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## Image Concerns and the Provision of Quality

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# Image concerns and the provision of quality

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Consumption patterns can be indicative of how a consumer wants to be perceived by others. In this paper, I study markets where consumers are heterogeneous with respect to both their concerns for the quality of goods and the image associated with buying them. Consumers with a taste for quality lend a positive image to the product of their choice and thereby increase the product's value to others. A monopolist restricts the product portfolio and charges price premia to allocate image along with quality. Heterogeneity in image concerns thereby provides a rationale for pooling consumers with differing quality preferences. Although image is correlated with a product's quality in equilibrium, an increase in the value of image may decrease quality provision. In a competitive market, premium prices are unsustainable so that image-concerned consumers buy excessive quality instead. By restricting the product space, monopoly allows for more efficient allocation of image and may therefore yield higher welfare than competition. Policy options to remedy the efficiency losses are discussed.

**Keywords:** image motivation, conspicuous consumption, two-dimensional screening, ethical consumption

**JEL-Codes** D21, D82, L15.

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*“People buy things not only for what they can do, but also for what they mean.”*  
-Levy (1959)-

## 1. Introduction

Goods are valuable not only through their intrinsic characteristics but consumption also has a symbolic value (e.g. Campbell, 1995). As consumers express their preference for a certain type of production through their consumption decisions (The Economist, 2006; Ariely and Norton, 2009) the purchasing choice becomes a signal of a consumer’s type. Consequently, each product is associated with an image which reflects the type of consumer who buys it. It is well-documented that consumers are willing to pay for this image (see e.g. Chao and Schor 1998; Charles et al. 2009; Heffetz 2011). Prominently, Toyota’s hybrid car Prius sells well because consumers feel it “makes a statement about [them]” (Maynard, 2007). Regarding the Prius, Sexton and Sexton (2011)’s empirical analysis indicates that “consumers are willing to pay up to several thousand dollars to signal their environmental bona fides through their car choices.” In this paper, I study the impact of such image concerns in markets. Specifically, I analyze quality provision and prices when individuals differ both in their valuations of quality and their desire for social image.<sup>1</sup> I first solve for the optimal product line offered by a monopolist and then a perfectly competitive setting. This allows me to disentangle the effects of strategic consumer behavior from the effects due to the strategic behavior of a (monopolistic) producer.

Anecdotal evidence suggests that, indeed, firms strategically tailor their products to consumers’ desire to be identified with certain characteristics. Advertisements play with product images. Examples include the German “Bionade”, which was advertised as “the official beverage of a better world” (see e.g. Ullrich, 2007), and the soft drinks “ChariTea” and “LemonAid”.<sup>2</sup> The latter two appeal to non-consumption values through a clever word play that links the name of the drink with charitable acts. Alternatively, the reader may think of expensive watches or cars (see Seabright, 2004, for examples) or the wine market (Bruwer et al., 2002). While conspicuous consumption is a well-researched

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<sup>1</sup>I employ the term image motivation or image concern for consumers’ interest in an observer’s inference about their type (for similar use see e.g. Ariely et al., 2009). Signaling motivation, status concern, or conspicuous consumption refer to the same phenomenon but sometimes restrict attention to the signaling of wealth. Cabral (2005) suggests to use “reputation” for situations “when agents believe a particular agent to be something.” The term “image” is more common in the relevant literature and thus used here.

<sup>2</sup>These two drinks are advertised with “Drinking helps!”. See e.g. <http://www.lemon-aid.de/>.

behavior (see e.g. in economics, Veblen, 1915; Ireland, 1994; Bagwell and Bernheim, 1996; Glazer and Konrad, 1996; Corneo and Jeanne, 1997, in sociology Campbell, 1995; Miller, 2009, psychology Griskevicius et al., 2010, and popular media *The Economist*, 2010; Beckert, 2010), little work formally investigates how the supply side reacts to consumers' signaling desires (but see Rayo 2013; Vikander 2011).

To the best of my knowledge, the strategic implications of heterogeneous image concerns on quality provision have not yet been studied without restrictions on the correlation of quality preferences with intrinsic motivation. Rayo (2013) analyzes how a monopolist allocates image if consumers differ in their image and quality concerns and both are proportional to each other. Interestingly, this proportionality assumption prevents any pooling that would not already occur in a simple model of quality provision without image concerns (e.g. Mussa and Rosen, 1978). This paper illustrates a different reason for pooling, namely that marginal utilities in both dimensions are not aligned. In addition, it proposes a new model for competition and shows that image concerns remain relevant if producers are price-takers and market outcomes are driven by consumer preferences alone.

To analyze these issues, I set up a simple model where consumers may derive utility from quality as well as from the image associated with a product. The image of a product emerges endogenously from the consumption decisions of individual consumers. Image is the conditional expectation of a consumer's type after purchases have been observed. Consumption is conspicuous in that it provides evidence of the personal characteristic "taste for quality".<sup>3</sup> The notion of quality is a general one here. For instance, quality can also refer to the extent to which production is environmentally friendly.

The first part of the paper concentrates on a monopolistic market. This captures an essential aspect of status goods, namely their inimitability. I extend a standard monopolistic model of quality provision (Mussa and Rosen, 1978) to allow for heterogeneity on the consumer side in both preferences for quality and in image motivation. This model allows me to study how the producer strategically adjusts product variety and prices in response to consumers' image concerns. Since in the long run, substitutes may evolve which also confer image, the analysis is complemented with a fully competitive setting.

The analysis reveals that monopolists react to heterogeneity of image concerns by distorting quality provision and not only prices. While a high-quality product with a quality level that is first best in the absence of image concerns is always available, the

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<sup>3</sup>Conspicuous consumption according to Veblen (1915, p. 47) is the "specialized consumption of goods as an evidence of pecuniary strength". Here, the "taste for quality" can be driven by wealth or expertise and thereby signaling this trait is equally valuable as signaling "pecuniary strength".

corresponding price as well as available alternatives reflect image concerns unless the value of image is sufficiently low. For intermediate levels of image concerns, the monopolist introduces a lower-(but positive)-quality, lower-price product to profitably screen consumers with respect to their willingness to pay a premium for image and increase market coverage. Purely image-concerned consumers pool with purely quality-concerned consumers and buy the lower-quality product. Hence, fewer consumers decide in favor of a zero-quality outside good. The high-quality product's price reflects its premium image and is attractive only to consumers who value both quality and image. Therefore, fewer consumers choose high quality than in the absence of image concerns. Depending on the distribution of consumer types, total provision of quality may even decrease as the value of image increases because the reduction in average quality outweighs the increase in market coverage. If image is very valuable, the monopolist does not offer a low-quality product. Instead he sells exclusively to consumers who value image in addition to quality so that market coverage and total quality provision decrease. In general, in response to image concerns, quality provision of monopolists may either increase or decrease.

In contrast to a monopolist, firms operating in perfect competition cannot strategically react to image concerns. Still, if the value of image is sufficiently large, the market outcome features product differentiation which is not driven by heterogeneous valuations for quality but by heterogeneous image concerns. In a competitive market, prices are driven down to marginal cost so that consumers cannot simply overpay to obtain a good image as they would be encouraged to do by a monopolist's product menu. Thus, in a competitive market, consumers who value both image and quality buy inefficiently high quality. Higher quality serves as a "functional excuse" to separate from lower valuation consumers. The quality used as functional excuse is too expensive for purely image-concerned consumers even if sold at marginal cost. Purely image-concerned consumers pool with purely quality-concerned consumers on a lower quality product. The lower quality product features exactly the same quality which is offered as "high quality" by the monopolist so that total quality provision is higher in competition than in monopoly. Interestingly, however, monopoly often yields higher welfare than competition. The reason is that consumers buy excessive quality in the competitive market in the sense that producing these quality levels is inefficient. Consumers need to use quality to acquire a good image but this way of signaling is inefficient. A monopolist allows for less wasteful signaling by restricting the product space.

The model applies to a wide range of settings; wine, cars or watches as well as technological devices such as mobile phones or notebooks are sold in the presence of image

concerns. Recently buying green or ethical has become conspicuous, the Prius being a popular example. To fix ideas, I illustrate the model and the main implications of image concerns within the framework of green consumption. The public good character of environmentally friendly production gives the problem another interesting twist because in that case total quality is particularly relevant.

**Example: green consumption** Suppose the production of a certain good exerts positive externalities on others, e.g. refraining from the use of hazardous inputs or using less polluting technology. In this context, quality measures to what extent the production process creates such positive externalities. Several empirical studies find that consumers are willing to pay a higher price for green products, i.e. products with positive externalities (e.g. Casadesus-Masanell et al., 2009). Suppose some consumers value these externalities as such while some value products with positive externalities because they are connected to higher social esteem.<sup>4</sup> My results explain how these image concerns affect the production process (i.e. the “quality”) as well as prices in monopoly and competition.

The main results translate to the example of green consumption as follows. In monopoly, the first-best quality, understood as the green quality which would be sold if image concerns were absent and preferences known, is always available. Product differentiation occurs through an additional green product with lower degree of environmental friendliness (lower production standards). Propagating green production through the introduction of a lower quality product is a strategic choice by the monopolist to maximize profits. Even though this increases the market share of green production, it does not necessarily indicate social responsibility on the monopolist’s part. Instead, the monopolist engages in strategic corporate social responsibility (Baron, 2001): he tailors his products to individuals’ demand for responsible products for profit-maximizing reasons. In competition, green quality is available at a much lower price than in monopoly. Thus, consumers who only value image pool with all intrinsic buyers at the green quality which is first best, i.e. the high quality level in monopoly. This dilutes the image associated with this level of green quality. Those who value image and quality resort to green products with even higher standards to sustain the image of being the most environ-

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<sup>4</sup>It does not matter whether intrinsic interest arises from externalities or from e.g. private health benefits. It is enough that some consumers derive intrinsic benefit from the green character of a product. Such an intrinsic motivation could also be motivated by altruism or “warm glow” (Andreoni, 1990). Image motivation has been studied in Glazer and Konrad (1996) and Harbaugh (1998) and is empirically documented in e.g. Griskevicius et al. (2010) and Sexton and Sexton (2011).

mentally responsible consumers. To summarize, my model predicts situations where (1) in monopoly, increases in image concerns increase the market size of green products but simultaneously decrease the quality of the average green product. (2) In competition, image concerns trigger sales of “greener” products and green production (weighted by standard) increases with image concerns.

These model predictions fit well with empirical observations. As consumers become more interested in social and environmental characteristics, supply responds to these preferences with corporate social responsibility becoming more and more widespread. The market for organic products grew on average by more than 14% per year between 1999 and 2007 (Sahota, 2009), and similarly Fairtrade sales experience two-digit annual growth rates in many European markets (Transfair.org, 2011). While the mainstreaming of responsible consumption seems to be welcome, critical voices lament a dilution of the underlying principles as products are tailored to a broader audience.<sup>5</sup> More recently, several actors in Fairtrade and organic production have introduced their own standards above the one implemented in mainstream retailing, as my model predicts for a competitive environment.<sup>6,7</sup>

The rest of the paper is structured as follows. I first introduce the monopolistic model and discuss two benchmark cases (Section 2) before the full model is analysed in detail in Section 3. Subsequently, Section 4 studies heterogeneous image concerns in a competitive market before welfare implications are addressed in Section 5. Section 6 presents possible policy interventions as well as extensions to interpreting quality as a public good and to a monopolistic market where the value of image is negative. In Section 7, I discuss how my work relates to other approaches in the literature. Section 8 concludes. Proofs which are not included in the main text are relegated to the Appendix.

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<sup>5</sup>See for instance Clark (2011) in Bloomberg Businessweek and Stevens (2011). Regarding the discussion about discounters engaging in Fairtrade sales see also <http://www.taz.de/!40673/>.

<sup>6</sup>See for instance <http://fair-plus.de/>, and Purvis (2008) on Fairtrade. For organic products, a number of voluntary agreements exist which enforce more stringent standards than e.g the certified organic standard of the European Union (see IFOAM, ated).

<sup>7</sup>Social responsible investing (SRI) has also grown rapidly since the late nineties and faster than investing in conventional assets under management with critical voices similarly calling in question the benefits (Haigh and Hazelton, 2004).

## 2. Monopolistic quality provision and image concerns: Model and benchmarks

### 2.1. The model

Consider a monopolist who sells products of potentially different quality to heterogeneous consumers from a population of unit mass. Quality is chosen by the monopolist on a continuous scale and perfectly observable. A product is a combination of quality and price and is in equilibrium associated with an image that reflects which consumer type buys the respective product.

**Consumers'** utility depends positively on quality  $s \in \mathbb{R}_{\geq 0}$  and image (or reputation)  $R \in [0, 1]$ , and negatively on price  $p \in \mathbb{R}_{\geq 0}$  of a product. Consumers can differ in both, their interest  $\sigma$  in quality (intrinsic motivation) and their interest  $\rho$  in image (image motivation). The two-dimensional type  $(\sigma, \rho)$  is drawn from  $\{0, 1\} \times \{0, 1\}$  with  $\text{Prob}(\sigma = 1) = \beta$ ,  $\text{Prob}(\rho = 1 | \sigma = 1) = \alpha_s$ , and  $\text{Prob}(\rho = 1 | \sigma = 0) = \alpha_n$ . The resulting four different types of consumers are indexed by  $\sigma\rho$ ; their frequencies are stated in Table 1. For a consumer of type  $\sigma\rho$ , utility takes the form:

$$(1) \quad U_{\sigma\rho}(s, p, R) = \sigma s + \rho \lambda R - p$$

The parameter  $\lambda > 0$  describes the value of image relative to the marginal utility from quality.<sup>8</sup> The image  $R$  of consumer  $(\sigma, \rho)$  is the expectation of her quality preference parameter  $\sigma$  conditional on her purchasing decision. It reflects an outside spectator's (or the consumer mass') inference of a consumer's interest in quality. A formal definition of image follows with the equilibrium definition in Section 2.3.

Table 1: Consumer types and their frequencies.

image concern		no $\rho = 0$	yes $\rho = 1$	$\Sigma$
quality concern	no: $\sigma = 0$	$(1 - \beta)(1 - \alpha_n)$	$(1 - \beta)\alpha_n$	$(1 - \beta)$
	yes: $\sigma = 1$	$\beta(1 - \alpha_s)$	$\beta\alpha_s$	$\beta$

<sup>8</sup>Alternatively I could allow for  $(\sigma, \rho)$  drawn from  $\{0, \bar{\sigma}\} \times \{0, \bar{\rho}\}$  for arbitrary  $\bar{\sigma}, \bar{\rho} > 0$ . This is equivalent to my formulation with  $\lambda = \frac{\bar{\rho}}{\bar{\sigma}}$ . Since  $\lambda$  gives the relative weight on image concerns I can also rewrite the analysis with a weight  $\gamma \in [0, 1]$  on image and a weight  $1 - \gamma$  on quality such that I obtain the above formulation with  $\lambda = \frac{\gamma}{1 - \gamma}$ .



