistication (or sense of taste) is decreasing in β_i; in other words, consumers with low β_i are sophisticated, and those with higher values of β_i are unsophisticated. Each consumer knows her own type but not that of others.

Although a product's tastefulness in and of itself does not provide any utility, it may assist one in social interactions. While many factors can enable and affect social interactions, we focus on the two specific roles of fashion products discussed in §2: (1) as a device to signal taste or access to information and (2) as a device to exhibit conformity. Specifically, the social utility that consumer i derives from an interaction with consumer j is

$$SU_i^j = A_i^j + C_i^j, \tag{2}$$

where A_i^j is i's utility from j's type and C_i^j is the utility from conformity.

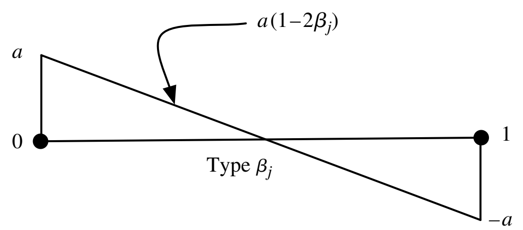
Mathematically, we need two attributes in A_i^j: (1) It should be decreasing in β_j to capture the idea that interactions with sophisticated consumers are more enjoyable than those with unsophisticated consumers. (2) It should be negative over some proper interval (β_a, β_b) such that $\beta_a \neq \beta_b$; if this were not true, then consumers would enjoy interactions with all types of players, in which case, they do not need fashion products to discriminate between sophisticated and unsophisticated consumers.[8] Although many functions satisfy these two attributes, we choose the following mean-zero function (see Figure 1),

$$A_i^j = a(1 - 2\beta_j), \tag{3}$$

where a is a positive constant, for two reasons. First, it normalizes the expected utility from interactions without information on partner's type to zero

[8] We have not imposed any cost on interactions; i.e., a social interaction is assumed to be costless. However, one could argue that social interactions incur physical, monetary, and opportunity costs. We can relax the second assumption on the mathematical form of A_i^j if we impose a finite cost on interactions.

Figure 1 *i*'s Utility from Partner *j*'s Type



($E[A_i^j] = \int_0^1 a(1-2\beta_j)\cdot d\beta_j = 0$). Second, the simple linear form makes the analysis tractable.

The second component of Equation (2), C_i^j, captures the utility from conformity. If both partners in a given interaction have the same product, they get a utility η from conforming; that is,

$$C_i^j = I(i, j)\eta, \tag{4}$$

where η is a positive constant, and $I(i, j) = 1$ if both i and j use the same product and 0 otherwise.

3.2. Timeline

Figure 2 depicts the timeline of the game. At Stage 1, the firm launches two products, A and B, and the true state of the world is realized. In this basic model, we assume that the firm does not receive any information on the state of the world. (In an extension in §5.1, we allow the firm to obtain imperfect information on θ.) However, it can choose the amount of information available to consumers about its products. Note that even if a firm does not know which of its collections is the most tasteful or "fashionable," it can still increase or decrease consumers' access to this information by varying the number of journalists with access to its fashion shows, the location of its stores, and the degree of detail on its websites. The extent of information restriction affects the number and type of people who can ascertain the true state of the world. If the firm severely restricts information, then only the most sophisticated consumers can discern whether A or B is more tasteful, whereas a more lax regime enables even the less sophisticated consumers to perceive the true state of the world. For instance, RLC's strategy of providing trend guides and much detail on its products will allow even less tasteful consumers to identify its fashion hits. On the other hand, YSL's strategy of designing extremely uninformative ads and websites will allow only the most sophisticated to identify its "it" bags. We model the degree of information restriction by the firm using parameter β. That is, we assume that the firm chooses a cutoff β such that all consumers of type $\beta_i \le \beta$ receive an informative signal $\sigma \in \{A, B\}$ on the state θ, whereas those above β do not. Without loss of generality, this informative signal is assumed to be correct with probability $1/2 < s < 1$.[9] The firm also chooses prices (P_A, P_B).

At Stage 2, consumers observe the firm's strategy and receive a signal if $\beta_i \le \beta$ and form beliefs on the state θ. At Stage 3, they decide whether to purchase A, B, or nothing.

Social interactions are modeled using a stylized dating game similar to those employed by Pesendorfer (1995) and Kuksov (2009). At the beginning of Stage 4, all consumers are randomly matched with another consumer from the unit mass of consumers.[10] Random matching is designed to capture the uncertainty in social interactions, where players cannot a priori predict their partner's type and choices.[11] Next, both players in a pair (i, j) simultaneously decide whether to date their respective partners or not. Consumer i is willing to date her partner j if $E_i[SU_i^j] \ge 0$. If *both* i and j are willing to date each other, then a date takes place, and they obtain social utilities SU_i^j and SU_j^i, respectively. The idea that both parties should be willing to date reflects the voluntary nature of social interactions.

Figure 2 Timeline

Stage 1 Firm launches two products A and B and chooses cutoff β, and prices (P_A, P_B). State θ is realized.	Stage 2 Consumer i observes firm's strategy and receives a signal σ on state θ if $\beta_i \le \beta$, where $\sigma \in \{A, B\}$ is correct with probability s.
Stage 3 All consumers decide whether to buy A, B, or nothing.	Stage 4 Each consumer is randomly matched with another consumer. Each person in a pair (i, j) decides if she wants to date her partner or not. A date occurs if and only if both choose to date.

[9] The analysis and the results remain the same if we instead assume that $0 < s < 1/2$, because the information content of a signal that is correct with probability $0 < s < 1/2$ is exactly the same as one that is correct with probability $1/2 < s < 1$ when there are only two states of the world.

[10] If we allowed for N interactions instead of one, then the total expected utility from the product would scale up by N. However, because this is only a scale effect, the main results of the paper would remain the same. Alternatively, the single random matching can also be interpreted as a unit mass of interactions.

[11] Both Simmel (1904) and Pesendorfer (1995) discuss the role of randomness in social interactions and its impact in spawning fashion. For example, Simmel suggests that big cities, where people know each other only fleetingly, are more likely to spawn fashions than small tribal communities where everyone knows each other. In terms of the analysis, it can be shown that a model where there is a probability χ of being matched with a partner whose ability and choices are known and a probability $(1-\chi)$ of being randomly matched yields similar results as long as $\chi < 1$.

The inference and dating decisions in the dating game mirror real interactions, where subsequent to meeting someone, a person often decides whether or not to interact with the other person based on external signals derived from clothing and accessories. For example, in a party, one may decide whether to hang out with someone (or not) based on how cool she looks. Similarly, one may decide to interact with a relative stranger at a club based on inferences drawn from her external accessories.

4. Equilibrium

Let $S = \{\beta, P_A, P_B\}$ be the firm's strategy, where β denotes the level of information restriction, and let P_A and P_B denote the prices of A and B, respectively. Let $\pi(S)$ be the firm's expected profit, such that

$$\pi(S) = \Pr(\theta = A)[D_A^A(S)P_A + D_A^B(S)P_B] + \Pr(\theta = B)[D_B^A(S)P_A + D_B^B(S)P_B], \quad (5)$$

where $D_\theta^A(S)$ and $D_\theta^B(S)$ denote the expected demands for A and B, respectively, in state θ for strategy S. Note that the firm conditions its strategy on its priors and not on the true state θ because it does not receive any additional information on the state of the world in Stage 1.

Consider a pure-strategy perfect Bayesian equilibrium, where the firm's and consumers' strategies are as follows: At Stage 1, the firm chooses strategy $S(\beta^*) = \{\beta^*, P(\beta^*), P(\beta^*)\}$; i.e., it chooses a cutoff β^* and prices both A and B at $P(\beta^*)$. At Stage 2, consumers of type β^* or less get a signal σ on state θ, and at Stage 3, they buy A if $\sigma = A$ and B if $\sigma = B$. Consumers of a type greater than β^* neither get a signal nor buy anything. Furthermore, at Stage 4, a consumer dates her partner if and only if the partner has purchased either A or B.

If $\beta^* < 1$, then the firm is withholding information from a segment of consumers (those from β^* to 1). In such cases, we refer to the equilibrium as a *cloaking equilibrium* because the firm cloaks information. If, instead, $\beta^* = 1$, then the firm is making information accessible to all consumers. In this case, we refer to the equilibrium as a *flaunting equilibrium*.[12] Hence, the equilibrium could either be cloaking or flaunting depending on the value of β^*. In §4.3, we show that without social signaling, the firm always flaunts, i.e., chooses $\beta^* = 1$. So cloaking can be interpreted as an equilibrium where the firm reveals less information in comparison to a benchmark case without social signaling.

We now examine this equilibrium in detail. First, we show that there are no profitable deviations for consumers. Next, we derive the equilibrium price $P(\beta^*)$ and show that there are no profitable deviations for the firm. Finally, we show uniqueness by considering all other possible equilibria and ruling them out.

4.1. Consumers' Strategies

Figure 3 shows the information set Ω_i and beliefs of consumer i at all stages of the game. At Stage 1, each consumer i knows only her own type β_i, and her belief on the state of the world, $\mu_i = \{\mu_A, \mu_B\}$, is the prior $\{0.5, 0.5\}$. At Stage 2, all consumers observe the firm's equilibrium strategy $S(\beta^*) = \{\beta^*, P(\beta^*), P(\beta^*)\}$. Moreover, consumers of type $0 \le \beta_i \le \beta^*$ receive a signal $\sigma = \{A, B\}$ on state θ. At this point these consumers update their beliefs, as shown in Figure 3. However, consumers of type $\beta^* < \beta_i \le 1$ do not receive a signal, and their beliefs remain at the priors. Note that in this game, consumers' beliefs are not directly influenced by the firm's actions because consumers know that the firm has no information on the true state of the world. That is, the firm cannot credibly signal the state of the world to consumers through its choice of cutoff or prices. Next, at Stage 3, each consumer i makes her purchase decision, which we denote using $f_i \in \{A, B, O\}$, where O denotes the no-purchase option. Finally, at Stage 4, each consumer i is paired with a partner j whose purchase f_j she observes. At this point i also updates her beliefs on j's type, as shown in Figure 3.

4.1.1. Dating Decision. Now consider the dating decision of consumer i at Stage 4 after she has been matched with a random consumer j. In this game,

Figure 3 **Consumers' Information Set and Beliefs in Equilibrium**

Stage 1 $\Omega_i = \{\beta_i\}$. $\mu_i = \{0.5, 0.5\}$.	Stage 2 If $0 \le \beta_i \le \beta^*$, $\Omega_i = \{\beta_i, S(\beta^*), \sigma\}$, where $\sigma = \{A, B\}$. $\mu_i = \{s, 1-s\}$ if $\sigma = A$. $\mu_i = \{1-s, s\}$ if $\sigma = B$. If $\beta^* < \beta_i \le 1$ $\Omega_i = \{\beta_i, S(\beta^*)\}$. $\mu_i = \{0.5, 0.5\}$.

Stage 3
If $0 \le \beta_i \le \beta^*$, then
$\Omega_i = \{\beta_i, S(\beta^*), \sigma, f_i\}$.
If $\beta^* < \beta_i \le 1$, then
$\Omega_i = \{\beta_i, S(\beta^*), f_i\}$.
	Stage 4
	If $0 \le \beta_i \le \beta^*$, then
	$\Omega_i = \{\beta_i, S(\beta^*), \sigma, f_i, f_j\}$.
	If $\beta^* < \beta_i \le 1$, then
	$\Omega_i = \{\beta_i, S(\beta^*), f_i, f_j\}$.
	If $f_j = \{A, B\}$, then
	$E_i(\beta_j) = \beta^*/2$.
	If $f_j = \{O\}$, then
	$E_i(\beta_j) = (1-\beta^*)/2$.

[12] Note that flaunting is different from hard selling (Chu et al. 1995). Flaunting refers to a scenario where the firm makes information regarding its products accessible to everyone, whereas hard selling refers to a scenario where the firm pushes consumers to buy products they do not want.

i infers j's type from j's product choice, and vice versa. So we can specify i's expected utility from dating j as $E_i[SU_i^j(f_i, f_j)]$; i chooses to date j if and only if $E_i[SU_i^j(f_i, f_j)] \geq 0$. In Lemma 1 in the appendix, we show that, in equilibrium, there is a date in a given match (i, j) if and only if both i and j have purchased either A or B. We discuss the intuition for this result here and refer interested readers to Appendix §A.1 for details.

First, consider the case where both i and j have purchased A. Here, i infers that j's type lies between 0 and β^* or that j's taste is more sophisticated than average. So i's expected utility from j's type (and vice versa) is

$$E_i[A_i^j(A, A)] = E_j[A_j^i(A, A)] = \frac{1}{\beta^*}\int_0^{\beta^*} a(1-2\beta)d\beta = a(1-\beta^*). \quad (6)$$

Furthermore, because both i and j have the same product, they also get utility η from conformity, and i's total expected utility from dating j (and vice versa) is

$$E_i[SU_i^j(A, A)] = E_j[SU_j^i(A, A)] = a(1-\beta^*)+\eta > 0. \quad (7)$$

Both i and j choose to date as the expected utility from the date, $a(1-\beta^*)+\eta$, is positive.

Similarly, in the case where i has A and j has B (or vice versa), both still recognize their partner's sophistication because only consumers from 0 to β^* get a signal and go on to buy. Hence, both i and j choose to date in this case also, even though they do not get any utility from conformity because $a(1-\beta^*) \geq 0$. The fact that a date ensues even when i and j have different products may tempt consumers who have not received a signal (i.e., those from β^* to 1) to buy A or B randomly. However, this possibility is ruled out in §4.1.3.

Finally, if one of the players has not bought anything (say, j), then her partner (say, i) infers that j's type lies between β^* and 1. That is, i infers that j is relatively unsophisticated, which in turn induces i to avoid a date with j. Hence, a date occurs only if both i and j have made a purchase.

Social Signaling in Equilibrium: Note that a consumer's own taste does not directly affect her social utility. However, signaling good taste enables her to attract partners with good taste and thereby affects her social utility indirectly. Hence, the dating game is an endogenous mechanism that captures the rationale for signaling good taste or sophistication. In a social interaction or dating game, a consumer has two tasks: (1) to infer her partner's type from the external signal (which is essentially her partner's product choice of A, B, or nothing) and (2) to send a positive signal about her own type to attract her partner to interact.

In the cloaking equilibrium (where $\beta^* < 1$), a consumer's fashion choice (purchase of A or B) is an informative signal of her type because only consumers with relatively good taste (those between 0 and β^*) buy A or B. Hence, cloaking can be interpreted as a *separating* equilibrium, where sophisticated consumers (with low β) separate themselves from the unsophisticated ones (with high β). Here, fashion goods play a key role in facilitating social interactions by resolving the uncertainty about one's social counterparts.

Even in a cloaking equilibrium, the signaling value of the firm's products, $a(1-\beta^*)$, decreases as β^* increases. That is, as the firm allows more people to access information, consumers' ability to signal their taste using the firm's products decreases. In the extreme, in the flaunting equilibrium, the firm allows everyone to access information by setting $\beta^* = 1$. Here, an individual's fashion choice does not provide any information on her taste because $a(1-\beta^*)|_{\beta^*=1} = 0$; i.e., consumers' posteriors on their partners' types are the same as their priors. Flaunting can therefore be interpreted as a *pooling* equilibrium where sophisticated consumers are unable to separate themselves from the unsophisticated ones.

4.1.2. Expected Social Utilities. Next, we derive the expected social utilities of consumers and show that they exhibit snob and bandwagon effects. Let su_θ^A be i's expected social utility from *using* A in state θ. From Lemma 1, we know that a consumer i chooses to date her partner j if and only if j has bought either A or B. Moreover, in equilibrium, the probability of being matched with a partner carrying A is exactly equal to the expected demand for A, and the probability of being matched with a partner carrying B is equal to the expected demand for B. Thus,

$$su_A^A = D_A^A(S(\beta^*))E_i[SU_i^j(A, A)] + D_A^B(S(\beta^*))E_i[SU_i^j(A, B)], \quad (8)$$

where $D_A^A(S(\beta^*))$ and $D_A^B(S(\beta^*))$ are the expected demands for A and B, respectively, in equilibrium when $\theta = A$ (see Table 1). Equation (8) can be simplified as

$$su_A^A = \beta^*[a(1-\beta^*)+s\eta], \quad (9)$$

where β^* is the probability of a date, and $a(1-\beta^*)+s\eta$ is the expected utility from the date. Similarly, we can

Table 1 Expected Demand in Equilibrium

State of the world	Expected demand for A	Expected demand for B	Total expected demand for A and B
$\theta = A$	$D_A^A(S(\beta^*)) = \beta^* s$	$D_A^B(S(\beta^*)) = \beta^*(1-s)$	β^*
$\theta = B$	$D_B^A(S(\beta^*)) = \beta^*(1-s)$	$D_B^B(S(\beta^*)) = \beta^* s$	β^*

derive the expected social utility from using A when $\theta = B$ as

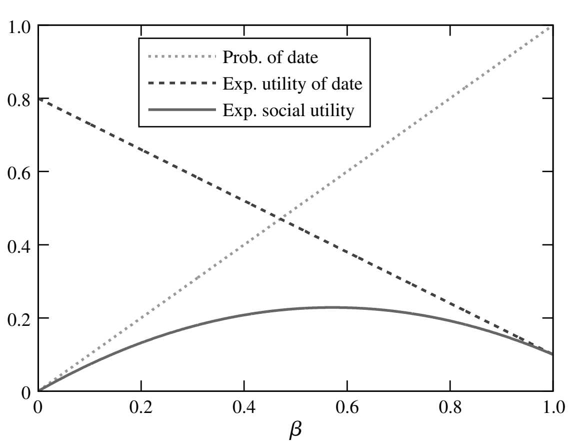
$$su_B^A = \beta^*[a(1-\beta^*) + (1-s)\eta], \quad (10)$$

where β^* is the probability of a date, and $a(1-\beta^*) + (1-s)\eta$ is the expected utility from the date.

In Lemma 2 in Appendix §A.2, we formalize the relationship between these social utilities and show that $su_A^A = su_B^B > su_A^B = su_B^A > su_A^O = su_B^O = 0$. In equilibrium, a larger fraction ($s\beta^*$) of people are expected to carry the tasteful product compared to the other product (whose expected demand is $(1-s)\beta^*$). Because a consumer obtains utility from conforming if and only if she is matched with someone who has bought the same product, she is better off buying the tasteful product. Hence, in equilibrium, the expected social utility from the tasteful product endogenously emerges as higher than that from the other product, even though we did not exogenously attribute any extra utility to it.

Snob and Bandwagon Effects: Note that each term in su_A^A and su_A^B has two components: (1) the expected utility from a date, which is $a(1-\beta^*) + s\eta$ in su_A^A and $a(1-\beta^*) + (1-s)\eta$ in su_A^B; and (2) the probability of a date, β^*. The expected utility from a date is always decreasing in β^* (see Figure 4). Inclusion of more people is always detrimental to a product's signaling value and has a negative impact on consumers' social utility. This can be understood as the *snob effect*—that is, as the demand for a fashion product increases, consumers' valuation of it decreases. On the other hand, the probability of a date (β^*) is increasing in β^*. Each extra person allowed into the market increases the probability of a successful interaction and thereby has a positive impact on consumers' social utility. This can be understood as the *bandwagon effect*; i.e., consumers' valuation of a product increases with demand. Our model thus endogenously produces the two common effects seen in the demand for fashion goods—the snob effect and the bandwagon effect, as described by Leibenstein (1950).

Figure 4 **Expected Social Utility** su_A^A ($s = 0.8$, $a = 0.7$, $\eta = 0.125$)



The struggle between these two effects highlights the core trade-off in the model: How exclusive should the fashion be? If very few people use it, even though they might be able to signal their stellar taste and interact with the most sophisticated people, there are not going to be many people to interact with. On the other hand, if almost everyone uses it, there would be no dearth of people to interact with, but the value of doing so would be minimal. Hence, the firm seeks to pick just the right cutoff β^* that trades off these two effects optimally.

4.1.3. Purchase Decision. Now consider the consumers' purchase decision. At Stage 3, there are two sets of consumers: (1) those from 0 to β^*, who have received a signal on state θ; and (2) those from β^* to 1, who have not received a signal. First, consider the consumers who have received a signal, say, $\sigma = A$. They have three options: buy A according to the signal, buy the other product B, or buy nothing (see Figure 5). Let $E_i(U_{\sigma=A}^A)$ be i's expected utility from buying A after she has received $\sigma = A$:

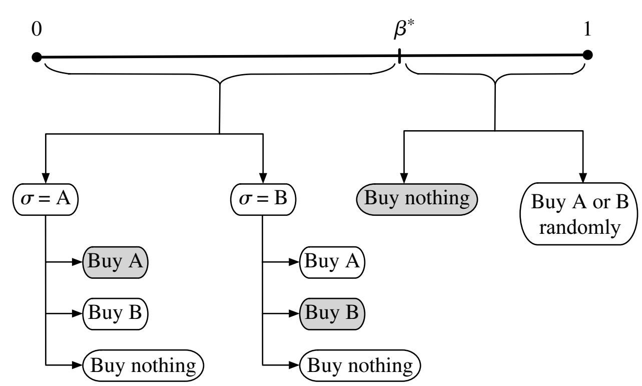
$$E_i(U_{\sigma=A}^A) = s(V + su_A^A - P(\beta^*)) + (1-s)(V + su_B^A - P(\beta^*)), \quad (11)$$

which is derived as follows: i's signal is correct with probability s, in which case her expected utility from A is $V + su_A^A - P(\beta^*)$. However, the signal is wrong with probability $1-s$, in which case her expected utility from A is $V + su_B^A - P(\beta^*)$.

We can similarly derive the expected utilities from buying B and buying nothing (denoted as O) after receiving signal A, and we show that the former is always less than the utility from buying A, and the latter is zero (see Appendix §A.3). Therefore, the only condition necessary to ensure that i buys A after receiving signal A is

$$s\big(V + su_A^A - P(\beta^*)\big) + (1-s)\big(V + su_B^A - P(\beta^*)\big) \geq 0. \quad (12)$$

Figure 5 **Purchase Decision Diagram**



Note. The shaded boxes represent consumers' equilibrium strategies.

The scenario where consumer i receives $\sigma = B$ is similar to the one described above. That is, we can show that all consumers from 0 to β^* buy according to their signal if (12) is true.

Now consider the purchase decisions of consumers from β^* to 1, who have not received a signal. They have two options: (1) buy nothing or (2) buy A or B randomly (see Figure 5). Let $E_i[Buy\_Randomly, \beta^*]$ be i's expected utility from buying randomly. If $\theta = A$, when buying randomly, i is likely to buy A with probability 0.5 and obtain utility $V + su_A^A - P(\beta^*)$. However, the probability of mistakenly buying B is also 0.5, in which case the expected utility is lower at $V + su_B^A - P(\beta^*)$. The $\theta = B$ scenario follows along similar lines, and we can show that

$$E_i[Buy\_Randomly, \beta^*] = 0.5(V + su_A^A - P(\beta^*)) + 0.5(V + su_B^A - P(\beta^*)). \quad (13)$$

Consumer i chooses not to deviate and buy randomly if

$$E_i[Buy\_Randomly, \beta^*] \leq 0. \quad (14)$$

As discussed in §4.1.2, in equilibrium, the expected social utility from the tasteful product is higher than that from the other product (see Lemma 2). However, a consumer who buys randomly is more likely to pick the nontasteful product (when compared with those who buy following their signals). Because the prices are set at willingness to pay for consumers who have received a signal (see §4.2), random purchase is always unprofitable in equilibrium. Hence, consumers who do not receive a signal optimally choose not to buy anything. In other words, (14) is always true in equilibrium. See Lemma 3 in the appendix for a summary of the purchase decisions of all the consumers in equilibrium (also highlighted in Figure 5 for convenience).

Interlinked Choice Decisions: A key point of note here is that a consumer's decision to buy depends not only on her own taste (or signal) but also on her beliefs about others' actions. (Recall that a consumer's purchase decision depends on su_A^A and su_A^B, which are functions of others' decisions.) This mutual dependence of social utilities creates interlinked decisions, where a consumer's purchase decision hinges not just on her own judgment of whether A or B is more tasteful but also on her expectation of the number of other people who consider A to be more tasteful than B (or vice versa). Our model thus captures the most crucial aspect of conspicuous consumption—*demand interdependency*.