The **monopolist** offers a menu of products  $\mathcal{M} \subset \mathbb{R}_{\geq 0}^2$  to maximize expected profit given that consumers self-select (second-degree price discrimination); due to privacy of consumer types perfect price discrimination is impossible. The monopolist cannot choose image directly, but takes into account which image will be associated with each of his products in equilibrium. Unit costs are assumed to be linear in quantity sold and convex increasing in quality, specifically  $c(s) = \frac{1}{2}s^2$ .<sup>9</sup>

Each consumer can choose a preferred product from the menu of quality-price offers or decide not to buy any of them. The latter case corresponds to obtaining the outside good of zero quality at a price of zero. Reservation utility is then equal to the utility derived from the image of non-buyers (=outside good buyers). The analysis remains essentially unchanged if buying an outside good with zero quality gives the same utility, say  $\bar{a}$ , for all consumers. Voluntary participation is taken care off by requiring the outside option  $(0,0)$  to be part of the product menu  $\mathcal{M}$ .<sup>10</sup> If the monopolist allocates  $(0,0)$  to a consumer type this means this type chooses the outside option.

## 2.2. The structure

The distribution of  $\sigma$  and  $\rho$  and the value of  $\lambda$  are common knowledge and so is the setup of the market interaction. Consumers privately learn their types. Quality is correctly perceived by consumers; cheating on quality is prevented e.g. through third-party verification or because it is obvious from inspection.

The timing is as follows (see also Figure 1):

- (i) The monopolist offers a menu  $\mathcal{M}$  of products. Qualities and prices are observed by all consumers.
- (ii) Consumers learn their types.
- (iii) All consumers simultaneously choose a product which maximizes utility for their type.
- (iv) Images associated with each product emerge according to purchasing decisions and payoffs realize.

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<sup>9</sup>Specifying a functional form allows to obtain closed form solutions. The results are qualitatively the same with constant unit costs  $c(s) = c$  (Friedrichsen, 2013a).

<sup>10</sup>In the following, taking  $(0,0)$  will also be referred to as non-participation since this is the meaning of it. Strictly speaking all types participate by construction.

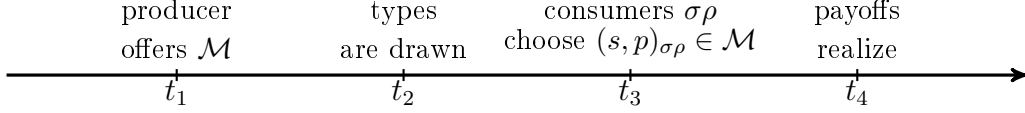


Figure 1: Timing

Whenever in the following the term “game” is used, this is to be understood as a “psychological game” (Geanakoplos et al., 1989) since consumers’ reduced form utilities directly depend on beliefs of others. A possible mechanism to microfound an image or status concern is a matching technology as in Pesendorfer (1995) or Rege (2008), where agents are interested in signaling that they are “good” to increase their chances of interacting with other “good” agents in the future. Agents may differ in image motivation because they engage in different types of interactions where the other’s type is more payoff-relevant or less so.<sup>11</sup>

### 2.3. Equilibrium

In the presence of image concerns the menu offered by the monopolist induces a game among consumers. Image-concerned consumers’ payoffs depend on image and thereby on equilibrium play. Consumers form beliefs about which products other consumer types buy and take this into account when deciding on their purchases. Consumers who value image have an incentive to buy a product which they believe is bought by consumers with an intrinsic interest in quality since this signals caring about quality and is rewarded with a higher image. Whether or not a consumer cares about image does not influence her image directly but influences the choice of a product and can thereby indirectly impact on the image. Image depends on the partition of consumers on different products and thereby only indirectly on absolute product quality.

For every menu  $\mathcal{M} \in \mathcal{P}(\mathbb{R}_{\geq 0}^2)$  the choice function  $b_{\mathcal{M}} : \{0, 1\}^2 \rightarrow \mathcal{M}$  states which product  $(s, p) \in \mathcal{M}$  is chosen by consumer type  $\sigma\rho$ .<sup>12</sup> For every menu  $\mathcal{M}$  the belief function  $\mu_{\mathcal{M}} : \mathcal{M} \rightarrow [0, 1]$  assigns probabilities to a consumer having  $\sigma = 1$  given that she buys a specific product  $(s, p)$  or does not participate. Beliefs are assumed to be identical for all consumers. Since there is a belief function for each menu, the

<sup>11</sup>This microfoundation implicitly assumes that there is a consensus about what is “good” and what is “bad”. Mailath and Postlewaite (2006) show how the value of an attribute (like quality here) can depend on social institutions (matching patterns) in a society.

<sup>12</sup>For ease of notation and because Friedrichsen (2013a) shows that mixed strategies are not optimal, I restrict attention to pure strategies here.

same product occurring in different menus can be associated with different beliefs. In equilibrium the posterior belief and thereby images must be consistent with Bayes' rule, that is they must reflect the actual distribution of types. Given that a choice occurs with positive probability the posterior belief  $\mu_{\mathcal{M}}$  must fulfill

$$(2) \quad \mu_{\mathcal{M}}(s, p) = \frac{\sum_{\rho=0,1} \text{Prob}(1, \rho) \text{Prob}(b_{\mathcal{M}}(1\rho) = (s, p))}{\sum_{\sigma=0,1} \sum_{\rho=0,1} \text{Prob}(\sigma, \rho) \text{Prob}(b_{\mathcal{M}}(\sigma\rho) = (s, p))}$$

**Definition 1.** *Given any menu  $\mathcal{M}$ , a pure-strategy equilibrium in the consumption stage is a set of functions  $b_{\mathcal{M}} : \{0, 1\}^2 \rightarrow \mathcal{M}$  and  $\mu_{\mathcal{M}} : \mathcal{M} \rightarrow [0, 1]$  such that*

- (i)  $b_{\mathcal{M}}(\sigma\rho) \in \text{argmax}_{(s,p) \in \mathcal{M}} \sigma s + \rho \lambda R(s, p) - p$  for  $\sigma, \rho \in \{0, 1\}$  (*Utility maximization*).
- (ii)  $R(s, p, \mathcal{M}) = E[\sigma | b_{\mathcal{M}}(\sigma\rho) = (s, p)] = \mu_{\mathcal{M}}(s, p)$  and  $\mu_{\mathcal{M}}$  is defined in (2) if  $(s, p)$  is chosen with positive probability and  $\mu_{\mathcal{M}} \in [0, 1]$  otherwise (*Bayesian Inference*).

*Mixed-strategy equilibrium is defined accordingly.*

An equilibrium of the complete game is given by a menu  $\mathcal{M}$ , a correspondence  $b_{\mathcal{M}}$  and a belief function  $\mu_{\mathcal{M}}$  such that among the feasible menus,  $\mathcal{M}$  gives the highest profit to the producer given that for each feasible menu consumer behavior is consistent with equilibrium as defined in Definition 1.<sup>13</sup> This equilibrium definition corresponds to a Perfect Bayesian Equilibrium in an extended game, where consumers are punished whenever their perceived image does not coincide with the Bayesian posterior. To simplify notation, in the following the argument  $\mathcal{M}$  in the image is dropped unless this creates ambiguities.

I assume throughout that in case of multiple equilibria in the consumption stage, the preferred equilibrium of the monopolist is played.<sup>14</sup> Furthermore, let the following tie-breaking rule hold for consumers who value quality but not image to facilitate the analysis. Friedrichsen (2013a) relaxes Assumption 1 and shows that it does not qualitatively affect the results.

<sup>13</sup>With slight abuse of notation I do not distinguish between the sets of offered and accepted products but denote both by  $\mathcal{M}$ . Since the two sets can only differ in options not taken in equilibrium one could assume an  $\epsilon$  cost for putting a product on the market to ensure that the monopolist offers only products which are accepted in equilibrium.

<sup>14</sup>This amounts to the monopolist maximizing also over  $\mu_{\mathcal{M}}$  in Problem 3. Each consumer in the continuum is atomless so that individual deviations are not profitable. However, sometimes profitable collective deviations exist and lead to multiple equilibria. Qualitatively similar results hold up when one instead assumes that, in every subgame, consumers coordinate on the equilibrium which maximizes consumer surplus (see Friedrichsen, 2013a).

**Assumption 1.** *Consumers with  $\sigma = 1, \rho = 0$  always buy  $(s, p)$  if indifferent with not participating, i.e. if  $U_{10}(s, p) = s - p = 0 = U_{10}(0, 0)$ .*

The monopolist solves the following Problem (3).

$$\begin{aligned}
(3) \quad & \max_{\mathcal{M}} \sum_{\sigma, \rho \in \{0, 1\}} \sum_{(s, p) \in \mathcal{M}} \text{Prob}(\sigma, \rho) \text{Prob}(b_{\mathcal{M}}(\sigma, \rho) = (s, p)) (p - c(s)) \\
& \text{s.t.} \\
(IC_{\sigma\rho - \sigma'\rho'}) \quad & \sigma s_{\sigma\rho} + \rho \lambda R(s_{\sigma\rho}, p_{\sigma\rho}) - p_{\sigma\rho} \geq \sigma s_{\sigma'\rho'} + \rho \lambda R(s_{\sigma'\rho'}, p_{\sigma'\rho'}) - p_{\sigma'\rho'} \\
& \text{for } \sigma, \rho, \sigma', \rho' \in \{0, 1\} \text{ and } (\sigma, \rho) \neq (\sigma', \rho') \\
(PC_{\sigma\rho}) \quad & \sigma s_{\sigma\rho} + \rho \lambda R(s_{\sigma\rho}, p_{\sigma\rho}) - p_{\sigma\rho} \geq \rho \lambda R(0, 0) \\
& \text{for } \sigma, \rho \in \{0, 1\} \\
(BI) \quad & R(s_{\sigma\rho}, p_{\sigma\rho}) = E[\sigma | b_{\mathcal{M}} = (s_{\sigma\rho}, p_{\sigma\rho})] \quad \text{for all } (s_{\sigma\rho}, p_{\sigma\rho}) \in \mathcal{M}, \sigma, \rho \in \{0, 1\} \\
& \text{which are bought with positive probability in equilibrium}
\end{aligned}$$

**Lemma 1. (*Existence*)** *For each product offer of the monopolist there exists a (not necessarily pure-strategy) equilibrium in the consumption stage.*

It is easily verified that for some product offers a pure-strategy equilibrium does not exist but at least one consumer type randomizes in equilibrium (see Example 1). With a continuum of consumers, such a mixed strategy can be interpreted as shares of consumers of the same type choosing different actions with certainty. At the population level this corresponds to a mixed strategy.

**Example 1.** *Suppose the monopolist offers  $\mathcal{M} = \{(0, 0), (1, 1)\}$  and  $\lambda \in (1, \frac{\beta + \alpha_n(1 - \beta)}{\beta})$ . A pure-strategy equilibrium does not exist. Type 01 does better buying  $(1, 1)$  than not buying when none of his type buys. However, when all of his type buy  $(1, 1)$  he does better not buying.*

While mixed strategies are required to prove existence of equilibrium in every subgame (see Example 1), the product menus for which only mixed-strategy equilibria exist are not profitable to the monopolist (Friedrichsen, 2013a). The following derivations therefore concentrate on the monopolist offering a product menu which induces a pure-strategy equilibrium in the consumption stage.

## 2.4. Benchmark cases: nobody or everyone values image

This section presents two benchmark cases with heterogeneity in quality preferences only: First, no consumer cares about image and, second, all consumers care about image. Importantly, this shows that homogeneous image concerns do not influence the production of quality, whereas heterogeneous image concerns do, as will be shown in Section 3.

In both cases where either none or all consumers value image, the monopolist faces only two consumer types which are distinguished by their valuations for quality. A fraction  $\beta$  of consumers value quality ( $\sigma = 1$ ), the others do not. Without loss of generality the analysis therefore only involves menus with at most two different qualities  $s_0, s_1$ .<sup>15</sup>

**Lemma 2. (*No image motivation*)** *If  $\alpha_s = \alpha_n = 0$ , the unique equilibrium is separating. Consumers obtain  $(s, p) = (1, 1)$  if they value quality and  $(0, 0)$  otherwise.*

Without image concerns, neither the quality-concerned consumer nor the unconcerned consumer obtain any rent; consumer surplus is equal to zero. The monopolist receives the entire surplus  $\beta(s_1 - c(s_1)) = \frac{\beta}{2}$ . A formal proof of this standard result (e.g. Bolton and Dewatripont, 2004, p. 52ff) is omitted here but included in Friedrichsen (2013a).

**Lemma 3. (*Homogeneous image motivation*)** *If  $\alpha_s = \alpha_n = 1$ , the unique equilibrium is separating. Consumers buy  $(1, 1 + \lambda)$  if they value quality and  $(0, 0)$  otherwise. The images associated with the two products in equilibrium are  $R_0 = R(0, 0) = 0$  and  $R(1, 1 + \lambda(1 - R_0)) = 1$ .*

Homogeneous image motivation increases the utility of buying a product which is bought by good types and thereby increases the price a monopolist can charge for it without changing the allocation of quality. The prize increase corresponds exactly to the image gain and, as in the absence of image motivation, aggregate consumer surplus is zero. The monopolist's profit is  $\beta(\frac{1}{2} + \lambda)$ . Image motivation increases the monopolist's profits by  $\beta\lambda$ . If  $p > s$ , the monopolist charges an **image-premium**. The image-premium is justified through the consumers' willingness to pay for the image associated with the product.

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<sup>15</sup>With full information and the ability to price-discriminate between consumers efficient qualities without image concerns are  $s_0^*, s_1^*$  such that  $c'(s_0) = 0$  and  $c'(s_1) = 1$ . This implies  $s_0^* = 0$  and  $s_1^* = 1$ .

### 3. Monopoly with heterogenous image concerns

This section covers the general case of Problem 3, where consumers may differ in their marginal utility from quality  $\sigma \in \{0, 1\}$  as well as their marginal utility from image  $\rho \in \{0, 1\}$ . To abstract from less interesting non-generic cases, I assume that each of the four feasible consumer types is indeed present in the market.

**Assumption 2.** *All consumer types occur with positive probability,  $\beta, \alpha_s, \alpha_n \in (0, 1)$ .*

Note that beliefs about other consumer types' play enter the final payoffs. Thus, before solving the game backwards, I identify potentially profitable consumer partitions in the consumption stage (Subsection 3.1). The partition that is associated with an equilibrium in the consumption stage pins down equilibrium beliefs and allows to subsequently characterize the optimal menus which induce these partitions as equilibrium outcomes. Finally, I compare profits across these menus to determine the profit maximizing menu (Subsection 3.2).

#### 3.1. The consumption stage

Only four types of pure-strategy equilibria in the consumption stage are consistent with profit maximization. Since in equilibrium, the monopolist maximizes his profits, it is without loss of generality that other equilibria in the consumption stage are not characterized here.

**Proposition 1.** *In equilibrium, only a standard good, a mass market, an image building menu, or an exclusive good as specified in Table 2 may be offered by the monopolist.*

In the proof, I first exclude all but four partitions of consumers as inconsistent with profit maximization. Second, I derive the prices and qualities which maximize the monopolist's profit subject to the corresponding incentive compatibility and participation constraints *given* each of the four partitions.

The **standard good** menu is identical to the separating menu without image motivation (see Lemma 2); all quality-concerned consumers buy a product  $(s, p) \neq (0, 0)$  whether or not they are also interested in image. In a **mass market** only ignorant consumers who do not care about either quality or image are excluded and consumers who value at least one of the two characteristics buy the same product. This is the menu with the largest market coverage and no differentiation with respect to the level of quality or price. The **image building** menu has the same market coverage but offers two distinct

Table 2: Equilibrium candidates from Proposition 1, products stated as (quality,price), purchasing group in curly brackets. Consumer types choosing (0, 0) are omitted.