4.2. Firm's Strategy

We now solve for the equilibrium cutoff β^* and prices $P_A = P_B = P(\beta^*)$. Given the optimal cutoff β^*, the maximum price that the firm can charge is derived from Equation (12) as

$$P(\beta^*) = V + \beta^*[a(1-\beta^*) + \eta\kappa], \quad (15)$$

where $\kappa = s^2 + (1-s)^2$. Now consider the firm's expected profit in equilibrium. Because the combined demand for A and B is the same for both $\theta = A, B$ (see Table 1), the firm's expected profit is the same in both states of the world and is given by

$$\pi(S(\beta^*)) = \beta^* P(\beta^*). \quad (16)$$

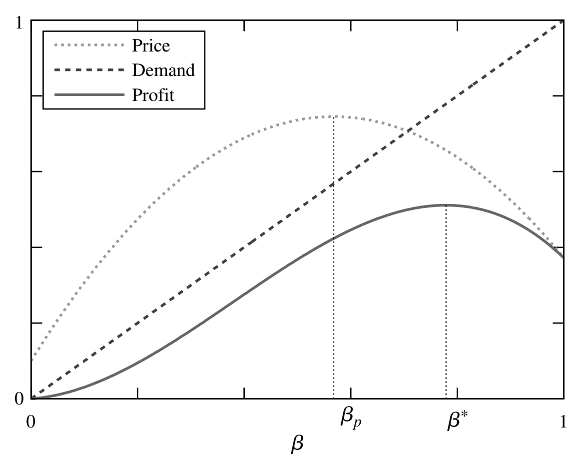
Now consider a deviation where the firm plays $\{\tilde{\beta}, P(\tilde{\beta}), P(\tilde{\beta})\}$, such that $\tilde{\beta} \neq \beta^*$. In Appendix §A.6, we derive consumers' best responses and show that the maximum profit that the firm can earn from this deviation is $\pi(S(\tilde{\beta})) = \tilde{\beta}P(\tilde{\beta})$, where $P(\tilde{\beta})$ has the same functional form as $P(\beta^*)$. To ensure that the firm does not deviate, we need $\beta^* P(\beta^*) \geq \tilde{\beta}P(\tilde{\beta})$ for all $0 \leq \tilde{\beta} \leq 1$. Thus β^* is the value that solves the following problem:

$$\text{Maximize } \tilde{\beta}P(\tilde{\beta}), \text{ such that } 0 \leq \tilde{\beta} \leq 1. \quad (17)$$

In Lemma 4 in Appendix §A.4, we solve this optimization problem and derive the optimal cutoff as $\beta^* = \min\{\hat{\beta}, 1\}$, where $\hat{\beta} = ((a + \eta\kappa) + \sqrt{(a+\eta\kappa)^2 + 3aV})/(3a)$. Hence, in equilibrium, the firm prices A and B at $P(\beta^*) = V + \beta^*[a(1-\beta^*) + \eta\kappa]$.

Trade-off Between Demand and Price: Recall that consumers' social utilities, su_A^A and su_A^B, exhibit both snob and bandwagon effects (see §4.1.2). Because $P(\tilde{\beta})$ is a function of these social utilities, it also follows an inverted U-shaped curve. Price is thus increasing with demand till $\beta_p = (a + \eta\kappa)/(2a)$ but decreasing after that (see Figure 6). Now consider the firm's optimization problem. When it chooses cutoff $\tilde{\beta}$, its profit is $\tilde{\beta}P(\tilde{\beta})$, where $\tilde{\beta}$ is the combined demand for A and B, and $P(\tilde{\beta})$ is the price of A and B. Till $\tilde{\beta} = \beta_p$, both demand and price are increasing in $\tilde{\beta}$. However, after β_p, the firm faces a trade-off: increasing $\tilde{\beta}$ decreases price but increases demand. Thus, the

Figure 6 **Price, Demand, and Profit as Functions of Cutoff** β ($s = 0.8$, $a = 2$, $\eta = 0.4$, $V = 0.1$)



choice of the optimal cutoff β^* is driven by the firm's desire to pick just the right level of exclusivity that maximizes its profit.

4.3. Benchmark Case: No Social Signaling

Before presenting the solution to the full model, we first consider a simple benchmark case without social signaling, that is, $a \to 0$. Here, the firm's products do not serve as signals of taste; i.e., consumers do not derive utility from interacting with sophisticated partners and therefore do not need to signal their own ability/taste to attract the sophisticated consumers to interact with them.

This game has a unique perfect Bayesian equilibrium, where the firm does not cloak information from any subset of consumers.

Proposition 1. *When there is no taste signaling* ($a \to 0$), *there exists a unique perfect Bayesian equilibrium where the firm allows all consumers access to information. It chooses an equilibrium cutoff* $\beta^* = 1$, *and prices A and B at* $P_A = P_B = P(1) = V + \eta\kappa$.

Proof. See Appendix §A.5. □

The key insight from Proposition 1 is that information restriction by the firm is driven by the social signaling game between consumers. In the absence of taste signaling, the firm has no reason to preserve the signaling value of the product. Recall that demand is always increasing in the cutoff $\tilde{\beta}$, but price is increasing only till $\tilde{\beta} = \beta_p = (a + \eta\kappa)/(2a)$. However, when $a \to 0$, $\beta_p \to \infty$; i.e., the maximum price that the firm can charge continues to increase indefinitely with $\tilde{\beta}$. Because both demand and price are increasing with the inclusion of more consumers, in equilibrium, the firm chooses the optimal cutoff $\beta^* = \min\{1, \infty\} = 1$.

Recall that we defined cloaking as an equilibrium in which $\beta^* < 1$. Hence, cloaking can be interpreted as an equilibrium where the firm provides less information than a benchmark case without social signaling.

4.4. Cloak or Flaunt?

We now present the solution to the full model. Recall that in §4.1 we showed that there are no profitable deviations for consumers. In §4.2 we derived the equilibrium cutoff as β^* and the prices of A and B as $P_A = P_B = P(\beta^*)$. When doing so, we considered a specific kind of deviation on the firm's part—those of the form $\{\tilde{\beta}, P(\tilde{\beta}), P(\tilde{\beta})\}$. However, there exist infinite other possible deviations for the firm. In Appendix §A.6, we consider all the possible deviations for the firm and show that none of them are more profitable than its equilibrium strategy. Specifically, we prove equilibrium *existence* as follows: first, for all deviations, we derive the off-equilibrium beliefs and best responses of consumers. Then we calculate the firm's expected profit under each deviation and show that it is strictly inferior to its equilibrium profit.

In Appendix §A.6, we also consider other possible equilibria for this game and rule them out. Note that we do not allow for scenarios where all consumers ignore their private signals and coordinate on a specific product based on arbitrary attributes such as lexicographic ordering of names, colors, price points, etc. In this context, we show that there exists no other perfect Bayesian equilibrium for this game; i.e., the equilibrium that we characterize in Proposition 2 is *unique*.

Proposition 2. *Let* $\beta^* = \min\{\hat{\beta}, 1\}$, *where* $\hat{\beta} = ((a + \eta\kappa) + \sqrt{(a + \eta\kappa)^2 + 3aV})/(3a)$. *For a given set of parameters* V, a, η, *and* s, *there exists a unique perfect Bayesian equilibrium, where the firm chooses to restrict information such that a consumer* i *receives a signal on state* θ *if and only if* $0 \le \beta_i \le \beta^*$. *Furthermore, it prices A and B at* $P_A = P_B = P(\beta^*) = V + \beta^*[a(1 - \beta^*) + \eta\kappa]$. *A consumer* i *buys A if* $\sigma = A$, *buys B if* $\sigma = B$, *and buys nothing if she does not receive a signal. Also,* i *chooses to date a partner* j *if and only if* $f_j \in \{A, B\}$.

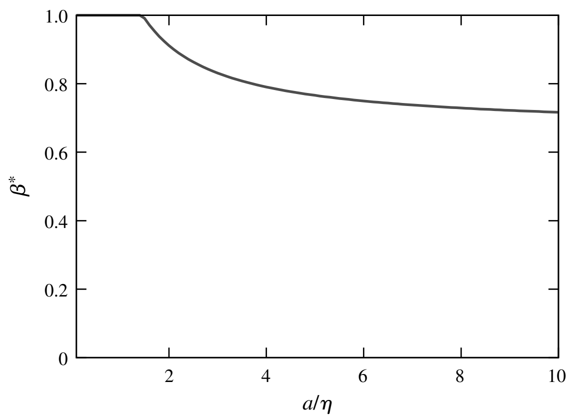
Proof. See Appendix §A.6. □

An important implication of Proposition 2 is that under certain conditions the firm may *strategically withhold information*. That is, it may structure its advertising campaign, website design, and store layout such that only sophisticated consumers (i.e., those of type β^* or less) are able to access information on the tastefulness of its products. Such an equilibrium where $\beta^* < 1$ is referred to as a cloaking equilibrium, i.e., one in which the firm cloaks information.

By withholding information, the firm sacrifices some demand from consumers, because those from β^* to 1 do not buy in equilibrium. Although this demand restriction reduces consumers' expected utility from conformity, it has other advantages. In equilibrium, it ensures that the unsophisticated consumers (i.e., those with relatively high β) are excluded from the market. This in turn enables the sophisticated consumers (those with relatively low β) to signal their type and interact with each other. So the firm is able to charge a premium for the signaling value of its products from the sophisticated consumers.

The cloaking equilibrium not only explains the behavior of firms such as YSL and Marc Jacobs that restrict information on their products, but it also provides general insights into the fashion firms' tendency to control information through tightly regulated fashion shows, obscure store locations, etc. In fact, concerns about the adverse impact of "too much information" abound in the fashion industry and are particularly well illustrated by the example of British fashion label Burberry, which suffered a serious decline in popularity when its trademark check

Figure 7 **Equilibrium Cutoff** ($s = 0.8$, $\eta = 10$, $V = 1$)



pattern was extensively adopted by the "chavs" in the United Kingdom (Finch 2003). (Chavs are classified as a social subclass conspicuous by their lack of good taste.[13]) Although Burberry has stopped manufacturing some of its products adopted by the chavs in order to salvage its fashion-conscious market (Dibb 2005), it continues to be cited as an example of the consequences of overexposure.

Moreover, the exact level of information restriction or the value of β^* depends on the market characteristics or model parameters (see Figure 7). As the extent of information restriction decreases, the number of people who are able to access information on the firm's products increases. So, depending on the model parameters, the unique cloaking equilibrium of the game could be one in which the firm is very secretive (β^* is very low) as in the case of Carpe Diem or one in which the firm is guarded, but not invisible, as in the case of YSL. At the extreme, the firm may overtly flaunt its products and allow everyone to access information on their relative tastefulness (such as RLC and Gap). In our model, this scenario corresponds to $\beta^* = 1$, and we refer to it as a flaunting equilibrium.

Whereas flaunting increases the demand for the firm's products and enables it to charge a premium for the increased conformity associated with its products, it destroys the signaling value of its products. Here, the sophisticated consumers are unable to use private information as a signal on their type; i.e., the lack of information asymmetry makes taste-signaling impossible.

Furthermore, the designation "fashionable" is given ex post in our model to the product that has been adopted by the majority of consumers. Recall that we did not exogenously attribute any extra utility to tastefulness or a priori deem either A or B as fashionable. Neither did we allow the firm to designate either product as fashionable. Rather, the tasteful product is endogenously expected to emerge as the fashion hit (or "it" product) in equilibrium, because of its higher expected demand.

Finally, note that the nature of fashion in a cloaking equilibrium is very different from that in a flaunting equilibrium. In the cloaking equilibrium, fashion denotes something tasteful or obscure, which people use to signal their taste. On the other hand, in the flaunting equilibrium, fashion is primarily a device for fitting in with the rest of the society. However, the role of fashion as a social device transcends both the equilibria.

4.5. Comparative Statics

We now examine how the firm's incentive to reveal information changes with market and consumer characteristics. This analysis provides some insight into why the decision to advertise fashion hits varies widely within the industry. Below, we present some comparative statics on the effects of varying the following parameters: (a) V, the consumption utility associated with the product; (b) η, the utility from conformity; and (c) a, the parameter associated with the utility from signaling taste. For all three cases, we use the equilibrium cutoff β^* as a measure of the firm's incentive to cloak information. Proposition 3 summarizes the results from our analysis.

Proposition 3. *The level of information restriction in equilibrium, β^*, is nondecreasing in consumption utility V and utility from conformity η and is nonincreasing in the taste-signaling component a.*

Proof. See Appendix §A.7. □

The first part of Proposition 3 indicates that the extent of information restriction decreases as the consumption utility V increases; i.e., when V is high compared to social utility, the flaunting equilibrium ($\beta^* = 1$) is more likely to exist. In other words, we are more likely to see cloaking if the social utility or fashion component associated with a product is high compared to the utilitarian component. Thus withholding information as a phenomenon is less likely in utilitarian categories such as computers or laundry detergents.

Second, as the value of conforming (η) increases, the extent of information available (β^*) increases; i.e., for high values of η, the flaunting equilibrium is more likely to exist. This is intuitive because the firm is able to mobilize a larger consumer base for higher values of β^*, which leads to increased conformity. Hence, we are more likely to see advertisements promoting fashion hits in markets where conforming with peers is

[13] A *Slate* magazine article (Gross 2006) defines "chavs" as "tough guys, skanks … and cheesy celebrities. The king and queen of the chavs are soccer star David Beckham and his wife, not-so-Posh Spice, Victoria Beckham."

relatively important. Third, as a (or the value of signaling) increases, the extent of information restriction increases. These results are demonstrated in Figure 7, in which the y axis represents the equilibrium cutoff β^*, and the x axis represents the relative values of signaling and conformity. Note that at high values of x, the relative value of signaling is high compared to the value of conformity, and therefore β^* is lower and the cloaking equilibrium is more likely to exist. However, the opposite is true for low values of x.

These results are consistent with the fact that brands that serve highly taste-conscious markets (such as YSL and Marc Jacobs) are less likely to advertise fashion hits compared to those that serve less taste-conscious markets (such as Gap and RLC). Finally, note that these findings go counter to the naive intuition that the firm should be more inclined to help consumers identify tasteful products, if consumers care about taste signaling.