$\sigma\rho$	$\lambda \leq 1$	$1 < \lambda \leq \lambda_1$	$\lambda_1 < \lambda \leq \lambda_2$	$\lambda_2 < \lambda \leq 2$	$\lambda > 2$
standard good	{10,11}	(1,1)	$(\lambda, \lambda)$		n.a.
mass market	{01,10,11}	$(\lambda \frac{\beta}{\beta+\alpha_n(1-\beta)}, \lambda \frac{\beta}{\beta+\alpha_n(1-\beta)})$		(1,1)	
image building	{01,10}	$(\lambda \frac{(1-\alpha_s)\beta}{(1-\alpha_s)\beta+\alpha_n(1-\beta)}, \lambda \frac{(1-\alpha_s)\beta}{(1-\alpha_s)\beta+\alpha_n(1-\beta)})$			(1,1)
	{11}	$(1, 1 + \lambda \frac{\alpha_n(1-\beta)}{(1-\alpha_s)\beta+\alpha_n(1-\beta)})$			$(1, 1 + \lambda \frac{\alpha_n(1-\beta)}{(1-\alpha_s)\beta+\alpha_n(1-\beta)})$
exclusive good	{11}	$(1, 1 + \lambda \frac{1-\beta}{1-\alpha_s\beta})$			
$\lambda_1 = \frac{\alpha_n(1-\beta)+\beta}{\beta}, \lambda_2 = \frac{\alpha_n(1-\beta)+(1-\alpha_s)\beta}{(1-\alpha_s)\beta}$					

products, a lower quality, lower price version for consumers who care about either image or quality and a premium version for image-concerned consumers with a taste for quality, which offers higher quality and higher image at a higher price. If image motivation is large, the two products can even have the same quality and differ only in image and price. Prices, of course are chosen strategically and induce consumers who value only image not to imitate those who value both quality and image. If the monopolist sells only an **exclusive good**, this product—independently of the value of image—features the quality level that would be first-best without image concerns. A premium price reflecting the image gain is sufficient to deter purely image-concerned consumers from buying this product because the cost of quality exceeds their willingness-to-pay. At the same time, however, the price premium is so high that it renders the exclusive product unattractive to purely quality-concerned consumers who therefore choose the outside good too. The purchasing behavior of consumers is illustrated in Figure 2.

In a fully separating equilibrium, consumer types must be correctly identified with respect to their interest in quality since their purchases disclose their types. This prevents purely image-concerned consumers from buying positive quality since this alone is worthless to them. Thereby they pool with consumers interested in neither image nor quality on the outside option (0, 0). The attempt of separating all four consumer types from each other fails.

**Corollary 1.** *An equilibrium with a fully separating menu does not exist.*

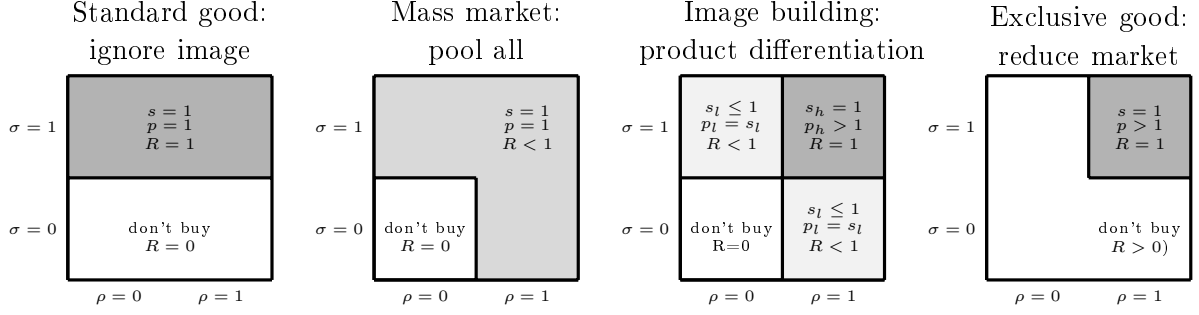


Figure 2: Possible market partitions in equilibrium (Proposition 1).

Moreover, pure image goods which would be bought by all image-concerned consumers irrespective of their quality concern are not viable. In terms of Figure 2, any product menu which induces a vertical partition of consumer types is unprofitable even for the highest values of image.

**Corollary 2.** *An equilibrium in which image-concerned consumers purchase from the monopolist and those not concerned with image choose the outside good does not exist.*

A pure image good would allow the monopolist to fully charge consumers for the value of their image gain without incurring any costs of producing quality for which purely image-concerned consumers would not pay for. However, exactly these consumers lower the image associated with the pure image good whereas the outside option is associated with a positive image too since purely quality-concerned consumers choose it. This implies that the gain in image when choosing the image good is relatively low. In fact, the monopolist makes strictly higher profits by offering an exclusive good instead which pools the purely image-concerned with the purely quality-concerned consumers and those who do not value either quality or image. This deteriorates the image on the outside good and improves the image on the good sold. In addition, the consumers who value quality and image are willing to pay for quality so that the monopolist incurs additional profit from producing a quality product instead of a pure image good with zero quality.

Formally,  $\Pi_{\text{pure image}} \leq (\alpha_s \beta + \alpha_n (1 - \beta)) \left( \frac{\alpha_s \beta}{\alpha_s \beta + \alpha_n (1 - \beta)} - \frac{(1 - \alpha_s) \beta}{(1 - \alpha_s) \beta + (1 - \alpha_n) (1 - \beta)} \right) < \alpha_s \beta \left( 1 - \frac{(1 - \alpha_s) \beta}{1 - \beta + (1 - \alpha_s) \beta} \right) < \Pi_{\text{exclusive good}}.$

### 3.2. Profit maximization

Having understood how consumers behave for given product offers, I identify for each value of image, which menu the monopolist offers to maximize his profits.



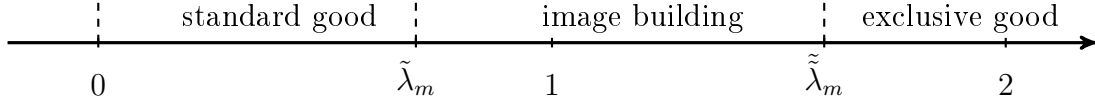


Figure 3: Equilibrium in monopoly.

**Proposition 2.** *There exist  $0 < \tilde{\lambda}_m \leq \tilde{\tilde{\lambda}}_m$  such that the profit-maximizing product offer of a monopolistic producer is given by*

- (i) *standard good if  $\lambda \leq \tilde{\lambda}_m$ .*
- (ii) *image building if  $\tilde{\lambda}_m \leq \lambda \leq \tilde{\tilde{\lambda}}_m$ .*
- (iii) *exclusive good if  $\lambda \geq \tilde{\tilde{\lambda}}_m$ .*

*If  $\alpha_s > \frac{1}{3}$  and  $\beta < \frac{3\alpha_s - 1}{\alpha_s + \alpha_s^2}$  and  $\alpha_n < \frac{\beta(1 + \alpha_s(\beta + \alpha_s\beta - 3))^2}{4\alpha_s(1 - \beta)^2}$ ,  $\tilde{\lambda}_m = \tilde{\tilde{\lambda}}_m$ . Thus, only standard good and exclusive good can be optimal.*

In the proof, the characterization of products from Proposition 1 is used to compute profit as a function of  $\lambda$  for each product offer. The optimal product offer for each distribution of preferences and each value of image is derived by comparing profits across menus. The profit-maximizing menu, optimal consumer behavior, and consistent beliefs together constitute the equilibrium of the complete game according to Section 2.3.

It is important to note that the threshold values of  $\lambda$  depend on the parameters but holding fixed a parameter set, the equilibrium is a standard good for low  $\lambda$ , an exclusive good for high  $\lambda$  and possibly image building for intermediate values of  $\lambda$ .

**Corollary 3.** *The interval of  $\lambda$  where image building is optimal is empty only if image concerns and intrinsic motivation are positively correlated,  $\alpha_n < \alpha_s$ .*

Image motivation only matters if it is intense enough. For  $\lambda$  close to zero, profits with the exclusive good and profits from image building are lower than profits from standard good so that offering a standard good must be optimal. Since not all consumers value image, the monopolist cannot charge an image-premium and the offer is identical to the one observed in the absence of image motivation (cf. Section 2.4).

When image motivation becomes more important,  $\lambda$  increases, profits from image building and exclusive good increase in  $\lambda$  while standard good profits remain constant or even decrease. Thus, the monopolist profits from modifying the menu. For intermediate values of image motivation, two products are sold and all consumers who value quality or image buy. One product is of high-quality and sells with an image-premium; the

other is priced at the monopoly price for quality<sup>16</sup>, can be of lower quality and has lower image. The introduction of the low quality into the market allows the monopolist to “build image” and sell to more consumers as well as increase prices for those who value both image and quality. When image motivation becomes even more important, the monopolist has an incentive to market a high-quality product exclusively to consumers who value both image and quality, so that the share of consumers buying high quality decreases as compared to the benchmark cases.

Figure 3 illustrates the findings of Proposition 2. In addition, Figure 4 shows a typical example for how the equilibrium thresholds depend on the fraction of intrinsically motivated consumers and demonstrates the relevance of the image building menu.

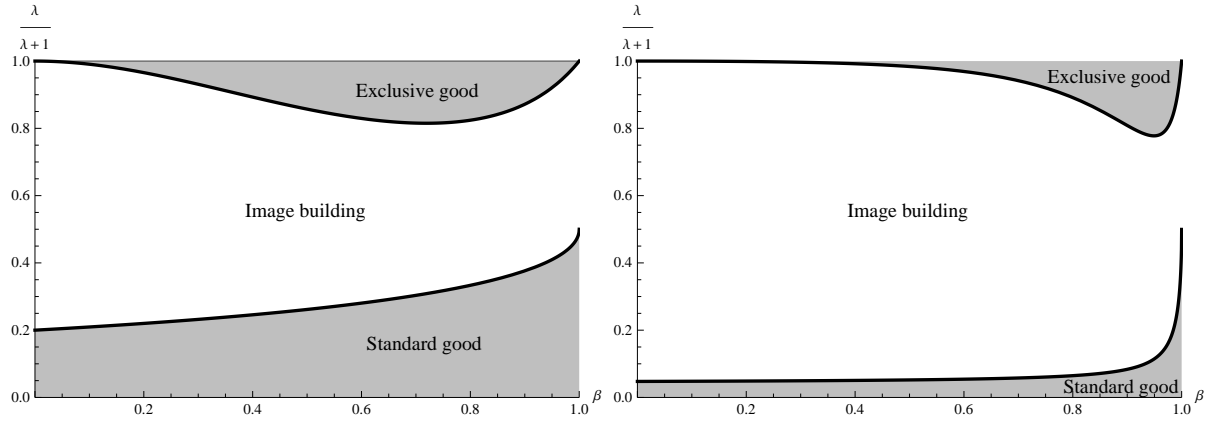


Figure 4: Equilibrium thresholds in monopoly for  $\alpha_s = \alpha_n = 0.5$  (left panel) and  $\alpha_s = \alpha_n = 0.9$  (right panel). The value of image is rescaled as  $\frac{\lambda}{\lambda+1} \in [0, 1]$  which is the weight on image in the utility function.

Let us define **total quality** in the market as the sum over the fractions of consumers multiplied with the quality of the product that they buy in equilibrium. An implication of Proposition 2 is that total quality in the market is not in general increasing in the value of image as illustrated in Figure 5. The reason is that changes in the value of image may induce the monopolist to offer a different menu of product which affects total quality in the market through reduce product quality (moving from standard good to image building) or market coverage (moving from image building to exclusive good).

**Corollary 4.** *There exist parameters such that an increase in the value of image  $\lambda$  decreases the total provision of quality in monopoly.*

<sup>16</sup>This equals the marginal cost of increasing quality,  $s$ , and has to be distinguished from the unit cost  $\frac{1}{2}s^2$ . For  $s < 2$  the monopoly price is greater than the unit cost such that the monopolist makes positive profits from selling.

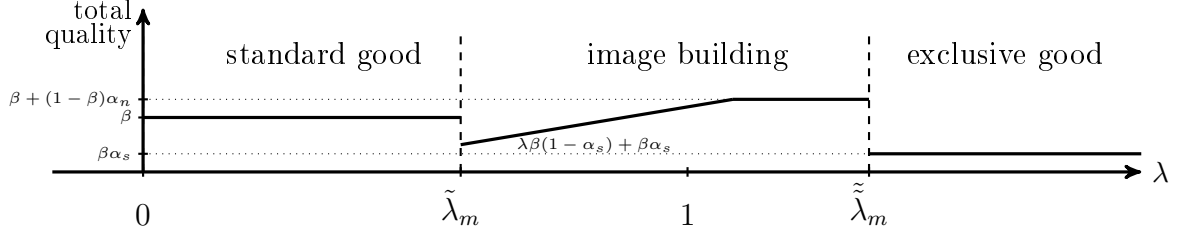


Figure 5: Total quality in monopoly. In the absence of image motivation, the first-best level of total provision is  $\beta$ .

To complement the analysis, let us analyze how changes in the preference distribution influence the equilibrium provision of quality.

Increases in the fraction of image-concerned consumers, whether they occur within those concerned with quality ( $\alpha_s$ ) or within those who do not value quality ( $\alpha_n$ ), trigger the monopolist to reduce quality and increase prices. Whereas this increases profits, it makes individual consumers worse off. As the share of quality-concerned consumers ( $\beta$ ) increases, the monopolist raises both quality (as long as it still below  $s = 1$ ) and prices. Aside from affecting products offered within a given type of equilibrium, changes in the preference distribution also affect the prevalence of different types of equilibrium. Figure 4 illustrates the effect of a homogeneous increase in image concerns. More generally, the standard good is offered more often if the share of consumers who experience utility from quality directly ( $\beta$ ) increases. However, if instead the fraction of consumers who buy a product only for its image ( $\alpha_n$ ) increases, the standard good becomes less attractive to the monopolist. Simultaneously, distortions in quality provision in form of either image building or the exclusive good become more prevalent the greater the share of consumers with image concerns.<sup>17</sup>

## 4. Competition

As a product becomes more familiar, more producers can credibly supply any desired quality level and a monopolistic market becomes less likely. This section illustrates that heterogeneous image concerns promote product differentiation which is not driven by heterogeneous quality valuations but by heterogeneous image concerns even in the absence of market power on the supply side. A crucial difference in a competitive market

<sup>17</sup>For formal statements and proofs see Friedrichsen, 2013a.

is, however, that for image motivation large enough all consumers who value image or quality buy a product with positive quality, whereas a monopoly would offer an exclusive good which is only bought by consumers who derive utility from both image *and* quality. Moreover, the mechanisms of separation are different. Taking the quality level which would be sold in the absence of image concerns as a benchmark, product differentiation occurs through an additional product with higher quality in the competitive market (upward distortion). This is in contrast to the monopoly, where separation is induced through an additional product with lower quality (downward distortion).