5. Extensions

We now consider three extensions of the basic model to demonstrate the robustness of our results and to explore their implications in different settings. In the first extension, we allow the firm to receive a signal on the true state of the world at the beginning of the game. In the second extension, we examine the impact of competition on firms' incentives to cloak information. Finally, in the third extension, we explore the differences between firm-created fashions and street fashions.

5.1. The Role of Firm's Private Information

In the fashion industry, each season's fashion cycle begins at least six months in advance. The fall/winter collections are exhibited in fashion shows in February, and the spring/summer collections are exhibited in September. During these shows firms receive feedback from fashion reviewers and editors on their collections. Hence, it is likely that a firm has some information on the relative tastefulness of its collections at the beginning of the season. Therefore, we now consider a scenario where the firm receives private information on the state θ, before choosing its pricing and advertising strategy.

We model the firm's private information as a signal $\lambda \in \{A, B\}$ on the true state of the world at Stage 1, after it launches the two products. This signal is correct with probability $1/2 < \omega < 1$. After receiving this information, the firm chooses the level of information restriction β^* and prices P_A and P_B. Stages 2–4 follow as described in Figure 2.

The addition of private information on the firm's part complicates the game. In this context, the perfect Bayesian equilibrium concept is insufficient to rule out unreasonable off-equilibrium beliefs. Therefore, we employ the Proper equilibrium concept, which imposes structure on off-path beliefs and rules out certain off-equilibrium paths (Myerson 1978).[14]

We discuss the main insights from the analysis here and refer interested readers to Appendix §A.8 for details. There are two coexisting Proper equilibria for this game. Equilibrium 1 is exactly the same as the equilibrium characterized in Proposition 2. The firm's equilibrium strategy is $S = \{\beta^*, P(\beta^*), P(\beta^*)\}$; i.e., the firm does not reveal its private information through its actions. In equilibrium 2, the firm's strategy is $S = \{\beta^*, P_1(\beta^*), P_2(\beta^*)\}$; i.e., it reveals its private information by pricing A (B) higher at $P_1(\beta^*)$ if it receives $\lambda = A$ ($\lambda = B$). Note that when the firm sets $(P_A, P_B) = (P_1(\beta^*), P_2(\beta^*))$, consumers who receive signal $\sigma = A$ are more confident that the state is A than they would be in equilibrium 1. This increases their willingness to pay for A compared to that in equilibrium 1. So the firm optimally chooses $P_1(\beta^*) > P(\beta^*)$. Although this price increase has a positive impact on the firm's profit, the downside is that consumers who receive signal $\sigma = B$ now attach a lower probability to state $\theta = B$. So their willingness to pay for B decreases, and the firm has to decrease B's price to $P_2(\beta^*) < P(\beta^*)$. Overall, the expected gain from the increase in A's price is exactly equal to the expected loss from the decrease in B's price. Specifically, we find that the firm's expected profit in both equilibria 1 and 2 is $\beta^* P(\beta^*)$, which is also equal to the firm's profit when it does not have private information (see Equation (16)). A key implication of these results is that the availability of private information does not increase the firm's profit.

Proposition 4. *The optimal level of information restriction chosen by the firm in equilibrium (β^*) is the same irrespective of whether it has access to private information or not.*

Proof. See Appendix §A.8. □

More importantly, the level of information restriction (cutoff β^*) is the same in both equilibria 1 and 2. Moreover, as shown in Proposition 4, this cutoff is exactly the same as that defined in Proposition 2. In short, the presence of private information does not affect the firm's incentive to cloak information.

[14] Proper equilibrium is a refinement of Selten's (1975) notion of perfect equilibrium. A perfect equilibrium is impervious to small perturbations in the equilibrium play; i.e., the equilibrium is stable even when a player trembles and plays off-equilibrium strategies with a small, but nonzero, probability. Proper equilibrium is a refinement of perfect equilibrium where the probabilities of trembles are assigned in decreasing order of profitability. That is, a player's first-best deviation is assigned a probability of ε, the second-best deviation is assigned a probability of ε^2, and so on. In other words, even if a player mistakenly plays an off-equilibrium strategy, she is more likely to play those that hurt her the least. See Fudenberg and Tirole (1991) for details.

5.2. Competition

So far we have shown that a monopolistic firm may choose to cloak information to preserve the signaling value of its products. We now examine the impact of competition on a firm's incentive to cloak information. In this section, we present an extension of our basic model with two firms instead of one.

5.2.1. Model Setup. Consider a duopoly with two firms F_A and F_B that produce one product each, say, A and B, of consumption utility V, which we normalize to zero. As before, there are two states of the world, $\theta = \{A, B\}$, denoting whether A or B is more tasteful. A priori, both states are equally likely; i.e., $\Pr(\theta = A) = \Pr(\theta = B) = 0.5$. The addition of competition complicates the game considerably. To keep it tractable, we make a few changes to the original model and present the modified timeline of the game below.

Stage 1 consists of three substages. At Stage 1A, both firms launch their respective products. As in the basic model, they receive no information on the true state of the world. At Stage 1B, both firms choose the level of information restriction. Previously, one firm had complete control over the level of information in the market. Now the total information in the market is affected by the actions of two firms. For example, if firm F_A allows all consumers easy access to information on A, then it is also indirectly revealing information about product B because a signal on A is also a signal on B. (Recall that $\Pr(\theta = A) = 1 - \Pr(\theta = B)$.) Therefore, we now model the total information restriction in the market as a function of the actions of both F_A and F_B. Let $\beta = f(x_A, x_B)$, where $0 \le x_A, x_B \le 1$. Let x_A and x_B denote the amount of information provided by firms F_A and F_B, and let β be the cutoff up to which consumers receive a signal on state θ. Furthermore, $0 \le f(x_A, x_B) \le 1$ and $df(x_A, x_B)/dx_A > 0$, $df(x_A, x_B)/dx_B > 0$. That is, the overall information in the market (or cutoff β) is strictly increasing with the information provided by both F_A and F_B. At Stage 1C, both firms choose prices for their respective products. Stages 2–4 proceed as before.

5.2.2. Equilibrium. Let $S_A = \{x_A, P_A\}$, and let $S_B = \{x_B, P_B\}$ denote the strategies of F_A and F_B. This leads to $\beta = f(x_A, x_B)$, which is the cutoff up to which consumers receive a signal on the true state of the world. The firms' expected profits are given by $\pi_A(x_A, x_B, P_A) = \frac{1}{2} f(x_A, x_B) P_A$ and $\pi_B(x_B, x_A, P_B) = \frac{1}{2} f(x_A, x_B) P_B$. We look for symmetric equilibria for this game and find that there exists a unique symmetric perfect Bayesian equilibrium where both firms choose the same level of information restriction x^* such that $\beta^* = f(x^*, x^*)$ and the same price $P(\beta^*) = \beta^*[a(1-\beta^*) + \eta\kappa]$. See Proposition 5 for details.

Proposition 5. *Let $\beta^* = \min\{\hat{\beta}, 1\}$, where $\hat{\beta} = (2(a + \eta\kappa))/(3a)$. For a given set of parameters a, η, and s, there exists a unique symmetric perfect Bayesian equilibrium where both firms choose strategy $S = \{x^*, P(\beta^*)\}$, where $\beta^* = f(x^*, x^*)$, and where $P(\beta^*) = \beta^*[a(1-\beta^*) + \eta\kappa]$. A consumer i buys A if $\sigma = A$, buys B if $\sigma = B$, and buys nothing if she does not receive a signal. Also, i chooses to date a partner j if and only if $f_j \in \{A, B\}$.*

Proof. See Appendix §A.9. □

Firms have two decision variables to attract consumers—information and price. Each firm may provide positive information about its own product that is discernible to the sophisticated consumers in order to attract them. Of course, in equilibrium, the information has to be credible; i.e., a firm cannot just claim that its product is the "it" product—it would have to furnish some evidence to this effect. This evidence may be implicitly provided through ads featuring celebrities with impeccable taste (such as the YSL ads with Kate Moss) or may be explicitly provided through popularity ranks and best-selling tags in ads and websites (as in RLC's website). Apart from information, firms can also alter prices to attract consumers. High prices can dissuade even sophisticated consumers who believe the product to be tasteful from buying the product. On the other hand, low prices can attract unsophisticated consumers who may buy a sufficiently low-priced product even if they cannot discern its tastefulness. This can, however, damage the signaling value of the product and repel sophisticated consumers. Hence, in equilibrium, both firms choose just the right price $P(\beta^*)$ that maximizes their respective profits.

Finally, note that the combined level of information restriction chosen by the two competing firms is exactly the same as that chosen by a monopolist when the consumption utility is normalized to zero. Hence, an important takeaway from this analysis is that the presence of competition does not preclude firms from cloaking information.

5.3. Firm-Created Fashions vs. Street Fashions

In the last few sections, we explored the role of firms in the market for fashion. However, consumers themselves often create fashions by adopting certain products. For example, in 1990s Japan, *kogyaru*, or a set of high-school girls, adopted a series of fashions such as loose socks (long socks loosened on the top to hang around the ankles) and camisole fashion (wearing camisoles as an outer garment) to emerge as high-profile trendsetters. Similarly, Hush Puppies was a dying brand in the mid-1990s before East Village kids in Manhattan adopted them as a fashion statement (Gladwell 2002). These types of grassroots trends that originate on the street as opposed to fashion studios or firms are usually called street fashions.

In all these cases, a core group of trendsetters designated a product as fashionable and informed their friends and social counterparts about it. How would we expect these trendsetters to promote their new trends? Earlier, we saw that a firm might be inclined to maintain exclusivity to maximize profit. Because consumers cannot monetize the fashions they start, would we expect them to reveal it to everyone? Are street fashions likely to be less exclusive than firm-created fashions? In this section, we extend our model to address these questions. Note that this analysis not only improves our understanding of street fashions but also allows us to contrast firms', trendsetters', and consumers' incentives to maintain exclusivity.

5.3.1. Street Fashion. Consider a scenario where the distribution of consumers is the same as before, but there is no firm driving the fashion. Let there exist infinite products $\{A_1, A_2, \ldots, \infty\}$ of consumption utility V, all of which are priced at $P \leq V$. Furthermore, suppose that these products can be ordered based on their tastefulness. Without loss of generality, we denote the most tasteful product as A_n. In this context, we examine both trendsetters' and consumers' incentives to cloak information.

Trendsetter's Incentives: First, consider a trendsetter who can identify the most tasteful product and reveal it to as many consumers as she wants at her discretion. The trendsetter may communicate the identity of the tasteful product through personal communication devices (like the *kogyaru*) or rely on word of mouth. Specifically, suppose that she can choose a cutoff $\tilde{\beta}_T$ (where $0 \leq \tilde{\beta}_T \leq 1$) and set up a mechanism such that all consumers from 0 to $\tilde{\beta}_T$ receive perfect information on the identity of the most tasteful product, whereas those above $\tilde{\beta}_T$ do not. (Although we acknowledge that this may not always be feasible for a given trendsetter, the objective here is to provide a benchmark to compare trendsetters' incentives with that of firms.) In this case, how many consumers would the trendsetter choose to include?

The expected social utility of the trendsetter if she chooses a cutoff $\tilde{\beta}_T$ is

$$\mathrm{E}U_T(\tilde{\beta}_T) = V - P + \tilde{\beta}_T[a(1-\tilde{\beta}_T)+\eta]. \quad (18)$$

The price P is not controlled by the trendsetter, nor does she obtain any profit from sales of any of the products. So her objective is to simply maximize her expected utility $\mathrm{E}U_T(\tilde{\beta}_T)$ by choosing the optimal cutoff. Moreover, because she already knows the identity of A_n, her choice of the cutoff is not restricted by her own type.

The trade-offs with respect to including more people remain the same as before, and it is trivial to show that $\mathrm{E}U_T(\tilde{\beta}_T)$ is maximized at $\hat{\beta}_T = (a+\eta)/(2a)$, so $\beta_T^* = \min\{\hat{\beta}_T, 1\}$. Note that β_T^* is independent of the trendsetter's own type. So a trendsetter always chooses the cutoff β_T^*, irrespective of her own type.

Consumers' Incentives: Now consider the incentives of a consumer i of type β_i. Consumer i receives information on the identity of A_n from the trendsetter if her type is less than the cutoff chosen by the trendsetter; i.e., $\beta_i \leq \beta_T^*$. So i's expected utility is

$$\mathrm{E}U_i(\beta_i, \beta_T^*) = V - P + \beta_T^*[a(1-\beta_T^*)+\eta] \quad \text{if } \beta_i \leq \beta_T^*, \quad (19)$$

$$\mathrm{E}U_i(\beta_i, \beta_T^*) = 0 \quad \text{if } \beta_i > \beta_T^*. \quad (20)$$

Equation (19) suggests that consumer i prefers the same cutoff as the trendsetter if $\beta_i \leq \beta_T^*$; i.e., $\beta_i^* = \min\{\hat{\beta}_T, 1\}$. However, if $\beta_i > \beta_T^*$, then i does not receive information on the identity of A_n and receives zero utility. So i would prefer the cutoff to be high enough to include her. Since $\mathrm{E}U_i(\beta_i, \tilde{\beta}_T)$ is decreasing in $\tilde{\beta}_T$ after β_T^*, i would want herself to be included, but not anyone beyond her. Therefore, the optimal cutoff from i's perspective is $\beta_i^* = \beta_i$ if $\beta_i > \beta_T^*$.