The model is the same as in Section 2 except for the supply side. Suppose now that all qualities are available at different prices equal to or above the marginal cost of provision,  $p(s) \geq c(s) = \frac{1}{2}s^2$ . This captures a situation of competition without actually modeling the interaction among producers.<sup>18</sup> The game reduces to all consumers simultaneously choosing a product  $(s, p) \in \mathcal{M}$  to maximize utility. The set from which they choose is now given as

$$\mathcal{M} = \left\{ (s, p) \in \mathbb{R}^2 \mid s \geq 0 \text{ and } p \geq \frac{1}{2}s^2 \right\}.$$

An equilibrium is given by consumer choices satisfying Definition 1. Images are formed as an outside spectator would form them and are consistent with consumers' actual choices in equilibrium. This spectator is a virtual second player who moves after consumers and who pays consumers in the form of image, so that the game resembles a signaling game. The equilibrium is generally not unique. I therefore rely on a refinement in the spirit of the Intuitive Criterion by Cho and Kreps (1987).<sup>19</sup>

## 4.1. Competitive equilibrium

Note first that consumers who value neither image nor quality never buy any product  $(s, p) \neq (0, 0)$ . Furthermore, a consumer who values quality alone will not be influenced by image and will always buy the product which offers the best deal in terms of quality and price. Her utility is independent of beliefs and maximized at  $(s, p) = (1, \frac{1}{2}) \in \mathcal{M}$ . Thus, the driving forces behind the equilibrium outcome are the decisions of the two consumer types who care about image. Since unconcerned consumers always choose the

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<sup>18</sup>This assumption precludes multi-product firms which could otherwise cross-subsidize products.

<sup>19</sup>Formally, the model does not have a receiver of signals and therefore is not a proper signaling game. The refinement as in Cho and Kreps (1987) cannot be applied explicitly since it is formulated in terms of best responses. Here, no party acts upon the product choice. Still, since the image is a reduced form expression of an expected response, and all consumers choose their preferred product in response to the associated image, the same logic applies.

outside good, the image of not buying is equal to zero unless any intrinsically motivated consumer also chooses this option.

For  $\lambda < \frac{1}{2}$  purely image-concerned consumers prefer  $(0, 0)$  over buying the product  $(s, p) = (1, \frac{1}{2})$  even when the latter is associated with the best image  $R(1, \frac{1}{2}) = 1$ . Since the choice of purely quality-concerned consumers is independent of beliefs, the image associated with product  $(s, p) = (1, \frac{1}{2})$  is  $R(1, \frac{1}{2}) = 1$ . Thus, consumers who value image and quality also choose  $(s, p) = (1, \frac{1}{2})$ . For  $\lambda < \frac{1}{2}$  this is the unique equilibrium.

For  $\lambda \geq \frac{1}{2}$ , purely image-concerned consumers gain from buying  $(1, \frac{1}{2})$  because of its image. In general equilibria are not unique anymore. I therefore analyze different classes of equilibria separately. When deriving these equilibria I allow for consumer types to randomize across different choices.

**Single-product equilibria** Consider equilibria such that unconcerned consumers do not buy, and all other consumer types pool on the product  $(1, \frac{1}{2})$ .

**Lemma 4.** *There exists a partially pooling equilibrium where all consumers who value quality buy  $(1, \frac{1}{2})$  and purely image-concerned consumers randomize between buying  $(1, \frac{1}{2})$  with probability  $q$  and not buying at all with probability  $1 - q$  where*

$$(4) \quad q = \begin{cases} 0 & \text{if } \lambda < \frac{1}{2} \\ (2\lambda - 1) \frac{\beta \alpha_s}{(2 - \beta) \alpha_n} & \text{if } \frac{1}{2} \leq \lambda \leq \frac{1}{2} \frac{(1 - \alpha_s) \beta + q \alpha_n (1 - \beta)}{(1 - \alpha_s) \beta} \\ 1 & \text{otherwise.} \end{cases}$$

The image associated with buying  $(1, \frac{1}{2})$  is  $R(1, \frac{1}{2}) = \frac{\beta}{q(1 - \beta) \alpha_n + \beta}$ .

In a competitive market,  $(1, \frac{1}{2})$  is always available to purely quality-concerned consumers. Thus, a competitive equilibrium analogous to the exclusive good does not exist.

For values of image up to one half, the efficient quality level  $s = 1$  is sold at a price equal to marginal cost to all consumers who care about quality and only to those. Those who do not value quality choose the outside option. This is the competitive version of the **standard good**; image does not manifest itself in changes in quality, price or purchasing behavior. For higher values of image, purchasing the product  $(1, \frac{1}{2})$  becomes attractive to purely image-concerned consumers since it is associated with image  $R(1, \frac{1}{2}) = 1$ . Thus, the only one-product equilibrium for  $\lambda > \frac{1}{2}$  is one of **(partial) mainstreaming** where consumers who value image or quality all buy  $(1, \frac{1}{2})$ . As purely image-concerned consumers buy  $(1, \frac{1}{2})$  with positive probability, the associated image decreases though.

When image becomes valuable enough, consumers who only value image buy  $(1, \frac{1}{2})$  with probability 1 since even the resulting image (which is strictly lower than one) is worth more than the price of  $\frac{1}{2}$ . For intermediate values of image, however, only a fraction  $q \in (0, 1)$  of purely image-concerned consumers buys  $(1, \frac{1}{2})$ .<sup>20</sup> In contrast to the monopolistic mass market where quality would typically be distorted downward, the quality level within any competitive mainstreaming equilibrium equals the level that would be first best without image concerns. Moreover, the product is priced at marginal cost, whereas the monopoly charges the strictly higher monopoly price for quality.

**Two-product equilibria** First note that if there are separating equilibria, they must involve real differences in quality of the products used to separate. Suppose to the contrary that two products  $(s, p)$ ,  $(s', p')$  form a separating equilibrium and  $s = s'$ . Separation requires that consumers who value image and quality buy a different product than purely image-concerned consumers. But for  $s = s'$  both prefer the same:

$$\begin{aligned}
U_{11}(s', p') &> U_{11}(s, p) \\
&\Leftrightarrow s' + \lambda R(s', p') - p' > s + \lambda R(s, p') - p' \\
&\Leftrightarrow \lambda R(s', p') - p' > \lambda R(s, p) - p \\
&\Leftrightarrow U_{01}(s', p') > U_{01}(s, p)
\end{aligned}$$

This is in contrast to the monopoly, where for high enough values of image, differentiation through price and image alone was sustainable as a special case of image building. The reason is that the monopolist can increase the price above marginal cost and thereby directs purely image-concerned consumers towards a lower-price product whereas those who value both image and quality are happy to pay a higher price for a better image.

It is easy to see that separating equilibria must induce a consumer partition where purely quality-concerned and purely image-concerned consumers pool on the product  $(1, \frac{1}{2})$  and consumers who value both quality and image separate from the others by buying another product  $(s', p')$ ; those who do not value either quality or image choose the outside option. Suppose to the contrary that consumers who value only quality buy  $(1, \frac{1}{2})$  whereas purely image-concerned consumers and those who value image and quality pool on a different product  $(s, p) \neq (1, \frac{1}{2})$ . The image of  $(s, p)$  is smaller than 1 due to the purchases of purely image-concerned consumers. Thus, consumers who value image and quality would be better off by also purchasing  $(1, \frac{1}{2})$  with associated image of 1.

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<sup>20</sup>This type of randomization is consistent with Assumption 1 but never chosen by the monopolist.

**Lemma 5.** For  $\lambda > \frac{1}{2}$ , we find  $\varepsilon > 0$  such that the two products  $(1, \frac{1}{2})$  and  $(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2})$  form a separating equilibrium with

$$R\left(1 + \varepsilon, \frac{(1 + \varepsilon)^2}{2}\right) = 1, \quad R\left(1, \frac{1}{2}\right) = \frac{\beta(1 - \alpha_s)}{\beta(1 - \alpha_s) + q(1 - \beta)\alpha_n}, \quad R(0, 0) = 0$$

where purely image-concerned consumers buy with probability  $q$  and

$$(5) \quad q = \begin{cases} (2\lambda - 1) \frac{\beta\alpha_s}{(1-\beta)\alpha_n} & \text{if } \frac{1}{2} < \lambda \leq \frac{1}{2} \frac{(1-\alpha_s)\beta + q\alpha_n(1-\beta)}{(1-\alpha_s)\beta} \\ 1 & \text{if } \lambda > \frac{1}{2} \frac{(1-\alpha_s)\beta + q\alpha_n(1-\beta)}{(1-\alpha_s)\beta} \end{cases}$$

Consumers who are willing to pay for both quality and image buy  $(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2})$ , a product which provides a **functional excuse**. These consumers use excessive quality as a way to pay a higher price to signal that they value quality. Purely image-concerned consumers refrain from imitating them because the price of the high quality product exceeds the value of the associated image. Instead, they buy  $(1, \frac{1}{2})$ . This same product is also bought by consumers who only value quality so that the associated image is positive.

## 4.2. Equilibrium refinement

There are generically many other separating equilibria. Furthermore, the pooling equilibrium from Lemma 4 also coexists with the separating one. I employ a refinement in the spirit of the Intuitive Criterion (IC) by Cho and Kreps (1987) to obtain a unique equilibrium prediction.<sup>21</sup> It turns out that the refinement rules out image-premia, i.e. equilibria in which consumers who value both quality and image buy overpriced products to obtain an image by spending more money than necessary. Instead they buy excessive quality at marginal cost. Furthermore, it rules out pooling equilibria where purely image-concerned consumers buy positive quality. Figure 6 illustrates the result.

**Proposition 3.** *The equilibrium satisfying the Intuitive Criterion is unique. All products are sold at marginal cost and the equilibrium is*

(i) *the standard good if  $\lambda \leq \frac{1}{2}$ .*

(ii) *functional excuse with  $\varepsilon = \sqrt{2\lambda \frac{q(1-\beta)\alpha_n}{\beta(1-\alpha_s) + q(1-\beta)\alpha_n}}$  if  $\frac{1}{2} < \lambda$ .*

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<sup>21</sup>Formally, my model is not a proper signaling game. See Footnote 19.

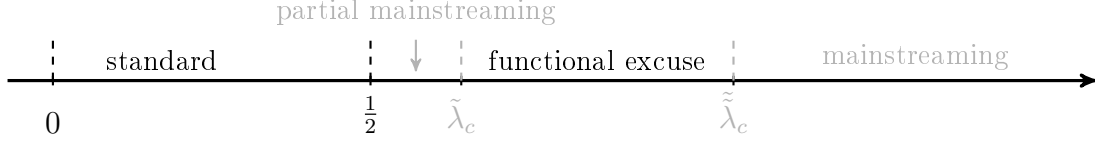


Figure 6: Competitive equilibrium for different values of image  $\lambda$ . Equilibria marked in gray fail the Intuitive Criterion but would make consumers better off.

In the proof, I first rule out other separating equilibria. Then, the pooling equilibrium is ruled out for  $\lambda > \frac{1}{2}$ . For this, I show that there always exists  $\varepsilon > 0$  such that a consumer who values both quality and image profits from deviating to product  $(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2})$  if he beliefs this to be associated with  $R = 1$ , while purely image-concerned consumers cannot profit from deviating to product  $(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2})$  for any belief. According to the Intuitive Criterion, this product can only be associated with  $R = 1$  since otherwise we would assign positive probability to a type who would never gain from choosing this product.

If the intensity of image motivation is small, the equilibrium resembles the monopolistic **standard good** case: the efficient quality level  $s = 1$  is sold to all consumers who care about quality. Those who do not value quality pick the outside option. This can be thought of as a conventional good without any quality component. If the value of image increases, purely image-concerned consumers are attracted by the same product and thus separation becomes worthwhile for the consumer who values image and quality. Product differentiation within the quality segment occurs even though the market is perfectly competitive. Consumers who value both quality and image are willing to buy overly high quality since utility is realized from both image and quality; they use a **functional excuse** to separate from other consumers and obtain higher image. Product differentiation then features an upward distortion in quality: The lower quality product has the efficient quality level  $s = 1$  and is bought by consumers who value either image or quality.<sup>22</sup> The high quality is chosen such that the product is not attractive for the purely image-concerned consumers due to its high marginal cost.<sup>23</sup> Recall from Proposition 2 that a monopolist in contrast achieves differentiation by offering a product with lower quality. This leads to lower average quality.

<sup>22</sup>The participation probability of purely image-concerned types is 0 for  $\lambda < \frac{1}{2}$ ,  $q_{sep}(\lambda) = (2\lambda - 1) \frac{((1-\alpha_s)\beta)}{(\alpha_n(1-\beta))}$  for  $\frac{1}{2} \leq \lambda < \frac{1}{2} \frac{(1-\alpha_s)\beta + \alpha_n(1-\beta)}{((1-\alpha_s)\beta)}$ , and 1 otherwise.

<sup>23</sup>Note that this result is driven by the additivity of utility from image and quality. The convex cost of quality production exceeds the value of quality for every quality level above one and only consumers who in addition realize image utility are willing to pay the price.



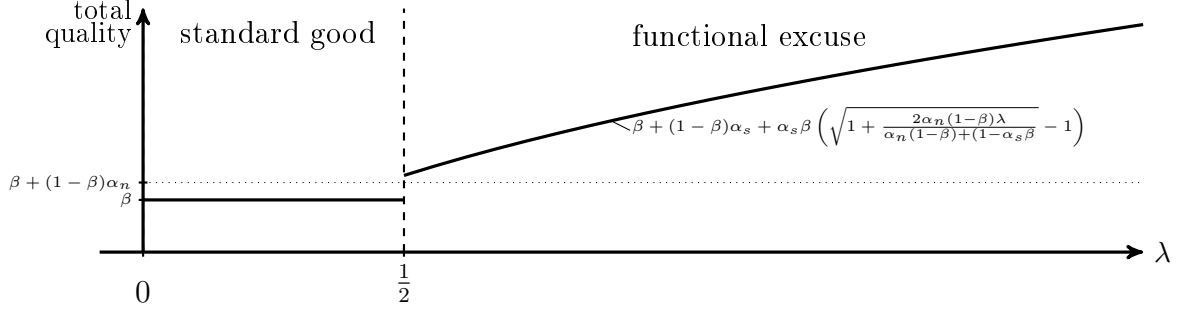


Figure 7: Total quality in the market with competition. In the absence of image motivation, the first-best level of total provision is  $\beta$ .

If the intensity of image motivation becomes very large, the upward distortion in quality becomes expensive. We find  $\frac{1}{2} < \tilde{\lambda}_c < \tilde{\tilde{\lambda}}_c$  such that the consumer who values image and quality would be better off by pooling on the lower quality product for all  $\lambda \in (\frac{1}{2}, \tilde{\lambda}_c)$  and  $\lambda > \tilde{\tilde{\lambda}}_c$  (**mainstreaming**, see Figure 6). Such a pooling equilibrium features partial participation by consumers who only value image for low  $\lambda$ ; it fails the Intuitive Criterion (see Friedrichsen, 2013a for details on the derivation of  $\tilde{\lambda}_c$  and  $\tilde{\tilde{\lambda}}_c$ ).

Proposition 3 characterizes the competitive equilibrium as a function of the value of image  $\lambda$ . From this, one can compute total quality in the market as illustrated in Figure 7. Total provision of quality depends on the qualities sold to consumers as well as on the fractions of consumers who buy a given quality. The following result is directly read-off from the figure:

**Corollary 5.** *Total provision of quality in competition increases in the value of image  $\lambda$ .*

In contrast to the monopoly case, the prevalence of different equilibria is unaffected by changes in the preference distribution since the threshold between standard good and functional excuse is independent of the preferences distribution. Moreover, changes in the frequencies of consumer types affect products and purchases only if consumers behave according to functional excuse and purely image-concerned consumers purchase  $(1, \frac{1}{2})$  with probability one. In this case, total provision of quality increases in  $\alpha_s$  and  $\alpha_n$  and is non-monotone in  $\beta$  (see Friedrichsen, 2013a for details). As long as purely image-concerned consumers randomize over choosing  $(0, 0)$  and buying  $(1, \frac{1}{2})$ , the products in “functional excuse” are independent of the preference distribution. Trivially, products and purchases do not depend on the preference distribution in “standard good” either.