5.3.2. Firm-Created Fashion. Now consider the cutoff that a firm would choose when it has perfect information on the identity of A_n and can communicate it to as many people as it wants. That is, it chooses a cutoff $\tilde{\beta}_F$ (where $0 \leq \tilde{\beta}_F \leq 1$) such that it *sells* the fashion to all consumers of type less than or equal to $\tilde{\beta}_F$. In this case, the firm's expected profit is

$$\mathrm{E}U_F(\tilde{\beta}_F) = \tilde{\beta}_F P(\tilde{\beta}_F), \quad (21)$$

where $P(\tilde{\beta}_F) = V + \tilde{\beta}_F[a(1-\tilde{\beta}_F)+\eta]$ is the price it can charge and $\tilde{\beta}_F$ is its demand. $\mathrm{E}U_F(\tilde{\beta}_F)$ is maximized at $\hat{\beta}_F = ((a+\eta)+\sqrt{(a+\eta)^2+3Va})/(3a)$, so $\beta_F^* = \min\{\hat{\beta}_F, 1\}$.[15]

Proposition 6. (a) *In street fashions, a trendsetter's utility is maximized at cutoff* $\beta_T^* = \min\{\hat{\beta}_T, 1\}$. *A consumer i's utility is maximized at* $\beta_i^* = \min\{\hat{\beta}_T, 1\}$ *if* $\beta_i \leq \beta_T^*$. *Otherwise, it is maximized at* $\beta_i^* = \beta_i$.

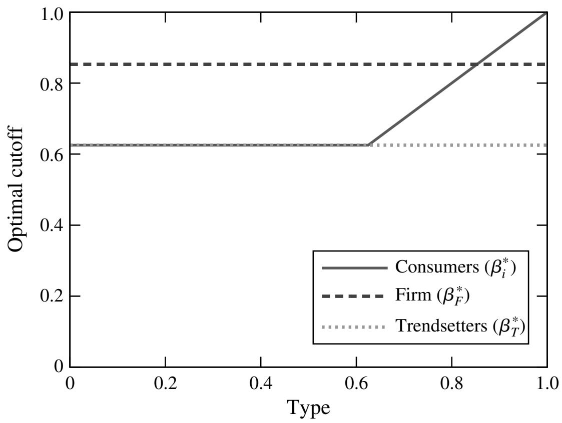
(b) *In firm-created fashions, the firm's utility is maximized at* $\beta_F^* = \min\{\hat{\beta}_F, 1\}$.

(c) *For all* a, η, *and* V, $\beta_T^* \leq \beta_F^*$.

The optimal exclusivities of trendsetters, consumers, and the firm are shown in Figure 8. Note that the incentives of consumers may or may not be aligned with that of trendsetters. Sophisticated consumers (with low β) would prefer the fashion to be exclusive and have the same optimal cutoff as trendsetters. On the other hand, the not-so-sophisticated consumers (with relatively high β) have different

[15] The derivations of β_T^*, β_i^*, and β_F^* are similar to the derivation of β^* in Lemma 4.

Figure 8 **Optimal Exclusivities—Consumers, Firm, and Trendsetters** ($a = 20$, $\eta = 5$, $V = 1$)



preferences—they do not want to be excluded from the trend, but they do not want anyone worse than themselves to be included.

Earlier, we suspected that trendsetters may reveal new fashion trends to everyone because they have no profit motives. However, we find the opposite is true: trendsetters tend to be more exclusive than the firm. In fact, the firm's incentive to monetize the fashion makes it more inclusive. The trendsetters' and firm's problems are fundamentally different—those who set trends strive to maximize the social utility associated with the trend, whereas a firm is focused on the profit.

Although this analysis has abstracted away from many of the details, it provides two key takeaways: (1) it suggests that the firms', trendsetters', and consumers' incentives to maintain exclusivity are misaligned, and (2) it enhances our understanding of street fashions; specifically, it provides some insight into why underground and street fashions that originate organically are often considered cooler or more exclusive than firm-driven fashions.

6. Conclusions, Limitations, and Future Research

In this paper we study the advertising and pricing strategy of firms in the fashion industry. We seek to explain why some firms actively conceal information on the tastefulness of their fashion products while others blatantly flaunt their tasteful or "it" products. We model fashion as a social device that plays the dual role of allowing people to both fit in with their peers and differentiate themselves by signaling their good taste or access to information. We then examine how the firm's communication interacts with consumers' valuation of fashion and how this in turn affects a firm's communication strategy. We find that the firm's communication undermines the value of the fashion goods under certain circumstances, and in those cases, it might be better for the firm to conceal information on the relative tastefulness of its products. We also show that, in equilibrium, the most tasteful product endogenously emerges as the fashion hit or "it" product with a higher expected demand, even though consumers do not derive utility from the tastefulness itself. Moreover, we find that a firm is more likely to cloak information if its consumers are taste conscious and if the consumption utility associated with its products is low (i.e., if its products are consumed more as social devices than for their utilitarian value).

While the discussion here mostly pertained to apparel and accessories, the phenomenon of withholding information is also seen in other conspicuously consumed categories. Restaurants and clubs often try to remain underground so that only those "in the know" are aware of their existence and location. According to a *New York Times* article (Williams and Ryzik 2007), "If you haven't cracked the code of the newest night spots in Manhattan, there might be a reason ... they are discreet to the point of invisible, quiet to the point of skittish, intimate to the point of anonymous." Similarly, art galleries hardly advertise their acclaimed pieces because one of the primary reasons for visiting them is to show off one's taste or ability to recognize good art.

More generally, fashion is a wide-ranging phenomenon and commands a multibillion-dollar industry, and our exploration of the field remains incomplete. Although we have taken the first step in modeling the role of information in the market for fashion, our analysis is not without shortcomings. First, we model taste (or access to information) as a vertical attribute and assume that all consumers prefer social interactions with high types or those with good taste. We also assume that all consumers know their own taste and respective levels of sophistication. However, taste can be interpreted as a subjective construct, varying on a horizontal rather than vertical scale, and consumers may face uncertainty regarding their own taste. Hence, a richer model that relaxes these assumptions may provide new insights on fashion hits. Second, in our static model, we focus on social signaling. However, real interactions often consist of both social signaling and social learning. That is, consumers not only signal their taste and type to each other but also learn from each other. A dynamic model would allow us to capture this learning and thereby yield additional insights on the microdiffusion of information and the role of consumers in shaping fashion cycles.

Third, factors not present in our model, such as the firm's inventory levels, budget constraints, and its consumers' taste for variety, may influence its decision to cloak/flaunt its "it" products. We also restrict our attention to the firm's pricing and communication strategies even though these decisions may be influenced by other firm-level decisions. For example, a firm may be tempted to offer a large number of products to ensure that only the very sophisticated consumers can identify the most tasteful product. Thus, a firm's communication and product line design may be interdependent decisions (as in Villas-Boas 2004). Finally, we focus only on the role of information in shaping fashion, but many other factors may influence or drive fashion. Fashion is often made difficult to use (as in high heels, uncomfortable clothes, etc.) so that it remains a costly signal. For example, the chic brand Bless often makes its products inaccessible by having consumers assemble them. Incorporating these aspects of fashion into existing models would be a useful next step.

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Appendix

A.1. Lemma 1

Lemma 1. *In any match (i, j) in equilibrium, there is a date if and only if both i and j have purchased either A or B.*

Proof. We consider all types of matches one by one and solve for the dating outcome in each.

Match Types—(A, A) and (B, B). Because only those who get a signal are expected to buy (consumers of type β, where $\beta \le \beta^*$), the purchase of either A or B implies that $\beta \le \beta^*$. For example, when both i and j have A, the expected utility from the partner's type is

$$E_i[A_i^j(A, A)] = E_j[A_j^i(A, A)] = \frac{1}{\beta^*}\int_0^{\beta^*} a(1-2\beta)\,d\beta = a(1-\beta^*). \quad (22)$$

Furthermore, because both i and j have the same product, they also get utility η from conformity, and the total expected utility from the date in a match of type (A, A) is

$$E_i[SU_i^j(A, A)] = E_j[SU_j^i(A, A)] = a(1-\beta^*) + \eta > 0. \quad (23)$$

Since $0 < \beta^* \le 1$ and $\eta > 0$, (23) is positive. Both i and j choose to date because the expected utility from the date is positive. The analysis of matches of type (B, B) follows along the same lines.

Match Types—(A, B) and (B, A). As before, if consumer j has purchased one of A or B, then i infers that $\beta_i \le \beta^*$ and $E_i[A_i^j(A, B)] = E_j[A_j^i(B, A)] = a(1-\beta^*) \ge 0$. However, there is no utility from conformity because the choices are dissimilar. Still, both i and j choose to date since

$$E_i[SU_i^j(A, B)] = E_j[SU_j^i(B, A)] = a(1-\beta^*) \ge 0. \quad (24)$$

Match Types—(A, O), (B, O), (O, A), and (O, B). Assume that i has A and j has O. The analysis for (B, O), (O, A), and (O, B) follows along the same lines. Consumer j's expected utility from i is given by (24), and i's expected utility from j is

$$E_i[SU_i^j(A, O)] = \frac{1}{1-\beta^*}\int_{\beta^*}^1 a(1-2\beta)\,d\beta = -a\beta^* < 0. \quad (25)$$

If j has not purchased anything, then i infers that j's type must lie between β^* and 1. So i's expected utility from j's type is given by (25). Note that $a\beta^*$ is strictly less than zero since $\beta^* > 0$ in equilibrium (see Appendix §A.4). In other words, i interprets j's lack of purchase as a negative signal on her type. Moreover, there is no utility from conformity. So i's expected utility from dating j is $E_i[SU_i^j(A, O)] = -a\beta^* < 0$. Hence, i chooses not to date j, and there is no date.

Match Type—(O, O). Here, i's expected social utility from a date with j (and vice versa) is the same as that specified in (25). Therefore both i and j optimally choose not to date.[16]

Hence, only if both i and j have purchased either A or B does a date take place.

A.2. Lemma 2

Lemma 2. *In equilibrium, the expected social utility from the tasteful product is higher than that from the nontasteful product. That is, $su_A^A = su_B^B > su_A^B = su_B^A > su_A^O = su_B^O = 0$.*

Proof. Let su_θ^A, su_θ^B, and su_θ^O be the expected social utilities from using A, B, and O (nothing), respectively, for a consumer i in state θ. Specifically, we have

$$su_A^A = D_A^A(S(\beta^*))E_i[SU_i^j(A, A)] + D_A^B(S(\beta^*))E_i[SU_i^j(A, B)], \quad (26)$$

$$su_B^A = D_B^A(S(\beta^*))E_i[SU_i^j(A, A)] + D_B^B(S(\beta^*))E_i[SU_i^j(A, B)], \quad (27)$$

$$su_A^B = D_A^B(S(\beta^*))E_i[SU_i^j(B, B)] + D_A^A(S(\beta^*))E_i[SU_i^j(B, A)], \quad (28)$$

$$su_B^B = D_B^B(S(\beta^*))E_i[SU_i^j(B, B)] + D_B^A(S(\beta^*))E_i[SU_i^j(B, A)], \quad (29)$$

$$su_A^O = su_B^O = 0, \quad (30)$$

[16] Note that if $f_i = f_j = O$, then i and j do not obtain any utility from conformity. Implicitly, those who do not buy are assumed to use some other outside products. For example, those who do not carry potentially fashionable bags may carry last season's bag or a utilitarian one bought from a department store. A model where there are infinite outside products is virtually the same as the current model, because the probability of being matched with someone who has the same outside product is zero. In short, fashion instigates conformity, which is not possible to achieve otherwise.

where $D_\theta^A(S(\beta^*))$ and $D_\theta^B(S(\beta^*))$ are the expected demands for A and B in state θ (see Table 1). The derivation of su_A^A is described in detail in §4.1.2. The rest of the social utilities (27)–(30) are derived in a similar fashion. Note that the expected utility from using nothing is zero in both states of the world (30) because consumers who do not purchase anything are always rejected by their partners. Furthermore, we can simplify the above equations by substituting for the demand functions from Table 1 and the expected utilities of dates from Appendix §A.1 as follows:

$$su_A^A = su_B^B = \beta^*[a(1-\beta^*) + s\eta], \tag{31}$$

$$su_B^A = su_A^B = \beta^*[a(1-\beta^*) + (1-s)\eta]. \tag{32}$$

Since $0 < \beta^* \le 1$ (see Appendix §A.4) and $s > 1-s$, it is clear that

$$su_A^A = su_B^B > su_A^B = su_B^A > su_A^O = su_B^O = 0. \tag{33}$$

A.3. Lemma 3

Lemma 3. *If* $s(V + su_A^A - P(\beta^*)) + (1-s)(V + su_B^A - P(\beta^*)) \ge 0$, *then a consumer i buys A if* $\sigma = A$, *B if* $\sigma = B$, *and nothing if she does not receive any signal. Otherwise, i does not buy anything, irrespective of whether she receives a signal or not.*

Proof. There are two types of consumers—those who have received a signal and those who have not. We consider each in turn.