## 5. Welfare analysis

Since image cannot be allocated independently of quality (it depends on equilibrium behavior), even a welfare maximizer would be bound to trade off efficiency in allocating image versus efficiency in allocating quality. Moreover, the partition of consumers determines how much image in total is allocated in the market. Since prices are an instrument to enforce a partition, they are in general not welfare neutral.

### 5.1. When does monopoly give higher welfare than competition?

Even though the monopolist does not in general implement the welfare maximizing allocation (see Friedrichsen, 2013b, for details), competition does in general not do better. The reason is that the monopoly can stabilize separation through its pricing while consumers use excessive quality to separate in competition. The former often yields higher welfare. In a competitive market, a luxury tax on excessive qualities can therefore improve welfare.

**Proposition 4.** *There generically exist parameters such that monopoly yields higher welfare than competition.*

*Proof.* The proof is by example.

**Example 2.** *Suppose  $\lambda = 1$ ,  $\beta = 0.5$ ,  $\alpha_n = 0.5$ , and  $\alpha_s = 0.5$ . Then  $\tilde{\lambda}_m = .5 < \lambda < 6 = \tilde{\tilde{\lambda}}_m$ . Welfare from monopoly, which yields image building, is 0.5625 whereas welfare from competition, which yields functional excuse, is 0.478553.*

Let me point out that the chosen parameters are reasonable by rephrasing the example: Suppose half of the population values quality, half is concerned with their image, and the image concern is independent of the taste for quality. If image and quality are weighed equally in the utility function, monopoly yields higher welfare than competition.

Welfare in monopoly is continuous in  $\lambda$  for  $\lambda \notin \{\tilde{\lambda}_m, \tilde{\tilde{\lambda}}_m\}$  and in competition for  $\lambda \neq \frac{1}{2}$ . Thus, we find parameter constellations close to the example such that welfare with monopoly is still higher than welfare with competition.  $\square$

When competition leads to higher welfare than monopoly, it also leads to higher consumer surplus than monopoly. But even if competition reduces welfare, consumers may still profit. We have seen that monopoly may lead to higher welfare under some circumstances. Thus, one can again ask for the distributional effect behind this finding. It turns out that purely quality-concerned consumers always benefit from competition.

In contrast to this, there exist parameters such that consumers who value image are better off in monopoly than in competition (see Friedrichsen, 2013b, for details and derivations).

Note that the competitive equilibrium consistent with the Intuitive Criterion is not in general the best one in terms of welfare. Importantly, though, the claim in Proposition 4 that the competitive market outcome may lead to lower welfare than monopoly does not depend on the refinement. Even when I use the equilibrium which gives the highest welfare in the competitive market, there still exist parameter constellations such that monopoly yields higher welfare (Friedrichsen, 2013a).

It is also noteworthy that the finding of Proposition 4 does not depend on the equilibrium selection in monopoly either. If instead of the equilibrium preferred by the monopolist, the equilibrium is selected which maximizes total consumer surplus, there still exist parameters such that monopoly yields higher welfare than competition even if compared with the “best-welfare” equilibrium in competition (see Friedrichsen, 2013a for details).

## 5.2. A minimum quality standard decreases and a luxury tax increases welfare

The model allows for the analysis of some common policy measures. The introduction of a minimum quality standard (MQS) which is intended to ensure all consumers get a high quality product can hurt consumers. With a binding minimum quality standard, the monopolist has to adjust the low quality upwards and the price for high quality downwards to achieve product differentiation; this benefits consumers. However, since the adjustments make product differentiation less profitable, the monopolist will resort to an exclusive good or standard good regime for a larger set of parameters. Through this supply reaction, regulation can trigger decreases in consumer surplus and in welfare.

**Lemma 6.** *There exist parameters such that the introduction of a binding minimum quality standard in a monopolistic market decreases consumer surplus and welfare.*

We have just seen that image concerns distort qualities upwards in a competitive market through the use of excessive quality as a functional excuse (see Lemma 5, Proposition 3). Thus, a minimum quality standard as analyzed for the monopoly case does not bite. However, if product differentiation prevails under competition, a tax on higher qualities can improve welfare. By increasing consumer prices above marginal costs, it

allows consumers to achieve a high image at lower qualities which can be produced more efficiently.

**Corollary 6.** *In competition, we can design a luxury tax on excessive quality such that welfare strictly increases.*

This finding mirrors the results in e.g. Ireland (1994) and Hopkins and Kornienko (2004) that taxation improves welfare in the presence of image or status concerns but in a very different model. In Ireland (1994), the tax corrects a problem of overconsumption by increasing the price of the good so that all consumption levels are shifted downwards without affecting the sorting of consumers. Here, the tax only affects the high quality product thereby shifting the separating equilibrium from where quality differences ensure separation to one where (mostly) price differences ensure separation. Hopkins and Kornienko (2004) analyze a consumption tax in the form of a Pigouvian tax that corrects the status externality. However, the optimal tax in their model depends on a consumer's income whereas in my model, a tax on certain qualities is sufficient to improve welfare. It is important to note, that in my model the tax does not necessarily constitute a Pareto improvement without further redistributive measures. Consumers who are concerned with quality and image might be worse off with a luxury tax than without it because the tax exceeds the private gain. The private gain is given by the reduction in price(=marginal cost) corrected for the reduction in quality.<sup>24</sup>

## 6. Extensions

My model applies to any context where the quality of a product matters and image concerns are relevant. This section deals with implications of this model if image is associated with a negative value or if quality has a public good character.

**Interest in “quality” is seen badly** Suppose the model is as laid out in the monopolistic case in Section 3 but now image decreases utility,  $\lambda < 0$ . Being recognized as a consumer who values quality gives a negative image and this image is more negative the better identified consumers preferences are from their consumption choice. Examples are goods where quality has a strong negative externality and its consumption is therefore seen as morally unacceptable. Imagine a preference for big, polluting cars. Being aware of the

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<sup>24</sup>The quality valuation minus marginal cost of quality is negative since image concerns induce the consumer to choose a quality that is greater than what is first best without image concerns. A reduction in quality reduces this margin by moving the quality level closer to first best.

fact that showing this preference gives a negative image is likely to influence purchasing behavior and thus should also be reflected in the marketing strategy of the producer. Another way to interpret a negative value of image would be a social norm against showing off. Consumers might still value good quality but at the same time dislike being identified as those who are rich enough to afford it. For instance, showing a taste for expensive jewelry can lead to reduced status in a neighborhood where equality is valued above all. The Scandinavian Jante Law seems to describe a pattern of group behavior consistent with this interpretation.

If quality is associated with stigma, the monopolist either reduces the price of quality or accepts to sell less than in the absence of image concerns. For small negative image concerns, the stigma of being interested in quality implies a lower price. Consumers who are indifferent with respect to image concerns profit from the existence of image-concerned consumers through a lower price for both of them. For stronger negative image concerns, those who care about image choose the outside option. In this case, the product sold is identical to the one offered in the absence of image concerns.

**Proposition 5.** *Suppose image exhibits a negative effect on utility.*

- (i) *For  $\lambda < -\frac{1}{2}\alpha_s$  only types who care about quality but not about image buy quality  $s = 1$  at monopoly price  $p = 1$ .*
- (ii) *For  $\lambda \geq -\frac{1}{2}\alpha_s$  both types who care about quality buy quality  $s = 1$  at price  $p = 1 + \lambda < 1$  below the conventional monopoly price.*

*Proof.* It is clear that purely image-concerned consumers cannot be attracted to buy at any positive price. Only quality-concerned consumers with  $\sigma = 1$  buy at all and therefore any product  $(s, p) \neq (0, 0)$  will obtain  $R(s, p) = 1$ . This implies that no differentiation in terms of image is possible. The monopolist therefore has to decide only whether to offer a product which is accepted by both—consumers who only value image and consumers who additionally value quality—or whether to separate the two. Suppose first that only purely quality-concerned consumers are served. Then the participation constraint of consumers who only value quality must bind:  $p_{10} = s_{10}$ . The maximal profit in this case is at  $s_{10} = 1$  with  $\Pi = \frac{(1-\alpha_s)\beta}{2}$ . Suppose instead that also image aware consumers buy. Then, the binding participation constraint is the one of consumers who value both quality and image:  $p_{11} = s_{11} - \lambda$ . The profit maximizing quality level is  $s_{11} = 1$  and profits are  $\Pi = (\frac{1}{2} - \lambda)(\beta)$ . The proof is completed by comparing the two expressions.  $\square$

An alternative view would not interpret image as a means of vertical dimension but instead take an identity perspective, where consumers are located on different value

positions and try to find a product which matches their identity (Akerlof and Kranton, 2000). In a version of this model in which consumers derive utility from signaling their preference for quality instead of following a common norm of what is “good” behavior the set of profitable product offers changes as compared to the preceding analysis. Pooling on a positive quality level does not occur anymore. Instead, the monopolist offers two products at opposite quality levels and charges an image premium on both of them.

**Quality as a public good** Extending the application to ethical consumption, we can interpret the purchase of quality as a private contribution to a public good through consumption as is done in Besley and Ghatak (2007). The monopolistic producer bundles the private consumption good with a contribution to the public good by engaging in responsible production methods. These are interpreted as quality here. Some consumers experience warm glow utility from purchasing the good with the bundled contribution (for warm glow see Andreoni, 1990). Some experience utility from being seen as contributors (image utility). Noone, however, takes into account that her individual purchase has an impact on the total provision of the public good. Suppose the public good has a social value of  $\gamma > 0$ . Then, the efficient level of total quality provision is  $\beta + \gamma$ .<sup>25</sup>

Image concerns can help to move total consumption of quality closer to this target but can also drive it further away from it when image becomes too valuable. In general, efficient provision will not be reached with monopoly. Provision in the competitive market is typically higher than in monopoly but not in general at the efficient level either. The reason for this result is of course that—in contrast to the socially efficient level of provision—the market-based provision of quality is independent of the social value of quality. This finding is also evident in Figures 5 and 7: If the social value per unit of quality is  $\gamma$ , the socially efficient provision level is  $\beta + \gamma$  which is constant in  $\lambda$  but in general different from the market-based levels of provision.

For products which have a public good character like Fairtrade or organic production, non-governmental organizations may try to “raise awareness” to foster their cause. However, “raising awareness” may, depending on its meaning, have unintended consequences. First, raising awareness can mean that public recognition increases and therefore the value of image,  $\lambda$ , increases. Second, raising awareness can mean that the number of intrinsically motivated consumers,  $\beta$ , increases. Finally, it can mean that the fraction of consumers who value image -  $\alpha_s, \alpha_n$ , whether or not they value quality - increases. Only

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<sup>25</sup>This analysis abstracts from distributional concerns. Taking into account heterogeneity in warm glow but ignoring image utility implies individually efficient contribution levels of  $s = \gamma$  for consumers with  $\sigma = 0$  and  $s = 1 + \gamma$  for individuals with  $\sigma = 1$ .

the latter two affect the distribution of preferences. At first sight, one might guess that all effects go in the same direction since they all increase the population-wide willingness-to-pay for quality. As has been shown in Corollary 4, however, this intuition is wrong; increases in image concerns can decrease the provision of quality.

## 7. Discussion of existing and new insights

A classic conspicuous consumption model as in Corneo and Jeanne (1997) or Bagwell and Bernheim (1996) features two goods, only one of which is conspicuous and assumes that all consumers care about their images and can signal their types by adjusting their purchased quantity freely. In such a model, consumers typically consume inefficiently as they try to establish higher levels of status (Ireland, 1994). This paper departs from the existing literature in two aspects which I discuss one after the other.

First, I assume unit demand. Each consumer buys exactly one unit of one of the offered products, either one with positive quality from the monopolist or the zero-quality outside good.<sup>26</sup> The unit-demand assumption forces the effect of image to show up in qualities. In the monopoly case, the producer decides on product offers and accordingly influences which images can be obtained.<sup>27</sup> In competition, consumers can freely choose quality but still are assumed to have unit demand so as to shut down signaling via consumed quantities. Without such an assumption, consumers use consumed quantities as signals (see e.g. Bagwell and Bernheim, 1996; Corneo and Jeanne, 1997). If image is not related to wealth but to other traits, however, signaling via quantity is unreasonable.

Second, I assume that consumers differ in their image motivation as well as in their intrinsic interest in quality whereas in other models consumers differ only in one dimension. This heterogeneity in image concerns yields interesting insights which are absent in one-dimensional models while keeping their results nested as special cases. In contrast to previous work, I do not impose any restriction on the correlation between both dimensions. Rayo (2013) extends a Mussa-Rosen type model of quality provision to allow for heterogeneous image motivation but assumes that marginal utility from quality and image are proportional to each other. This assumption implies that consumer heterogeneity can be captured by one dimension and it thereby precludes distortions in quality provision other than those well-known from the literature on one-dimensional

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<sup>26</sup>In particular with respect to food and clothes, which are necessary goods and purchased by (almost) everybody, this assumption seems a reasonable simplification.

<sup>27</sup>This also contrasts with models of prosocial behavior where individuals can choose their desired level of prosocial activity and thereby their signal freely (e.g. Bénabou and Tirole, 2006).

screening. Pooling occurs if and only if the monopolist's marginal revenue function is somewhere decreasing in consumer type.<sup>28</sup> My model illustrates a different reason for pooling, namely that marginal utilities in both dimensions are not aligned.<sup>29</sup> If image and quality concerns are perfectly positively correlated this corresponds to the proportionality assumption in Rayo (2013), the hazard rate condition is trivially fulfilled, and pooling does not occur in my model either. Similarly, if everyone values image, my model's predictions are consistent with Vikander (2011) who assumes that all consumers care about status to the same degree but differ in intrinsic preference for the good in question.

By adding another preference parameter to a conspicuous consumption model, my model contributes to the literature on two-dimensional screening. In contrast to classical models of quality provision in the line of Mussa and Rosen (1978) and Maskin and Riley (1984), the monopolist here faces a two-dimensional screening problem. Types are binary in both dimensions as in the introduction to two-dimensional screening by Armstrong and Rochet (1999). In contrast to Armstrong and Rochet (1999), image as the additional product characteristic cannot be chosen freely in my model. The monopolist faces the additional restriction that image must be consistent with consumers' purchasing choices. He offers a product menu and lets consumers self-select (second-degree price discrimination). Thus, the monopolist manipulates signaling possibilities and images in the market through his product offers. In my model, pooling occurs generically and for reasons different from the bunching condition in standard screening models. Due to the heterogeneity in image concerns, allocating image is not a zero-sum game anymore. Pooling is then a tool to create value in the form of image to consumer types who value image but who by themselves do not contribute to a positive image.