Purchase Decision of Consumers Who Have Received a Signal. Consider a consumer i who has received a signal $\sigma = A$. From i's perspective, $\Pr(\theta = A \mid \sigma = A) = s$ and $\Pr(\theta = B \mid \sigma = A) = 1-s$. Therefore, i's expected utility from buying A, B, and nothing, respectively, is

$$E_i(U_{\sigma=A}^A) = s(V + su_A^A - P(\beta^*)) + (1-s)(V + su_B^A - P(\beta^*)),$$
$$E_i(U_{\sigma=A}^B) = s(V + su_A^B - P(\beta^*)) + (1-s)(V + su_B^B - P(\beta^*)),$$
$$E_i(U_{\sigma=A}^O) = 0.$$

Consumer i prefers to buy A over B if $E_i(U_{\sigma=A}^A) \ge E_i(U_{\sigma=A}^B)$. This inequality can be simplified to $V + su_A^A + (1-s)su_B^A - P(\beta^*) \ge V + (1-s)su_B^B + su_A^B - P(\beta^*)$. Substituting $su_B^B = su_A^A$ and $su_A^B = su_B^A$, we have

$$(2s-1)(su_A^A - su_A^B) \ge 0. \tag{34}$$

Since $(2s-1) > 0$ and $su_A^A - su_A^B > 0$, (34) is always true. So the only condition required to ensure that i buys A is $E_i(U_A \mid \sigma = A) \ge E_i(U_O \mid \sigma = A) = 0$, which can be simplified to

$$s(V + su_A^A - P(\beta^*)) + (1-s)(V + su_A^B - P(\beta^*)) \ge 0. \tag{35}$$

Similarly, i's expected utilities from buying A, B, and O when she receives $\sigma = B$ are

$$E_i(U_B \mid \sigma = B) = s(V + su_B^B - P(\beta^*)) + (1-s)(V + su_A^B - P(\beta^*)), \tag{36}$$

$$E_i(U_A \mid \sigma = B) = s(V + su_B^A - P(\beta^*)) + (1-s)(V + su_A^A - P(\beta^*)), \tag{37}$$

$$E_i(U_O \mid \sigma = B) = 0. \tag{38}$$

Using (33), it is easy to show that $E_i(U_{\sigma=B}^B) = E_i(U_{\sigma=A}^A)$, $E_i(U_{\sigma=B}^A) = E_i(U_{\sigma=A}^B)$, and $E_i(U_{\sigma=A}^O) = E_i(U_{\sigma=B}^O) = 0$. Therefore, $E_i(U_{\sigma=B}^B) > E_i(U_{\sigma=B}^A)$; i.e., i prefers to buy B over A when she receives $\sigma = B$. Thus, the only condition necessary for purchase is $E_i(U_{\sigma=B}^B) \ge E_i(U_{\sigma=B}^O) = 0$, and this reduces to (35).

Purchase Decision of Consumers Who Have Not Received a Signal. A consumer i who has not received a signal has two options: (1) buy nothing or (2) buy A or B randomly. The utility from buying nothing is zero. Let $E_i[Buy\_Randomly, \beta^*]$ be the expected utility from random purchase. The derivation of $E_i[Buy\_Randomly, \beta^*]$ is outlined in §4.1.3; i chooses to buy nothing if

$$E_i[Buy\_Randomly, \beta^*] = 0.5(V + su_A^A - P(\beta^*)) + 0.5(V + su_B^A - P(\beta^*)) \le 0. \tag{39}$$

This inequality can be simplified to $(2s-1)^2(su_A^A - su_B^A) \ge 0$ by substituting for $P(\beta^*)$ from (40). From Lemma 2, we know that $(su_A^A - su_B^A) > 0$. Furthermore, $(2s-1)^2 > 0$ because $s > 0.5$. Hence, (39) is always true; i.e., consumers who have not received a signal never choose to deviate and buy A or B randomly.

A.4. Lemma 4

Lemma 4. *In equilibrium, the firm chooses the optimal cutoff* β^*, *where* $\beta^* = \min\{\hat{\beta}, 1\}$ *and* $\hat{\beta} = ((a+\eta\kappa) + \sqrt{(a+\eta\kappa)^2 + 3aV})/(3a)$. *Furthermore, it prices A and B at* $P(\beta^*) = V + \beta^*[a(1-\beta^*) + \eta\kappa]$.

Proof. We know that consumers who receive a signal will buy according to their signal if (35) is true. Hence, the maximum price that the firm can charge is given by

$$P(\beta^*) = V + \beta^*[a(1-\beta^*) + \eta\kappa], \tag{40}$$

where $\kappa = [s^2 + (1-s)^2]$. Because the total demand for A and B is the same for both $\theta = A, B$, the firm's expected profit in both states of the world is $\pi(S(\beta^*)) = \beta^* P(\beta^*)$. Now consider a deviation where the firm plays $\{\tilde{\beta}, P(\tilde{\beta}), P(\tilde{\beta})\}$, such that $\tilde{\beta} \ne \beta^*$. As discussed in §4.2, the firm's profit from this deviation is $\pi(S(\tilde{\beta})) = \tilde{\beta} P(\tilde{\beta})$, where $P(\tilde{\beta}) = V + \tilde{\beta}[a(1-\tilde{\beta}) + \eta\kappa]$. To ensure that the firm does not deviate, we need $\beta^* P(\beta^*) > \tilde{\beta} P(\tilde{\beta})$ for all $0 \le \tilde{\beta} \le 1$. Therefore, β^* is the solution to the following problem:

$$\text{Maximize } \tilde{\beta} P(\tilde{\beta}), \text{ such that } 0 \le \tilde{\beta} \le 1. \tag{41}$$

The first-order condition of (41) has two roots: $((a+\eta\kappa) \pm \sqrt{(a+\eta\kappa)^2 + 3aV})/(3a)$. One of the roots is always negative and therefore ruled out. Let $\hat{\beta}$ be the positive root. The second-order condition (S.O.C.) of (41) is $2[(a+\eta\kappa) - 3a\beta]$. At $\beta = \hat{\beta}$, the S.O.C. reduces to $-2\sqrt{(a+\eta\kappa)^2 + 3aV}$. Hence, $\hat{\beta}$ is the profit-maximizing cutoff. However, this value could be greater than 1. Because it is not possible to choose a cutoff greater than 1, $\beta^* = \min\{\hat{\beta}, 1\}$.

Finally, there are two points worth noting here. First, $\beta^* > 0$ because both $\hat{\beta}$ and 1 are positive. Second, since $\beta^* > 0$, it follows from (40) that $P(\beta^*) > V$.

A.5. Proof of Proposition 1

Started formally, we can define equilibrium for the case when $a \to 0$ as follows.

Perfect Bayesian Equilibrium. *For a given set of parameters $V, \eta, s, a \to 0$, there exists a unique perfect Bayesian equilibrium where the firm chooses the strategy $\beta^* = 1$ and $P_A = P_B = P(1) = V + \eta\kappa$, and where all consumers receive a signal on state θ. A consumer i buys A if she receives $\sigma = A$ and buys B if she receives $\sigma = B$. Also, i chooses to date a partner j if and only if $f_j \in \{A, B\}$.*

Proof. Now we derive the optimal cutoff as $\beta^* = 1$. In Lemma 4, we derived β^* as $\min\{\hat{\beta}, 1\}$, where $\hat{\beta} = ((a + \eta\kappa) + \sqrt{(a+\eta\kappa)^2 + 3aV})/(3a)$. It is clear that as $a \to 0$, $\hat{\beta} \to \infty$. So $\beta^* = \min\{1, \infty\} = 1$; i.e., $\beta^* = 1$ is the firm's optimal strategy in equilibrium.

We refer readers to the proof of Proposition 2 shown in the next section for the proof of equilibrium existence and uniqueness. Note that the general proof shown below also applies to a case where $\beta^* = 1$, so we do not repeat it here.

A.6. Proof of Proposition 2

The proof is presented in two parts. First, we show existence; i.e., we show that there exist no profitable deviations for the firm and consumers in equilibrium. Next, we show uniqueness by considering all other possible equilibria and ruling them out.

Existence. To show that the equilibrium exists, we need to show that both consumers and the firm do not deviate from their equilibrium strategies. In Lemmas 1 and 3, we have already shown that there are no profitable deviations for consumers. Here, we thus consider the firm's deviations. As discussed in the main text, a firm's actions do not affect consumers' beliefs in this game because the firm has no information on the true state of the world. Therefore, consumers' beliefs remain at $\{0.5, 0.5\}$ even if the firm deviates from its equilibrium strategy. With this in mind, we now consider all possible deviations on the firm's side.

(a) $\beta^*, P_A = P_B = P < P(\beta^*)$.

- If $P \le E_i[Buy\_Randomly, \beta^*] < P(\beta^*)$, then the firm cannot prevent consumers from β^* to 1 from buying. Hence, all the consumers will choose to buy, and the maximum price that a firm can charge is the willingness to pay of consumers from β^* to 1, which is $V + \frac{1}{2}\eta$. So the maximum profit that the firm can earn from this deviation is $V + \frac{1}{2}\eta$. However, if the firm sets the cutoff at 1, it can charge $P_A = P_B = P(1) = V + \kappa\eta$ and obtain profit $V + \kappa\eta$, which is always greater than $V + \frac{1}{2}\eta$. Because we know that β^* is the value that maximizes the function $\beta^* P(\beta^*)$, it follows that $\beta^* P(\beta^*) \ge 1$. $P(1) = V + \kappa\eta > V + \frac{1}{2}\eta$. Hence, the profit from this deviation is always less than the equilibrium profit.
- If $E_i[Buy\_Randomly, \beta^*] < P < P(\beta^*)$, then consumers' best responses remain the same as that in equilibrium, because those from β^* to 1 still choose not to buy anything. Hence, the firm's profit is $\beta^* P$, which is always less than the equilibrium profit $\beta^* P(\beta^*)$ since $P < P(\beta^*)$.

(b) $\beta^*, P_A = P_B > P(\beta^*)$.

In this case, the prices of A and B exceed the maximum willingness to pay of consumers (which as we know from (40) to be exactly equal to $P(\beta^*)$). Hence, none of the consumers buy, and the firm's profit is zero, which is strictly less than the equilibrium profit. Hence, this is not a profitable deviation.

(c) $\beta^*, P_A > P(\beta^*)$.

Here, consumers who get $\sigma = A$ do not buy A because P_A exceeds their expected utility (see (35)). Therefore, the willingness to pay of consumers who receive $\sigma = B$ drops to $V + \kappa[a(1-\beta) + \eta]$; i.e., the maximum price that the firm can charge for B is $P_B = V + \kappa[a(1-\beta^*) + \eta]$. Both the price and demand from this deviation are lower than the equilibrium price and demand. Hence, the profit from this deviation is lower than the equilibrium profit.

(d) $\beta^*, P_B > P(\beta^*)$.

This is similar to case (c); i.e., the profits from this deviation are less than the equilibrium profit.

(e) $0 < \tilde{\beta} \ne \beta^*$.

For any $\tilde{\beta} > 0$, the willingness to pay of consumers who receive $\sigma = A$ is exactly the same as that of consumers who receive $\sigma = B$ and is equal to $P(\tilde{\beta}) = V + \tilde{\beta}[a(1-\tilde{\beta}) + \eta\kappa]$. Hence, it is always optimal for the firm to price both A and B at $P_A = P_B = P(\tilde{\beta})$. Moreover, the firm's demand in this case is $\tilde{\beta}$. Thus, the firm's profit from this deviation is $\tilde{\beta} P(\tilde{\beta})$, which is always less than $\beta^* P(\beta^*)$ because β^* is the value that maximizes the function $\beta P(\beta)$.

(f) $\tilde{\beta} = 0$, $P_A = P_B = V + \frac{1}{2}\eta$.

Here, the firm completely restricts information. Consumers' best response is to buy A or B randomly, and their expected utility from doing so is $V + \frac{1}{2}\eta$. Hence, the maximum price that the firm can charge is $V + \frac{1}{2}\eta$, and its demand is 1. The profit from this deviation is $V + \frac{1}{2}\eta$. As shown in case (a), this is always less than the equilibrium profit.

Hence, there are no profitable deviations for both the firm and consumers.

Uniqueness. Because consumers' beliefs are not affected by the firm's actions, none of the off-path actions considered in the discussion above can be in equilibrium because the firm can always deviate and play $\{\beta^*, P(\beta^*), P(\beta^*)\}$, which will always fetch higher profits. Thus, all other strategies except $\{\beta^*, P(\beta^*), P(\beta^*)\}$ are ruled out, and the equilibrium characterized in Proposition 2 is the unique perfect Bayesian equilibrium of the game.

A.7. Proof of Proposition 3

We know that $\beta^* = \min\{\hat{\beta}, 1\}$, where $\hat{\beta} = ((a+\eta\kappa) + \sqrt{(a+\eta\kappa)^2 + 3aV})/(3a)$.

Case 3a: If $0 < \hat{\beta} < 1$, $\beta^* = \hat{\beta}$ and $d\beta^*/dV = d\hat{\beta}/dV = 1/(2\sqrt{(a+\eta\kappa)^2 + 3aV}) > 0$. If $\hat{\beta} \ge 1$, $\beta^* = 1$ and $d1/dV = 0$.

Case 3b: If $0 < \hat{\beta} < 1$, q$\beta^* = \hat{\beta}$ and $d\beta^*/da = d\hat{\beta}/da = -(2\eta\kappa\hat{\beta} + V)/2a < 0$. If $\hat{\beta} \ge 1$, $\beta^* = 1$ and $d1/da = 0$.

Case 3c: If $0 < \hat{\beta} < 1$, $\beta^* = \hat{\beta}$ and $d\beta^*/d\eta = d\hat{\beta}/d\eta = (k\hat{\beta}/\sqrt{(a+\eta\kappa)^2 + 3aV}) > 0$. If $\hat{\beta} \ge 1$, $\beta^* = 1$ and $d1/d\eta = 0$.

A.8. Proof of Proposition 4

We first outline the two coexisting Proper equilibria for this game below.

Perfect Bayesian Equilibrium. Let $\beta^* = \min\{\hat{\beta}, 1\}$, where $\hat{\beta} = ((a + \eta\kappa) + \sqrt{(a+\eta\kappa)^2 + 3aV})/(3a)$. For a given set of parameters V, a, η, and s, there exist two Proper equilibria.

Equilibrium 1.

- *Firm's strategy*: For $\lambda \in \{A, B\}$, the firm chooses to restrict information such that only consumers of type 0 to β^*

receive a signal on state θ, and it prices A and B at $P(\beta^*) = V + \beta^*[a(1-\beta^*) + \eta\kappa]$.

- *Consumers' strategy*: Consumer i buys A if $\sigma = A$, buys B if $\sigma = B$, and buys nothing if she does not receive any signal. Also, i chooses to date a partner j if and only if $f_j \in \{A, B\}$.

Equilibrium 2. Let $\kappa_1 = (ws^2 + (1-w)(1-s)^2)/(ws + (1-w)(1-s))$ and $\kappa_2 = (w(1-s)^2 + (1-w)s^2)/(w(1-s) + (1-w)s)$.

- *Firm's strategy*: If $\lambda = A$, then a firm chooses to restrict information such that only consumers of type 0 to β^* receive a signal on state θ. It prices A at $P_1(\beta^*) = V + \beta^*[a(1-\beta^*) + \eta\kappa_1]$ and B at $P_2(\beta^*) = V + \beta^*[a(1-\beta^*) + \eta\kappa_2]$, where $P_1(\beta^*) > P_2(\beta^*)$ (and vice versa for $\lambda = B$).
- *Consumers' strategy*: Consumer i buys A if $\sigma = A$, buys B if $\sigma = B$, and buys nothing if she does not receive any signal. Also, i chooses to date a partner j if and only if $f_j \in \{A, B\}$.

Next, we show the existence of these equilibria and rule out all the other equilibria for this game. The proof is presented in three parts. First, we show the existence of Equilibrium 1, next the existence of Equilibrium 2, and finally, we show that there are no other equilibria for this game.

Equilibrium 1. First, consider deviations on the consumers' part. In this equilibrium, consumers' beliefs remain at $\{0.5, 0.5\}$ because the firm prices both A and B at the same price (i.e., the firm's actions do not convey any information on the true state of the world). Hence, the game that consumers' face here is exactly the same as that in the equilibrium defined in Proposition 2. Therefore, following the arguments from the proofs of Lemmas 1, 2, and 3, we can show that there are no profitable deviations for consumers. Furthermore, it is clear that this equilibrium is impervious to trembles on the part of a consumer.

Next, consider deviations on the firm's part. In equilibrium, the firm plays $S(\beta^*) = \{\beta^*, P(\beta^*), P(\beta^*)\}$ both when it receives signal $\lambda = A$ and B. To derive the off-path beliefs, assume that the firm trembles; i.e., it plays $S(\beta^*)$ with probability $1-\delta$ and deviates with probability δ, where δ is arbitrarily small. The firm has infinite possible deviations on both the cutoff and prices. For each $\lambda = A$ and B, we order all the deviations in decreasing order of profitability as follows: the most profitable deviation is played with probability ε, the next most profitable deviation is played with probability ε^2, and so on. Because there are infinite such deviations, the total probability of deviation is given by $\delta = \varepsilon/(1-\varepsilon)$. In the limit, $\delta \to 0$ as $\varepsilon \to 0$. Furthermore, because our model is symmetric, the probability distribution of deviations when the firm receives $\lambda = B$ is a mirror image of the probability distribution of deviations when it receives $\lambda = A$. For example, since $\pi(\tilde\beta, P_1, P_2 \mid \lambda = A) = \pi(\tilde\beta, P_2, P_1 \mid \lambda = B)$, if the firm plays $\{\tilde\beta, P_1, P_2\}$ with probability ε^m when $\lambda = A$, then the probability of deviation to $\{\tilde\beta, P_2, P_1\}$ when $\lambda = B$ is also ε^m. That is, $\Pr[\tilde\beta, P_1, P_2 \mid \lambda = A] = \Pr[\tilde\beta, P_2, P_1 \mid \lambda = B]$ for all P_1, P_2. Without loss of generality, we now consider all possible deviations for the firm when it receives $\lambda = A$.

(a) $\beta^*, P_A = P_B = P < P(\beta^*)$.

The analysis of this case is the same as that of case (a) in the proof of Proposition 2.

(b) $\beta^*, P_A = P_B = P > P(\beta^*)$.

The analysis of this case is the same as that of case (b) in the proof of Proposition 2.

(c) $\tilde\beta, P_A = P_1 > P_B = P_2$.

Let consumers' beliefs following this deviation be (μ_A, μ_B). We can derive μ_A as follows:

$$\mu_A = \frac{\Pr[\tilde\beta, P_1, P_2 \mid \lambda = A]\Pr(\lambda = A)}{\Pr[\tilde\beta, P_1, P_2 \mid \theta = A]\Pr(\lambda = A) + \Pr[\tilde\beta, P_2, P_1 \mid \theta = A]\Pr(\lambda = B)}. \tag{42}$$

Let consumers' best responses be as follows: consumer i buys A if $\sigma = A$, B if $\sigma = B$, and nothing if she does not receive a signal. Furthermore, she dates a partner j if and only if $f_j \in \{A, B\}$. Since $P_1 > P_2$ and $w > 1-w$, the firm's profits can be ordered as follows:

$$\begin{aligned}
&\pi(\tilde\beta, P_1, P_2 \mid \lambda = A)\\
&\quad = \tilde\beta\{P_1[ws + (1-w)(1-s)] + P_2[w(1-s) + (1-w)s]\}\\
&\quad > \pi(\tilde\beta, P_2, P_1 \mid \lambda = A)\\
&\quad = \tilde\beta\{(P_1[w(1-s) + (1-w)s] + P_2[ws + (1-w)(1-s)]\}.
\end{aligned}$$

Thus the firm's profit is higher when it prices A higher upon receiving $\lambda = A$ and pricing B higher upon receiving $\lambda = B$. From symmetry, it is clear that $\pi(\tilde\beta, P_1, P_2 \mid \lambda = A) = \pi(\tilde\beta, P_2, P_1 \mid \lambda = B)$ and $\pi(\tilde\beta, P_2, P_1 \mid \lambda = A) = \pi(\tilde\beta, P_1, P_2 \mid \lambda = B)$. Therefore, we can assign the following probabilities to these trembles: $\Pr[\tilde\beta, P_1, P_2 \mid \lambda = A] = \Pr[\tilde\beta, P_2, P_1 \mid \lambda = B] = \varepsilon^m$ and $\Pr[\tilde\beta, P_2, P_1 \mid \lambda = A] = \Pr[\tilde\beta, P_1, P_2 \mid \lambda = B] = \varepsilon^{m+n}$, where $m, n > 0$. Using these equalities, we can rewrite (42) as $\mu_A = \varepsilon^m/(\varepsilon^m + \varepsilon^{m+n})$. It is clear that $\mu_A \to 1$ as $\varepsilon \to 0$. Moreover, following exactly the same arguments as those employed in the proof of Equilibrium 2 (see below), we can show that the maximum prices that the firm can charge from this deviation is $P_1(\tilde\beta) = V + \beta^*[a(1-\tilde\beta) + \eta\kappa_1]$ for A and $P_2(\tilde\beta) = V + \beta^*[a(1-\beta^*) + \eta\kappa_2]$ for B, where κ_1 and κ_2 are as defined in Proposition 4. Also, we can show that the firm's profit from this deviation is $\tilde\beta P(\tilde\beta)$. From Lemma 4, we know that this value is maximized at $\tilde\beta = \beta^*$. Hence, the maximum profit that the firm can earn from this deviation is $\beta^* P(\beta^*)$, which is not greater than the equilibrium profit.

(d) $\tilde\beta = 0, P_A = P_B = V + \frac{1}{2}\eta$.

The analysis of this case is the same as that of case (f) in the proof of Proposition 2.

In sum, there are no profitable deviations for the firm or consumers in equilibrium, which guarantee its existence.

Equilibrium 2. First, consider consumers' strategies. Because the expected demand for A and B in this equilibrium is the same as that characterized in Proposition 2, Lemmas 1 and 2 are directly applicable here. However, the purchase decisions of consumers are somewhat different because in this case the firm's prices are also a signal of the true state of the world. That is, upon seeing $P_A = P_1(\beta^*) > P_B = P_2(\beta^*)$, consumers update their prior from $\{0.5, 0.5\}$ to $\{w, 1-w\}$. We now consider the purchase decisions of consumers in detail.

Purchase Decision of Consumers Who Have Received a Signal: Consider a consumer i who has received a signal $\sigma = A$. From i's perspective, $\Pr(\theta = A \mid \sigma = A) = t_1 = ws/(ws +$

$(1-w)(1-s)$), and $\Pr(\theta=B \mid \sigma=A)=1-t_1=((1-w)(1-s))/(ws+(1-w)(1-s))$. Therefore, i's expected utility from buying A, B, and nothing, respectively, is

$$E_i(U^A_{\sigma=A}) = t_1(V+su^A_A-P_1(\beta^*))+(1-t_1)(V+su^A_B-P_1(\beta^*)),$$

$$E_i(U^B_{\sigma=A}) = t_1(V+su^B_A-P_2(\beta^*))+(1-t_1)(V+su^B_B-P_2(\beta^*)),$$

$$E_i(U^O_{\sigma=A}) = 0.$$

As before, we can easily show that, in equilibrium, i always prefers to buy A over B upon receiving $\sigma=A$. Hence, the only constraint to ensure that i buys A is $E_i(U_A \mid \sigma=A) \geq E_i(U_O \mid \sigma=A)=0$, which can be simplified to

$$t_1(V+su^A_A-P_1(\beta^*))+(1-t_1)(V+su^B_A-P_1(\beta^*)) \geq 0. \quad (43)$$

Next, consider a consumer i who has received a signal $\sigma=A$. From i's perspective, $\Pr(\theta=A \mid \sigma=A)=t_2=(w(1-s))/(w(1-s)+(1-w)s)$, and $\Pr(\theta=B \mid \sigma=A)=1-t_2=((1-w)s)/(w(1-s)+(1-w)s)$. Therefore, i's expected utility from buying A, B, and nothing, respectively, is

$$E_i(U^A_{\sigma=B}) = t_2(V+su^A_A-P_1(\beta^*))+(1-t_2)(V+su^A_B-P_2(\beta^*)),$$

$$E_i(U^B_{\sigma=B}) = t_2(V+su^B_A-P_1(\beta^*))+(1-t_2)(V+su^B_B-P_2(\beta^*)),$$

$$E_i(U^O_{\sigma=A}) = 0.$$

Again, we can easily show that, in equilibrium, i always prefers to buy B over A upon receiving $\sigma=B$. Hence, the only constraint to ensure that i buys B is $E_i(U_B \mid \sigma=B) \geq E_i(U_O \mid \sigma=B)=0$, which can be simplified to

$$t_2(V+su^B_A-P_2(\beta^*))+(1-t_1)(V+su^B_B-P_2(\beta^*)) \geq 0. \quad (44)$$

In equilibrium, both (43) and (44) are just satisfied. Hence, consumers who receive a signal choose not to deviate from their equilibrium strategies.