While I model images as signals about a consumer's type, others model image as a consumption externality which depends only on the number of consumers (e.g. Pastine and Pastine, 2002; Amaldoss and Jain, 2011; Buehler and Halbheer, 2012). In those models, image is not related to the average consumer type who buys a certain product but image is simply a function of the number of consumers who purchase the product. In this approach, some authors distinguish "snobs" (Leibenstein, 1950) who prefer to consume in a small group and followers who gain utility the more others consume the

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<sup>28</sup>This corresponds to a violation of the often made assumption that the hazard rate of the type distribution is increasing. In such a case pooling occurs also in the absence of image motivation. Bolton and Dewatripont (2004) discuss this phenomenon as "bunching and ironing" (p. 88ff).

<sup>29</sup>Note the similarity to a bundling problem. If the correlation between the individual valuations for the two commodities or dimensions are not too strongly positive, bundling is the optimal strategy for the monopolist (e.g. Bolton and Dewatripont, 2004, p. 210).



same product. The signaling approach is more general: Corneo and Jeanne (1997) show that status concerns can induce a follower and a snob effect as in Leibenstein (1950).

## 8. Conclusion

In this paper, I analyze quality provision and prices under the assumption that individuals differ in their valuation of quality as well as in their interest in social image. Assuming that consumers can derive utility from the quality of a product or the social image attached to it, I derive the optimal product line offered by a monopolist for any combination of four types of consumers and compare it to a perfectly competitive market with respect to welfare and quality provision.

When image concerns are sufficiently strong, ignoring image concerns does not maximize either welfare or monopoly profits but instead product offers are distorted to take consumers' signaling desire into account. Even though not justified by heterogeneous valuations of quality, different quality levels can be sold in equilibrium to accommodate heterogeneous image concerns. By introducing a low quality product, the monopolist creates value in the form of the associated image and thereby manages to sell to more consumers. However, doing so may even decrease total quality provision. In a competitive market, consumers' image concerns also induce differentiated product purchases. In contrast to the monopoly case, consumers use inflated quality as a functional excuse to separate from others and improve their image. Consequently, total quality provision increases. The competitive outcome of separation via inflated quality is less efficient than separation in monopoly which is induced through menu restrictions. Therefore, welfare is higher in monopoly than in competition for generic sets of parameters.

Contrary to what one might expect, image concerns do not always increase the provision of quality. Instead, the monopolist tailors to image concerns by increasing prices for those consumers who are willing to pay a premium for the image in addition to the price for quality. To charge as high an image premium as possible on the highest quality product, the producer may either offer a low quality alternative and thus depress average quality or reduce the market to an exclusive high-price product. Thus, if quality is considered a public good, as seems reasonable when we talk about quality as representing working standards, environmentally friendly production methods, or other components of CSR, image concerns can be detrimental. If advertising these causes or campaigns which are intended to raise awareness do not increase consumers' intrinsic interest but raise only their image concerns, such publicity campaigns can induce a reduction in the

total provision of the public good. Under competition, however, quality provision never decreases when image concerns increase. Even though competition leads to higher total consumption of quality, welfare may be lower than in monopoly if the cost of providing quality as well as the utility provided through image are taken into account.

The predictions for the monopoly case in my model depend on how both motivations are correlated. However, little research has investigated heterogeneity in image concerns. In related work (Friedrichsen and Engelmann, 2013), we conduct laboratory experiments to test whether intrinsically motivated individuals exhibit stronger or less pronounced image concerns when it comes to buying Fairtrade chocolate. We find evidence for a negative relationship, i.e. those who do not value Fairtrade chocolate intrinsically exhibit stronger image concerns.

## Appendix

### A. Proofs

In the proofs, I refer to unconcerned consumers as type 00, to purely image-concerned consumers as type 01, to purely quality-concerned consumers as type 10, and to consumers who value both quality and image as type 11. In the one-dimensional benchmarks, type 0 refers to consumers with  $\sigma = 0$  and type 1 to consumers with  $\sigma = 1$ . Participation and incentive constraints are indexed correspondingly. The non-participation corresponds to a product  $(0,0)$ , the image of which might be positive. I index images, qualities, and prices within a menu by L and H to indicate that these values belong to, respectively, the ‘low’ and ‘high’ product, where the ranking is based on the image. To simplify notation define  $\lambda_1 := \frac{\alpha_n(1-\beta)+\beta}{\beta}$  and  $\lambda_2 := \frac{\alpha_n(1-\beta)+(1-\alpha_s)\beta}{(1-\alpha_s)\beta}$ .

#### Proof of Lemma 3

*Proof.* Suppose the monopolist offers a **separating** contract and that given this contract the preferred equilibrium of the monopolist is played. Due to separation  $R_1 = 1$  and  $R_0 = 0$ . In analogy to the case without image motivation, by profit maximization type 0’s participation constraint and type 1’s incentive compatibility constraint bind:  $p_0 = 0 \cdot s_0 + \lambda R_0 = 0$  and  $p_1 = 1 \cdot s_1 - (1 - 0)s_0 + \lambda(R_1 - R_0) = s_1 - s_0 + \lambda$ .

The maximization problem becomes

$$\max_{s_0, s_1} \beta(s_1 - s_0 + \lambda - \frac{1}{2}s_1^2) + (1 - \beta)(-\frac{1}{2}s_0^2).$$

Taking derivatives and observing that quality cannot be negative gives

$$\begin{aligned}\beta(1 - s_1) &= 0 \Rightarrow s_1^* = 1 \\ -\beta - (1 - \beta)s_0 &< 0 \Rightarrow s_0^* = 0.\end{aligned}$$

Prices are  $p_1^* = 1 + \lambda$  and  $p_0^* = 0$ . It is easily seen that the participation constraint of type 1 and the incentive compatibility constraint of type 0 are fulfilled at these values. The profit corresponding to the separating menu is  $\Pi^S = \frac{\beta}{2} + \beta\lambda > 0$ . Profit decreases with imperfect separation since then consumers of type 1 do not buy, the image of non-participation becomes positive, and therefore those who do buy pay less.

Suppose there is full **pooling**, i.e. the same product  $(s, p) \neq (0, 0)$  is bought by all consumers. The participation constraint of type 0 is the strictest and thus binds:  $p = 0 \cdot s + \lambda(\beta 1 + (1 - \beta)0 - R_0) = \lambda(\beta - R_0)$ . Since the outside good is chosen only out of equilibrium, the consumption stage has a continuum of equilibria with associated images  $R_0 = E[\sigma|(0, 0)] \in [0, \beta]$ . Obviously, the monopolist's profit from pooling is largest for  $R_0 = 0$ . In this case profit maximization gives  $s^* = 0$  and  $p^* = \beta\lambda$ . The corresponding profit is  $\Pi^P = \beta\lambda < \Pi^S$ . Profits are just shifted upwards by  $\lambda\beta$  as compared to the situation without image motivation. The equilibrium offer is separating. If non-participation is associated with higher image out of equilibrium, profits will be even lower and thus pooling is not optimal.<sup>30</sup>  $\square$

### Proof of Lemma 1

*Proof.* Suppose the monopolist offers  $\mathcal{M} \subset \mathbb{R}_{\geq 0}^2$ . Denote by  $(s, p)^*$  the product in  $\mathcal{M}$  which maximizes  $s - p$ . Assume without loss of generality that the maximizer is unique.<sup>31</sup> Then type 10 buys this product. Note that unconcerned consumers who do value neither quality nor image,  $\sigma = \rho = 0$  decide not to buy from the monopolist for

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<sup>30</sup>Note that after the separating contract has been offered, there is another equilibrium in the consumer game. High type consumers could collectively deviate to buying the lower quality thereby realizing higher utility since then  $R(0, 0) = \beta$ . Since the monopolist would in this case make zero profits, offering this menu cannot be optimal for the monopolist so that I do not have to consider it further. The same argument applies to equilibria where only a fraction of consumers coordinates. I discuss contracts which are robust against consumer coordination in Friedrichsen (2013a).

<sup>31</sup>If there were two maximizers  $(s, p) \neq (s', p')$ , in the consumption stage two equilibria exist where consumers behave as if  $(s, p)$  or  $(s', p')$  was the unique maximizer of  $s - p$  and ignore the other one. Possibly the consumption stage has mixed strategy equilibria in addition. Note, however, that the monopolist is always better off including only one of the two products in the menu, namely the one that yields a higher profit margin  $p - \frac{1}{2}s^2$ .

any positive price. Thus, non-participation  $(0,0)$  always occurs in equilibrium and its image is restricted by Bayes' rule.

Let beliefs be such that  $R(s,p) = 0$  for all  $(s,p) \in \mathcal{M}$  with  $(s,p) \neq (s,p)^*$  and  $R((s,p)^*) > 0$ . Then,  $(s,p)^* = b_{\mathcal{M}}(10) = b_{\mathcal{M}}(11)$ . Furthermore,  $(0,0) = b_{\mathcal{M}}(00)$ .

Finally,

$$b_{\mathcal{M}}(01) = \begin{cases} (0,0) & \text{if } \lambda < R((s,p)^*)^{-1}p \\ \in \{(0,0), (s,p)^*\} & \text{if } \lambda = R((s,p)^*)^{-1}p \\ (s,p)^* & \text{if } \lambda > R((s,p)^*)^{-1}p \end{cases}$$

I distinguish two cases:

**Case 1:** Suppose  $(s,p)^* \neq (0,0)$ . Then, for  $\lambda < \frac{\beta}{\beta + \alpha_n(1-\beta)}$  and for  $\lambda > 1$ , a pure strategy equilibrium in the consumer game exists. For  $\lambda < \frac{\beta}{\beta + \alpha_n(1-\beta)}$ , types 10 and 11 buy  $(s,p)^*$  and type 00 and 01 do not buy. For  $\lambda > 1$ , types 10, 11, and 01 buy  $(s,p)^*$  and type 00 does not buy. For  $\frac{\beta}{\beta + \alpha_n(1-\beta)} \leq \lambda \leq 1$ , a mixed strategy equilibrium exists, where types 10, 11 and fraction  $q$  of type 01 buy. Type 00 and fraction  $(1-q)$  of type 01 do not buy. The mixing probability is given by  $q = \frac{(\lambda-p)\beta}{p\alpha_n(1-\beta)}$ .

**Case 2:** Suppose  $(s,p)^* = (0,0)$ . Then, the consumption stage has a pure strategy equilibrium in which no consumer buys but all choose  $(0,0)$ .  $\square$

## Proof of Proposition 1

*Proof.* I first prove that the monopolist will offer at most two products different from the non-participation option. Remember that for expositional reasons the latter,  $(0,0)$  is always part of the product menu  $\mathcal{M}$ . Second, I exclude all but four partitions of consumers on products as inconsistent with profit maximization in Lemma A2. Third, I derive the prices and qualities which maximize the monopolist's profit subject to the corresponding incentive compatibility and participation constraints *given* each of the four partitions in Lemmas A3 to A6. For ease of exposition I introduce the names for the equilibrium candidates already in Lemma A2. Later, these names refer only to the equilibrium candidates which remain in Proposition 1.

**Lemma A1.** *The monopolist offers at most 2 products and non-participation  $(0,0)$ .*

*Proof.* Suppose the monopolist offers  $(0,0)$ ,  $(s_L, p_L)$ ,  $(s_H, p_H)$ , where  $(s_L, p_L) \neq (s_H, p_H)$  and both are different from non-participation. Suppose further there is a pure-strategy equilibrium in the consumer game, where type 00 takes  $(0,0)$ , type 10 and 01 take  $(s_L, p_L)$ , and type 11 takes  $(s_H, p_H)$  and profit is maximal in the set of 2 product menus

with voluntary participation. I show (by contradiction) that the monopolist cannot increase profits by offering a third (non-zero) product  $(s', p') \notin \{(s_L, p_L), (s_H, p_H)\}$ . By Corollary 1 a menu with 3 products and non-participation involves randomization of at least one consumer type and (partial) pooling. Type 00 always takes  $(0, 0)$ .

(i) Suppose a single type  $\sigma\rho \in \{01, 10, 11\}$  randomizes over  $(s', p')$  and his original choice. Type 01 alone would not buy  $(s', p')$  because it has zero image. Type 10 or 11 only randomizes if  $s' - p' = s_i - p_i$  for  $i = L, H$ , respectively. But if  $(s', p')$  gives higher per unit profit, the original offer was not optimal.

(ii) Suppose types 11 and 10 buy  $(s', p')$ . Then,  $R(s', p') = R(s_H, p_H) = 1$ . For type 10 it must hold that  $p_L - p' = s_L - s'$ , for type 11  $p_H - p' = s_H - s'$ . These imply  $p_H = p_L + (s_H - s_L)$ . The participation constraint of type 10,  $p_L \leq s_L$ , yields  $p_H \leq s_H$  and  $p' \leq s'$ . At the profit maximum both bind and quality is  $s' = s_H$ . But then  $p' = p_H$ .

(iii) Suppose  $(s', p')$  is bought by types 11 and 01. Then  $p' \leq R(s', p')$  and profit would increase if type 10 bought  $(s', p')$  too to increase the feasible price  $R(s', p')$  (see Lemma A2). This does not maximize profits either as shown in Lemma A8.

(iv) Suppose types 10 and 01 buy  $(s', p')$  and thus  $R(s', p') \in (0, 1)$ . Assume that  $R(s', p') > R(s_L, p_L)$ . Then, incentive compatibility and profit maximization yield  $s_L = \min\{\lambda(R(s_L, p_L) - R_0), 1\} \leq 1$  and  $p_L = s_L$  as well as  $s' = \min\{\lambda(R(s', p') - R(s_L, p_L)), 1\} \leq 1$  and  $p' = s'$ . Since costs are convex in  $s$ , profit from types 10 and 01 is concave in  $s$  and is highest if only one product is offered to types 01 and 10.

(v) Suppose  $(s', p')$  is bought by types 11, 10 and 01. According to Lemma A8 the original menu  $(0, 0)$ ,  $(s_L, p_L)$ ,  $(s_H, p_H)$  must yield higher profit.

The same arguments apply for offering several additional products. Since it is not profitable to introduce an additional product into the two-product menu, it is not profitable to offer even more products.  $\square$

**Lemma A2.** *If the monopolist maximizes profits, the equilibrium features one of the following four consumer partitions ( $s, s_L, s_H > 0$  and  $p, p_L, p_H > 0$ ): **Standard good** - types 10 and 11 buy  $(s, p)$ , others  $(0, 0)$ . **Mass market** - types 01, 10, and 11 buy  $(s, p)$ , others  $(0, 0)$ . **Image building** - types 01 and 10 buy  $(s_L, p_L)$ , type 11 buys  $(s_H, p_H)$ , others  $(0, 0)$ . **Exclusive good** - type 11 buys  $(s, p)$ , others  $(0, 0)$ .*

*Proof.* First, Lemma 2 states an equilibrium candidate which offers strictly positive profit under heterogeneous image concerns. Any other equilibrium candidate must offer strictly positive profit. Second, type 00 chooses  $(0, 0)$  in any equilibrium since she values neither quality nor image. Further, it is always profitable to sell  $s > 0$  to type 11. Thus,

no equilibrium candidate can pool these two types. Third, type 01 does not buy if her image is zero but she only buys if she is pooled with type 10 or type 11.

Finally, in equilibrium type 01 and type 11 choose the same product *only* if type 10 chooses the same product. Suppose to the contrary that the monopolist offers  $(s_P, p_P)$  to types 01 and 11, a different product  $(s_{10}, p_{10})$  to type 10 and type 00 chooses  $(0, 0)$ . I consider two separate cases.