Purchase Decision of Consumers Who Have Not Received a Signal: In this case, i's expected utility from buying A, B, and nothing, respectively, is

$$E_i(U^A_{\sigma=\varnothing}) = w(V+su^A_A-P_1(\beta^*))+(1-w)(V+su^A_B-P_2(\beta^*)),$$

$$E_i(U^B_{\sigma=\varnothing}) = w(V+su^B_A-P_1(\beta^*))+(1-w)(V+su^B_B-P_2(\beta^*)),$$

$$E_i(U^O_{\sigma=A}) = 0.$$

It can be easily shown that both $E_i(U^A_{\sigma=\varnothing})$ and $E_i(U^B_{\sigma=\varnothing})$ are strictly less than zero. Hence, consumers who have not received a signal optimally choose not to buy anything.

Next, consider the firm's strategy. Equations (43) and (44) give the maximum willingness to pay of consumers who have received signals A and B. So the maximum price that the firm can charge for A and B can be derived from (43) and (44) as $P_1(\beta^*)$ and $P_2(\beta^*)$, as defined in Proposition 4. Hence, the firm's expected profit in equilibrium is $\beta^* P_1(\beta^*)[ws+(1-w)(1-s)]+\beta^* P_2(\beta^*)[w(1-s)+(1-w)s]$. This can be simplified to $\beta^* P(\beta^*)$, which is exactly the same as the firm's profit in the equilibrium characterized in Proposition 2. Therefore, following the same argument as that in Lemma 4, we can derive the optimal cutoff as $\beta^*=\min\{\hat{\beta},1\}$, and $\hat{\beta}=((a+\eta\kappa)+\sqrt{(a+\eta\kappa)^2+3aV})/(3a)$.

Now, we consider all the deviations on the firm's part and show that none of them are more profitable than the equilibrium strategy. As with the case of Equilibrium 1, assume that the firm trembles and plays off-equilibrium strategies with an arbitrarily small probability δ.

(a) β^*, $P_A=P_B=P<P(\beta^*)$.

The analysis of this case is the same as that of case (a) in the proof of Proposition 2.

(b) β^*, $P_A=P_B=P>P(\beta^*)$.

The analysis of this case is the same as that of case (b) in the proof of Proposition 2.

(c) β^*, $P_A=P_B=P(\beta^*)$.

In this case, consumers' beliefs and best responses are similar to those in Equilibrium 1. Hence, the maximum profit that the firm can earn from this deviation is $\beta^* P(\beta^*)$, which is not greater than the equilibrium profit.

(d) $\tilde{\beta}$, $P_A=P_1>P_B=P_2$.

This analysis follows along the same lines as case (c) in Equilibrium 1. That is, we can show that the maximum profit from this deviation cannot exceed $\beta^* P(\beta^*)$.

(e) $\tilde{\beta}=0$, $P_A=P_B=V+\frac{1}{2}\eta$.

The analysis of this case is the same as that of case (f) in the proof of Proposition 2.

In sum, there are no profitable deviations for the firm or consumers in equilibrium, which guarantee its existence.

Other Possible Equilibria. We now show that there are exists no other Proper equilibrium for this game.

(a) For $\lambda \in \{A,B\}$, $\tilde{\beta}$, $P_A=P_B=P$.

Consider a class of equilibria where the firm chooses a cutoff $0<\tilde{\beta}\leq 1$ and sets the same price P for A and B irrespective of its signal. In this case, consumers' beliefs remain at $\{0.5, 0.5\}$, and their best responses are similar to those outlined in Lemmas 1 and 3 (with $\tilde{\beta}$ as the cutoff instead of β^*). As shown earlier, the maximum profit that the firm can obtain in such an equilibrium is $\tilde{\beta}P(\tilde{\beta})$, when it prices $P_A=P_B=P(\tilde{\beta})$. Furthermore, from the analysis of cases (a) and (b) in the proof of Proposition 2, we know that this is always less than $\beta^* P(\beta^*)$. Hence, any other combination of cutoff and equal prices other than β^*, $P_A=P_B=P(\beta^*)$ cannot be in equilibrium.

(b) $\tilde{\beta}$; if $\lambda=A$, $P_A=P_1>P_B=P_2$ and if $\lambda=B$, $P_A=P_2>P_B=P_1$.

Consider a class of equilibria where the firm chooses to price A higher if $\lambda=A$ (and vice versa) for all cutoffs. As discussed above, the maximum prices that the firm can charge in this case are $P_A=P_1(\tilde{\beta})$ and $P_B=P_2(\tilde{\beta})$. Hence, the firm's expected profit in this case is $\tilde{\beta}\{P_1[ws+(1-w)(1-s)]+P_2[w(1-s)+(1-w)s]\}$. As we know from the analysis of Equilibrium 2, this is maximized when $\tilde{\beta}=\beta^*$. Hence, any other strategy where A is priced higher than B, but $\tilde{\beta}\neq\beta^*$ and $P_A\neq P_1(\beta^*)$ and $P_B\neq P_1(\beta^*)$ cannot be in equilibrium.

(c) $\tilde{\beta}$; if $\lambda=A$, $P_A=P_2<P_B=P_1$ and if $\lambda=B$, $P_A=P_1>P_B=P_2$.

Consider a class of equilibria where the firm chooses to price A lower if $\lambda=A$ (and vice versa) for all cutoffs. The firm's profit from such a strategy is $\pi(\tilde{\beta},P_2,P_1 \mid \lambda=A)=\tilde{\beta}\{(P_1[w(1-s)+(1-w)s]+P_2[ws+(1-w)(1-s)]\}$, which is always lower than

$$\pi(\tilde{\beta},P_1,P_2 \mid \lambda=A) \cdot\tilde{\beta}\big\{P_1[ws+(1-w)(1-s)]+P_2[w(1-s)+(1-w)s]\big\}.$$

Given this profitable deviation, this strategy cannot be in equilibrium.

(d) $\tilde{\beta}=0$, $P_A=P_B=V+\frac{1}{2}\eta$.

As shown in case (f) in the proof of Proposition 2, this strategy cannot be in equilibrium because if the firm deviates and plays $\{\beta^*, P(\beta^*), P(\beta^*)\}$, its profit increases. Hence, this cannot be in equilibrium.

In sum, there are no other Proper equilibria for this game other than those outlined in Proposition 4.

A.9. Proof of Proposition 5

The proof is presented in two parts. First, we show equilibrium existence (i.e., there are no profitable deviations for both the firm and consumers). Next, we show uniqueness by ruling out all other symmetric perfect Bayesian equilibria.

Existence. Consumers in this equilibrium face exactly the same game as that in the equilibrium outlined in Proposition 2. So Lemmas 1, 2, and 3 are directly applicable here, and there are no profitable deviations for consumers. Next, we consider the deviations on the firm's part and rule them out. As in the main model, firms' actions do not affect consumers' beliefs because both firms have no information on the true state of the world. Hence, consumers' beliefs remain at $\{0.5, 0.5\}$ both in and off equilibrium. Without loss of generality, we consider all deviations for firm A (the firm B case is similar).

(a) First, consider deviations at Stage 1B, i.e., deviations in x. Let $x_A=\tilde{x}\neq x^*$. Here, the cutoff changes to $\tilde{\beta}=f(\tilde{x}, x^*)\neq\beta^*$ because $df(x_A, x_B)/dx_A>0$. So at Stage 1C, both firms optimally choose $P_A=P_B=P(\tilde{\beta})$. Therefore, F_A's expected profit is $\frac{1}{2}\tilde{\beta}P(\tilde{\beta})$. From Lemma 4, we know that β^* is the cutoff that maximizes the function $\frac{1}{2}\beta P(\beta)$. Hence, F_A's profit from this deviation is lower than its equilibrium profit $\frac{1}{2}\beta^*P(\beta^*)$.

(b) Next, consider deviations at Stage 1C, i.e., deviations in the price.

- If $P_A>P(\beta^*)$, then none of the consumers who receive $\sigma=A$ buy because the price exceeds their expected utility from product A. Hence, the firm's demand and profit go to zero. So the firm chooses not to deviate.
- Let $\beta^*[a(1-\beta^*)+\eta/2]<P_A<P(\beta^*)$. We now rederive the consumers' best responses. First, consider the expected utility of consumers from β^* to 1, who do not buy anything in equilibrium. Their expected utility from deviating to buy A is

$$\begin{aligned}E_i(U^A_{\sigma=\phi}) &= 0.5(su^A_B-P_A)+0.5(su^A_A-P_A)\\ &= \beta^*\left[a(1-\beta^*)+\frac{\eta}{2}\right]-P_A<0. \qquad (45)\end{aligned}$$

Since $P_A>\beta^*[a(1-\beta^*)+\eta/2]$, it follows that $E_i(U^A_{\sigma=\phi})<0$. Hence consumers from 1 to β^* do not deviate to buy A. Next, consider the consumers from 0 to β^*, who have received the signal $\sigma=B$. Their expected utility from buying A is

$$\begin{aligned}E_i(U^A_{\sigma=B}) &= s(su^A_B-P_A)+(1-s)(su^A_A-P_A)\\ &= \beta^*[a(1-\beta^*)+2s(1-s)\eta]-P_A. \qquad (46)\end{aligned}$$

From (45), we know that $\beta^*[a(1-\beta^*)+\eta/2]-P_A<0$. Moreover, we know that $\beta^*[a(1-\beta^*)+\eta/2]>\beta^*[a(1-\beta^*)+2s(1-s)\eta]$ because $s>\frac{1}{2}$. It therefore follows that $\beta^*[a(1-\beta^*)+2s(1-s)\eta]-P_A<0$. So even consumers from 0 to β^* with signal $\sigma=B$ do not deviate to buy A with this price reduction. The expected profit of firm A from this deviation is $\frac{1}{2}\beta^*P_A$, which is always less than its expected profit in equilibrium ($\frac{1}{2}\beta^*P(\beta^*)$) because $P_A<P(\beta^*)$. Hence, the firm will not deviate.
- Let $P_A\leq\beta^*[a(1-\beta^*)+\eta/2]$. In this case, consumers' beliefs and best responses are as follows: all consumers believe that no one else will buy the product; i.e., $su^A_A=su^A_B=0$. Hence, none of the consumers buy A on this off-equilibrium path. (Note that these are the only consistent beliefs and strategies possible on this off-equilibrium path.) The expected profit of the firm from this deviation is zero, which is strictly less than its equilibrium profit. Hence, the firm will not deviate.

In sum, there are no profitable deviations for both firms and consumers, which confirms the existence of the equilibrium for all the parameters a, η, and s.

Uniqueness. Now we consider other possible symmetric equilibria and rule them out.

(a) Consider an equilibrium where both firms choose $\tilde{x}\neq x^*$ at Stage 1B such that $0<\tilde{\beta}=f(\tilde{x}, \tilde{x})$. So, at Stage 1C, both firms optimally choose $P(\tilde{\beta})=\tilde{\beta}[a(1-\tilde{\beta})+\eta\kappa]$, and their expected profit is $\frac{1}{2}\tilde{\beta}P(\tilde{\beta})<\frac{1}{2}\beta^*P(\beta^*)$. Recall that the profit function is increasing in β till β^*. So if $\tilde{\beta}<\beta^*$, then both firms have an incentive to deviate and increase x. If instead, $\tilde{\beta}>\beta^*$, both firms have an incentive to deviate and decrease x. So there cannot exist a symmetric equilibrium where F_A and F_B choose $x\neq x^*$.

(b) Consider an equilibrium where both firms choose x^* at Stage 1B, giving rise to cutoff $\beta^*=f(x^*, x^*)$, and at Stage 1C they choose $P<P(\beta^*)$. In this case, their profits are $\frac{1}{2}\beta^*P$. However, recall that the expected utility of consumers who buy A and B is $P(\beta^*)=\beta^*[a(1-\beta^*)+\eta\kappa]$. Hence, both firms have an incentive to deviate and increase the price to $P(\beta^*)$.

(c) Consider an equilibrium where both firms choose x^* at Stage 1B, giving rise to cutoff $\beta^*=f(x^*, x^*)$, and at Stage 1C they choose $P>P(\beta^*)$. In this case, their profits are zero because the prices of A and B exceed the expected utility of consumers. Hence, both firms have an incentive to deviate and lower prices to V to capture the full demand.

(d) Consider an equilibrium where both firms choose $\tilde{x}$ such that $f(\tilde{x}, \tilde{x})=0$ and price their respective products at $P_A=P_B\leq\frac{1}{2}\eta$. In this case, the consumers' best response is to buy A or B randomly. So each firm's profit is at most $\frac{1}{2}(\frac{1}{2}\eta)$. However, both firms have an incentive to deviate and reduce the price by ϵ and gain the full market.

Hence, there exists no other symmetric perfect Bayesian equilibrium for this game.

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