**Case 1:**  $(s_{10}, p_{10}) = (0, 0)$ . Then,  $R(0, 0) = \frac{\beta(1-\alpha_s)}{(1-\beta)(1-\alpha_n)+\beta(1-\alpha_s)}$ , whereas the product  $(s_P, p_P)$ —chosen by consumers of types 11 and 01—has  $R(s_P, p_P) = \frac{\beta\alpha_s}{(1-\beta)\alpha_n+\beta\alpha_s}$ . The maximum price  $s_P$  is determined by type 01's participation constraint,  $\lambda R(s_P, p_P) - p_P \geq R(0, 0)$ . If this is fulfilled, type 11's participation constraint is automatically fulfilled. Thus,  $p_P = \lambda(R(s_P, p_P) - R(0, 0))$  and the optimal prize is independent of quality. Since quality is costly, the monopolist sets  $s_P = 0$  and profit from pooling types 01 and 11 is at most  $\Pi^* = (\beta\alpha_s + (1-\beta)\alpha_n)\lambda(\frac{\beta\alpha_s}{(1-\beta)\alpha_n+\beta\alpha_s} - \frac{\beta(1-\alpha_s)}{(1-\beta)(1-\alpha_n)+\beta(1-\alpha_s)})$ . Selling instead only to type 11 allows to sell  $(s, p) = (1, 1 + \lambda(1 - \frac{\beta(1-\alpha_s)}{1-\alpha_s\beta}))$  and obtain profits  $\Pi^E = \beta\alpha_s(1 + \lambda(1 - \frac{\beta(1-\alpha_s)}{1-\alpha_s\beta})) - \frac{1}{2}$ . Profit from only selling to type 11 strictly dominates profits from the offer that pools type 01 and 11:

$$\begin{aligned}\Pi^E - \Pi^* &> \frac{\alpha_s\beta}{2} - \alpha_s\beta\lambda\frac{\beta(1-\alpha_s)}{1-\alpha_s\beta} + (\beta\alpha_s + (1-\beta)\alpha_n)\lambda\frac{\beta(1-\alpha_s)}{1-\alpha_s\beta} \\ &= \frac{\alpha_s\beta}{2} + (1-\beta)\alpha_n\lambda\frac{\beta(1-\alpha_s)}{1-\alpha_s\beta} > 0\end{aligned}$$

**Case 2:** Suppose  $(s_{10}, p_{10}) \neq (0, 0)$ . Then, consumers obtain images  $R(0, 0) = 0$ ,  $R(s_P, p_P) = \frac{\beta\alpha_s}{(1-\beta)\alpha_n+\beta\alpha_s}$ , and  $R(s_{10}, p_{10}) = 1$ . Incentive compatibility for purely quality-concerned consumers requires  $s_P - p_P = s_{01} - p_{01} \leq s_{10} - p_{10}$  which implies by  $R(s_P, p_P) < 1$  that  $s_P + \lambda R_P - p_P = s_{11} + \lambda R_{11} - p_{11} < s_{10} + \lambda - p_{10} = s_{10} + \lambda R_{10} - p_{10}$ . This violates incentive compatibility for consumers of type 11.  $\square$

To further restrict the set of equilibrium candidates, the following four lemmas characterize the offers which—for a given partition—give the highest profit.

**Lemma A3.** *In **standard good**, the monopolist maximizes profits by offering*

$$(s, p) = \begin{cases} (1, 1) & \text{if } \lambda \leq 1 \\ (\lambda, \lambda) & \text{if } \lambda > 1 \end{cases}$$

*for  $\lambda \leq 2$ . If  $\lambda > 2$  a standard good cannot be profitably sustained.*

*Proof.* Denote the product offered by the monopolist by  $(s, p)$  with  $s, p > 0$  and the image corresponding to it by  $R$ . Types 01 and 00 are not willing to pay for quality, do not buy, and obtain an image of zero  $R(0, 0) = 0$ . Type 10 buys  $(s, p)$  if  $s - p \geq 0$ . Type 11 receive additional image utility and buys too. As profit increases in  $p$ ,  $s = p$ . To prevent type 01 from buying  $(s, p)$ , it has to fulfill  $\lambda R(0, 0) \geq \lambda R - p = \lambda R - s$ . The monopolist chooses  $s$  to maximize  $\beta(s - \frac{1}{2}s^2)$  such that  $s \geq \lambda R = \lambda$ . If the separation is sustained  $R = 1$  and thus,  $s = \max\{1, \lambda\}$ . If image concern is more than twice as large as marginal utility from quality,  $\lambda > 2$ , a standard good menu is not feasible anymore. Hindering type 01 from buying would require a quality so high that profit is negative.  $\square$

**Lemma A4.** *In **mass market**, the monopolist maximizes profits by offering*

$$(s, p) = \begin{cases} (\lambda R, \lambda R) & \text{if } \lambda \leq R^{-1} \\ (1, 1) & \text{if } \lambda > R^{-1} \end{cases}.$$

*Proof.* Type 00 does not buy and receives image  $R(0, 0) = 0$ . The remaining group has image  $R = \frac{\beta}{\beta + \alpha_n(1 - \beta)}$ . Incentive compatibility for types 01 and 10 requires  $p \leq \min\{\lambda R, s\}$ . If these hold, incentive compatibility for type 11 follows. Since profit is increasing in price and a higher  $p$  does not violate any other constraint,  $p = \min\{\lambda R, s\}$ .

I show in two steps that profit maximization requires  $s \leq \min\{\lambda R, 1\}$ . Since profit is increasing in  $s$  for  $s \leq 1$  this implies  $s = \min\{\lambda R, 1\}$ .

**Step 1:** Show that  $s \leq \lambda R$ . Suppose to the contrary  $s > \lambda R$ . Consider an alternative product  $(s', p') = (\lambda R, \lambda R)$  which offers lower quality at the same price. Incentive compatibility is still fulfilled and profit increases by  $\Delta\Pi = (\beta + \alpha_n(1 - \beta))(-\frac{1}{2}(\lambda R)^2 + \frac{1}{2}s^2)$ . Since  $s > \lambda R$  by assumption,  $\Delta\Pi > 0$  contradicting optimality.

**Step 2:** Show that  $s \leq 1$ . From step 1 we know  $s \leq \lambda R$  and therefore  $p = s$ . I distinguish two cases depending on the size of  $\lambda$ . Suppose first  $\lambda \leq R^{-1}$ . In this case  $\lambda R \leq 1$  and part 1 applies. Suppose now  $\lambda > R^{-1}$ . Then,  $\lambda R > 1$ . The monopolist chooses  $s$  to maximize  $(\beta + \alpha_n(1 - \beta))(s - \frac{1}{2}s^2)$  such that  $s \leq \lambda R$ . Since  $\lambda R > 1$ , the optimal high quality is unconstrained and thus  $s = 1$ .  $\square$

**Lemma A5.** *In **image building**, the monopolist maximizes profits by offering*

$$(s_L, p_L) = \begin{cases} (\lambda R_L, \lambda R_L) & \text{if } \lambda \leq R_L^{-1} \\ (1, 1) & \text{if } \lambda > R_L^{-1} \end{cases} \text{ and } (s_H, p_H) = \left(1, 1 + \lambda \frac{\alpha_n(1 - \beta)}{(1 - \alpha_s)\beta + \alpha_n(1 - \beta)}\right)$$

*Proof.* Type 00 does not buy and  $R(0,0) = 0$ . The group of types 10 and 01 receives image  $R_L = \frac{\beta(1-\alpha_s)}{(1-\alpha_s)\beta + \alpha_n(1-\beta)}$  and type 11 gets image  $R_H = 1$ . Incentive compatibility for type 11 requires  $s_H + \lambda R_H - p_H \geq s_L + \lambda R_L - p_L$  which is equivalent to

$$(6) \quad p_H \leq p_L + \lambda \frac{\alpha_n(1-\beta)}{(1-\alpha_s)\beta + \alpha_n(1-\beta)} + s_H - s_L$$

Participation of 10 and 01 requires  $p_L \leq \min\{\lambda R_L, s_L\}$  and their buying the low product is incentive compatible if  $s_L - p_L \geq s_H - p_H$  and  $\lambda R_L - p_L \geq \lambda R_H - p_H$ . Profit increases in  $p_H$  and all other constraints are relaxed if the price for high quality goes up. Thus, (6) binds and  $p_H = p_L + \lambda \frac{\alpha_n(1-\beta)}{(1-\alpha_s)\beta + \alpha_n(1-\beta)} + s_H - s_L$ . Then, price is chosen as high as possible at  $p_L = \min\{\lambda R_L, s_L\}$ . I show in two steps that profit maximization requires  $s_L \leq \min\{\lambda R_L, 1\}$ . Since profit is increasing in  $s$  for  $s \leq 1$  this implies  $s_L = \min\{\lambda R_L, 1\}$ .

**Step 1:** Show that  $s_L \leq \lambda R_L$ . Suppose instead that  $s_L > \lambda R_L$ . Consider an alternative product  $(s', p') = (\lambda R_L, \lambda R_L)$  which offers lower quality at the same price. Adjust the price of the high quality product by the same amount if necessary to ensure incentive compatibility. Profit increases by at least  $\Delta\Pi = (\beta(1-\alpha_s) + (1-\beta)\alpha_n)(-\frac{1}{2}(\lambda R_L)^2 + \frac{1}{2}(s_L)^2)$ . Since  $s_L > \lambda R_L$ ,  $\Delta\Pi > 0$ . Any change in price and quality for type 11 (ignored here) increases profits further. Thus, the original product offer was not optimal.

**Step 2:** Show that  $s_L \leq 1$ . By step 1  $s_L \leq \lambda R_L$  and therefore  $p_L = s_L$ . I distinguish two cases depending on  $\lambda$  and show that  $s_L = 1 < \lambda R_L$  is optimal if  $\lambda > R_L^{-1}$  and  $s_L = \lambda R_L$  otherwise. Suppose first that  $\lambda \leq R_L^{-1}$ . Then,  $\lambda R_L \leq 1$  and by step 1 the claim is true. Suppose now  $\lambda > R_L^{-1}$ . Then,  $\lambda R_L > 1$ . Thus, I have  $p_L = s_L$  and  $p_H = \lambda \frac{\alpha_n(1-\beta)}{(1-\alpha_s)\beta + \alpha_n(1-\beta)} + s_H$ .

Using these values, the monopolist chooses  $s_L, s_H$  to maximize

$$(\beta(1-\alpha_s) + (1-\beta)\alpha_n)(s_L - \frac{1}{2}s_L^2) + \beta\alpha_s(\lambda \frac{\alpha_n(1-\beta)}{(1-\alpha_s)\beta + \alpha_n(1-\beta)} + s_H - \frac{1}{2}s_H^2).$$

This yields  $s_L = s_H = 1$  and  $p_L = 1 < 1 + \lambda \frac{\alpha_n(1-\beta)}{(1-\alpha_s)\beta + \alpha_n(1-\beta)} = p_H$ . □

**Lemma A6.** *In **exclusive market**, the monopolist maximizes profits by offering*

$$(s, p) = (1, 1 + \lambda \frac{1-\beta}{1-\alpha_s\beta}).$$

*Proof.* If we require 00, 01, and 10 to make the same choice, it must be that none of them buys since 00 will never buy. The group's image is positive,  $R(0,0) = \frac{(1-\alpha_s)\beta}{1-\alpha_s\beta} < 1$ . Type 11 has image  $R_H = 1$ . Incentive compatibility for 11 requires  $p_H \leq s_H + \lambda(R_H - R_L) =$



$s_H + \lambda \frac{1-\beta}{1-\alpha_s\beta}$ . For 10 not to prefer 11's product requires  $s_H \leq p_H$  and for 01 incentive compatibility requires  $p_H \geq \lambda(R_H - R_L)$ . Both are relaxed if  $p_H$  increases and profit goes up. Thus,  $p_H = s_H + \lambda(R_H - R_L)$ .

The profit maximization problem of the monopolist becomes

$$\max_{s_H} \Pi = \beta \alpha_s (s_H + \lambda \frac{1-\beta}{1-\alpha_s\beta} - \frac{1}{2} s_H^2)$$

The profit maximizing choice is  $s_1^* = 1$  and  $p_1 = 1 + \lambda \frac{1-\beta}{1-\alpha_s\beta}$ .  $\square$

Lemmas A2, A3, A4, A5, and A6 together constitute the proof of Proposition 1.  $\square$

## Proof of Proposition 2

*Proof.* I first characterize the profit functions associated with each equilibrium candidate, then exclude mass market from consideration, and finally compare profits across the remaining equilibrium candidates to identify which maximizes profit.

**Lemma A7.** (i) Profit in standard good ( $\Pi^S$ ) is constant for  $\lambda < 1$  and decreasing and concave for  $\lambda \geq 1$ . (ii) Profit in image building ( $\Pi^I$ ) is increasing and concave for  $\lambda < \frac{\alpha_n(1-\beta)+(1-\alpha_s)\beta}{(1-\alpha_s)\beta}$  and linearly increasing for  $\lambda > \frac{\alpha_n(1-\beta)+(1-\alpha_s)\beta}{(1-\alpha_s)\beta}$ . (iii) Profit in exclusive good ( $\Pi^E$ ) is linearly increasing.

*Proof.* Lemmas A3, A5, and A6 yield the following profit functions:

$$(7) \quad \Pi^S = \begin{cases} \frac{\beta}{2} & \text{if } \lambda \leq 1 \\ \beta \left( \lambda - \frac{\lambda^2}{2} \right) & \text{otherwise} \end{cases}$$

$$(8) \quad \Pi^I = \begin{cases} \frac{\beta(\alpha_n(1-\beta)(\alpha_s+2\lambda)+(1-\alpha_s)\beta(\alpha_s(1-\lambda)^2+(2-\lambda)\lambda))}{2\alpha_n+2(1-\alpha_n-\alpha_s)\beta} & \text{if } \lambda \leq \lambda_2 \\ \frac{1}{2}(\beta + \alpha_n(1-\beta)) + \frac{\alpha_n\alpha_s(1-\beta)\beta\lambda}{(1-\alpha_s)\beta+\alpha_n(1-\beta)} & \text{otherwise} \end{cases}$$

$$(9) \quad \Pi^E = \alpha_s\beta \left( \frac{1}{2} + \frac{(1-(1-\alpha_s)\beta - \alpha_s\beta)\lambda}{1-\alpha_s\beta} \right)$$

From these I derive

$$\begin{aligned}
\frac{\partial \Pi^S}{\partial \lambda} &= \begin{cases} 0 & \text{if } \lambda \leq 1 \\ \beta(1-\lambda) < 0 & \text{if } \lambda \geq 1 \end{cases} & \frac{\partial^2 \Pi^S}{\partial \lambda^2} &= \begin{cases} 0 & \text{if } \lambda \leq 1 \\ -\beta < 0 & \text{if } \lambda \geq 1 \end{cases} \\
\frac{\partial \Pi^I}{\partial \lambda} &= \begin{cases} \frac{\beta(\alpha_n(1-\beta)+(1-\alpha_s)^2\beta(1-\lambda))}{\alpha_n+(1-\alpha_n-\alpha_s)\beta} > 0 & \text{if } \lambda \leq \lambda_2 \\ \frac{\alpha_n\alpha_s(1-\beta)\beta}{\alpha_n+(1-\alpha_n-\alpha_s)\beta} > 0 & \text{if } \lambda \geq \lambda_2 \end{cases} & \frac{\partial^2 \Pi^I}{\partial \lambda^2} &= \begin{cases} \frac{(1-\alpha_s)^2\beta^2}{-\alpha_n-(1-\alpha_n-\alpha_s)\beta} < 0 & \text{if } \lambda \leq \lambda_2 \\ 0 & \text{if } \lambda \geq \lambda_2 \end{cases} \\
\frac{\partial \Pi^E}{\partial \lambda} &= \frac{\alpha_s(1-\beta)\beta}{1-\alpha_s\beta} > 0 & \frac{\partial^2 \Pi^E}{\partial \lambda^2} &= 0
\end{aligned}$$

□

**Lemma A8.** *Offering a mass market product, i.e. a product which attracts all but the ignorant consumers, is never optimal for the monopolist.*

*Proof.* Profit from the image building menu  $\Pi^I$  is given in equation 8. From Lemma A4, I compute profit in the mass market as

$$(10) \quad \Pi^M = \begin{cases} \frac{1}{2}\beta\lambda \left(2 - \frac{\beta\lambda}{\beta+\alpha_n(1-\beta)}\right) & \text{if } \lambda \leq \lambda_1 \\ \frac{1}{2}(\alpha_n(1-\beta) + \beta) & \text{otherwise} \end{cases}$$

Suppose  $\lambda \leq \lambda_1$ . Rearranging terms in the profit functions (see Lemma A7) yields

$$\Pi^I - \Pi^M > 0 \Leftrightarrow \lambda^2 \frac{\alpha_s\beta^2(\alpha_n(2-\alpha_s)(1-\beta)+\beta-\alpha_s\beta)}{2(\alpha_n(1-\beta)+\beta)((1-\alpha_s)\beta+\alpha_n(1-\beta))} - \lambda \frac{(1-\alpha_s)\alpha_s\beta^2}{(1-\alpha_s)\beta+\alpha_n(1-\beta)} + \frac{\alpha_s\beta}{2} > 0$$

The discriminant of the quadratic expression in  $\lambda$  is negative since  $\alpha_s, \alpha_n, \beta \in (0, 1)$  by Assumption 2. Thus, the expression does not have a real root. Since the coefficient of the quadratic term is positive,  $\Pi^I > \Pi^M$  for all  $\lambda \geq 0$ .

Suppose  $\lambda_1 < \lambda \leq \lambda_2$ .

$$\begin{aligned}
\Pi^I - \Pi^M &> 0 \\
\Leftrightarrow -\lambda^2 \frac{((1-\alpha_s)\beta)^2}{2((1-\alpha_s)\beta+\alpha_n(1-\beta))} + \lambda \frac{((1-\alpha_s)\beta)^2+(1-\alpha_s)\beta\alpha_n(1-\beta)+\alpha_n(1-\beta)\alpha_s\beta}{(1-\alpha_s)\beta+\alpha_n(1-\beta)} - \frac{(1-\alpha_s)\beta+\alpha_n(1-\beta)}{2} &> 0
\end{aligned}$$

The left-hand side corresponds to a parabolic function in  $\lambda$  which opens downwards and has two roots, which enclose the interval  $(\lambda_1, \lambda_2]$ . Thus, for  $\lambda_1 < \lambda \leq \lambda_2$ , it takes only positive values and  $\Pi^I > \Pi^M$ .

Suppose  $\lambda > \lambda_2$ . In this case,  $\Pi^I - \Pi^M = \frac{\alpha_n\alpha_s(1-\beta)\beta\lambda}{(1-\alpha_s)\beta+\alpha_n(1-\beta)} > 0$ . □

**Derivation of  $\tilde{\lambda}_m$ :**

For  $\lambda \geq 1$ ,  $\Pi^S$  is decreasing in  $\lambda$ ,  $\Pi^M$  is increasing in  $\lambda$ , and at  $\lambda = 1$   $\Pi^M > \Pi^S$  (equations 7 and 10). By Lemma A8  $\Pi^M$  is never maximal and therefore  $\tilde{\lambda}_m < 1$ .

Suppose  $\lambda < 1$ . Rearranging terms gives

$$\Pi^S \geq \Pi^I \Leftrightarrow \lambda^2 - \lambda \frac{2(\alpha_n(1-\beta) + (1-\alpha_s)^2\beta)}{(1-\alpha_s)^2\beta} + \frac{\alpha_n + (1-\alpha_s - \alpha_n)\beta}{(1-\alpha_s)\beta} \geq 0$$

This expression has two roots  $\lambda^{(1),(2)} = 1 + \frac{\alpha_n(1-\beta)}{(1-\alpha_s)^2\beta} \pm \frac{\sqrt{\alpha_n(1-\beta)(\alpha_n(1-\beta) + (1-\alpha_s)^2(1+\alpha_s)\beta)}}{(1-\alpha_s)^2\beta}$  and it is easy to see that  $\lambda^{(1)} < 1 < \lambda^{(2)}$  so that we have

$$(11) \quad \Pi^S \geq \Pi^I \text{ if } \lambda \leq \lambda^{(1)} = 1 + \frac{\alpha_n(1-\beta)}{(1-\alpha_s)^2\beta} - \frac{\sqrt{\alpha_n(1-\beta)(\alpha_n(1-\beta) + (1-\alpha_s)^2(1+\alpha_s)\beta)}}{(1-\alpha_s)^2\beta} =: \lambda_{SI}$$

Using the respective profit functions from equations 7 and 9 I obtain

$$(12) \quad \Pi^S \geq \Pi^E \text{ if } \lambda \leq \frac{(1-\alpha_s)(1-\alpha_s\beta)}{2\alpha_s(1-\beta)} =: \lambda_{SE}$$

Standard good is optimal if and only if it gives higher profit than image building and exclusive good,  $\tilde{\lambda}_m := \min\{\lambda_{SE}, \lambda_{SI}\}$ . Using the definitions in (11) and (12) I compute

$$(13) \quad \lambda_{SE} \leq \lambda_{SI} \Leftrightarrow \alpha_s > \frac{1}{3} \text{ and } \beta < \frac{3\alpha_s - 1}{\alpha_s + \alpha_s^2} \text{ and } \alpha_n \leq \frac{\beta(1 + \alpha_s(\beta + \alpha_s\beta - 3))^2}{4\alpha_s(1-\beta)^2}$$

and thus have

$$\tilde{\lambda}_m := \begin{cases} \frac{(1-\alpha_s)(1-\alpha_s\beta)}{2\alpha_s(1-\beta)} & \text{if 13 holds} \\ 1 + \frac{\alpha_n(1-\beta)}{(1-\alpha_s)^2\beta} - \frac{\sqrt{\alpha_n(1-\beta)(\alpha_n(1-\beta) + (1-\alpha_s)^2(1+\alpha_s)\beta)}}{(1-\alpha_s)^2\beta} & \text{otherwise} \end{cases}$$

**Derivation of  $\tilde{\lambda}_m$ :**

Suppose  $\lambda \leq \lambda_2$ .

$$(14) \quad \Pi^I \geq \Pi^E \Leftrightarrow \lambda^2 - \lambda 2 \frac{\beta(1-\alpha_s) + (1-\beta)\alpha_n - \beta\alpha_s(1-\beta\alpha_s)}{\beta(1-\alpha_s)(1-\beta\alpha_s)} \leq 0$$

The expression has two real roots  $\lambda^{(1)} = 0$  and  $\lambda^{(2)} = 2 \frac{\beta(1-\alpha_s) + (1-\beta)\alpha_n - \beta\alpha_s(1-\beta\alpha_s)}{\beta(1-\alpha_s)(1-\beta\alpha_s)}$  and it is  $\Pi^I > \Pi^E$  if  $\lambda \in [0, \min\{\lambda^{(2)}, \lambda_2\}]$ . Define for later use

$$(15) \quad \lambda_{IE, \text{low}} := \lambda^{(2)} = 2 \frac{\beta(1-\alpha_s) + (1-\beta)\alpha_n - \beta\alpha_s(1-\beta\alpha_s)}{\beta(1-\alpha_s)(1-\beta\alpha_s)}$$

Suppose now  $\lambda \geq \lambda_2$ . Rearranging terms yields

$$(16) \quad \Pi^I \geq \Pi^E \Leftrightarrow \lambda \leq \frac{1}{2} \frac{(\beta(1-\alpha_s) + (1-\beta)\alpha_n)^2(1-\beta\alpha_s)}{(1-\alpha_s)\beta^2\alpha_s(1-\beta)(1-\alpha_n)} =: \lambda_{IE,high}$$

$\Pi^I$  is concave in  $\lambda$  for  $\lambda \leq \lambda_2$ , linear thereafter and  $\Pi^E$  is linear in  $\lambda$  for all values of  $\lambda$  (Lemma A7). Furthermore, we see that  $\Pi^E|_{\lambda=0} < \Pi^I|_{\lambda=0}$ . Thus,  $\Pi^I$  crosses  $\Pi^E$  only once and from above. Therefore, the region of  $\lambda$  where image building is optimal, is an interval.<sup>32</sup> With  $\lambda_{IE,low}$  and  $\lambda_{IE,high}$  as defined in equations 15 and 16 we have

$$(17) \quad \lambda_{IE,high} \geq \lambda_2 \Rightarrow \lambda_{IE,low} \geq \lambda_2, \text{ and } \lambda_{IE,low} \leq \lambda_2 \Rightarrow \lambda_{IE,high} \leq \lambda_2 \\ \text{and } \lambda_{SE} \leq \lambda_{SI} \Rightarrow \lambda_{IE,low} \leq \lambda_{SI}$$

Using (13) and (17), I define

$$(18) \quad \tilde{\lambda}_m = \begin{cases} \lambda_{SE} & \text{if (13) holds} \\ \lambda_{IE,low} & \text{if } \lambda_{IE,low} \leq \lambda_2 \text{ and } \neg(13) \text{ holds} \\ \lambda_{IE,high} & \text{if } \lambda_{IE,high} \geq \lambda_2 \text{ and } \neg(13) \text{ hold} \end{cases}$$

□

### Proof of Corollary 3:

*Proof.* Suppose  $\alpha_s > \frac{1}{3}$  and  $\beta < \frac{3\alpha_s-1}{\alpha_s+\alpha_s^2}$  and  $\alpha_n < \frac{\beta(1+\alpha_s(\beta+\alpha_s\beta-3))^2}{4\alpha_s(1-\beta)^2}$  so that by Proposition 2 image building is never optimal. The proof is by contradiction.

Since  $\frac{\beta(1+\alpha_s(\beta+\alpha_s\beta-3))^2}{4\alpha_s(1-\beta)^2}$  is increasing in  $\beta$ , we have  $\alpha_n < \frac{(1+\alpha_s)(3\alpha_s-1)^3}{16\alpha_s}$ . Suppose  $\alpha_n \geq \alpha_s$ . The above implies  $\frac{(1+\alpha_s)(3\alpha_s-1)^3}{16\alpha_s} \geq \alpha_s \Leftrightarrow 27\alpha_s^4 - 34\alpha_s^2 + 8\alpha_s - 1 \geq 0$ . However, if  $\alpha_s > \frac{1}{3}$  then  $27\alpha_s^4 - 34\alpha_s^2 + 8\alpha_s - 1 = 27\alpha_s^2(\alpha_s^2 - 1) - 7\alpha_s(\alpha_s - 1) - 1 < 0$ . □

### Proof of Lemma 4

*Proof.* First note that there cannot be a partially pooling equilibrium at another product since purely quality-concerned consumers will always defect to buying  $(1, \frac{1}{2})$ .

Also note that for  $\lambda < \frac{1}{2} \frac{\alpha_n(1-\beta)+(1-\alpha_s)\beta}{(1-\alpha_s)\beta}$ , purely image-concerned consumers must be indifferent between buying  $(1, \frac{1}{2})$  and choosing  $(0, 0)$ . In equilibrium only a fraction  $q$  of the purely image-concerned consumers buy  $(1, \frac{1}{2})$ . The associated image is then

<sup>32</sup>The interval is empty if and only if  $\Pi^I$  crosses  $\Pi^E$  before it crosses  $\Pi^S$  ( $\lambda_{SE} \leq \lambda_{SI}$ , cf. Corollary 3).

$R(1, \frac{1}{2}, q) = \frac{\beta}{q(1-\beta)\alpha_n + \beta}$ . The indifference condition for purely image-concerned consumers (image utility equals price) pins down its participation probability  $q$  and thereby the associated image uniquely:

$$(19) \quad \lambda \frac{\beta}{q(1-\beta)\alpha_n + \beta} = \frac{1}{2} \quad \Leftrightarrow \quad q = (2\lambda - 1) \frac{\beta\alpha_s}{(2-\beta)\alpha_n}$$

The value  $q$  increases monotonically in  $\lambda$  over  $[\frac{1}{2}, \frac{1}{2} \frac{\alpha_n(1-\beta) + (1-\alpha_s)\beta}{(1-\alpha_s)\beta}]$ ; the decrease in image through increased  $q$  exactly balances the increase in the marginal value of image  $\lambda$ .

Images associated with all other products must be such that no consumer type wants to switch. This is ensured for instance by beliefs  $\mu(s', p') = 0$  for all  $(s', p') \neq (1, \frac{1}{2})$ .  $\square$

### Proof of Lemma 5

*Proof.* Suppose two products  $(1, \frac{1}{2})$  and  $(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2})$  constitute a partially separating equilibrium: type 11 buys  $(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2})$ , type 10 buys  $(1, \frac{1}{2})$ , type 00 chooses  $(0, 0)$ . Type 01 buys  $(1, \frac{1}{2})$  with probability  $q$  and chooses  $(0, 0)$  with probability  $1 - q$ , where  $q$  is given in equation 5. Images are  $R(0, 0) = 0$ ,  $R(1, \frac{1}{2}) = \frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s) + q(1-\beta)\alpha_n}$ , and  $R(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2}) = 1$ . Suppose out-of-equilibrium beliefs are  $\mu(s, p) = 0$  for all other products.

Clearly, type 10 prefers  $(1, \frac{1}{2})$  over any other product independent of beliefs.

Type 01 indeed prefers  $(1, \frac{1}{2})$  over  $(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2})$  in the proposed equilibrium if

$$(20) \quad U_{01}(1, \frac{1}{2}, R(1, \frac{1}{2})) > U_{01}(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2}, R(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2}))$$

$$\Leftrightarrow \lambda \frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s) + q(1-\beta)\alpha_n} - \frac{1}{2} > \lambda - \frac{(1+\varepsilon)^2}{2}$$

$$\Leftrightarrow \varepsilon > \underline{\varepsilon} := \sqrt{1 + 2\lambda \frac{q(1-\beta)\alpha_n}{\beta(1-\alpha_s) + q(1-\beta)\alpha_n}} - 1$$

For  $\lambda < \frac{1}{2} \frac{(1-\alpha_s)\beta + q\alpha_n(1-\beta)}{(1-\alpha_s)\beta}$ , participation of type 01 is partial since the image of the low quality product under full participation is too low to compensate for the price of  $\frac{1}{2}$ . The participation probability  $q$  of type 01 is given in Equation 5 in the main text.

Consumer type 11 prefers  $(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2})$  over  $(1, \frac{1}{2})$  if

$$\begin{aligned}
(21) \quad U_{11}(1, \frac{1}{2}, R(1, \frac{1}{2})) &< U_{11}(1 + \varepsilon, \frac{(1 + \varepsilon)^2}{2}, R(1 + \varepsilon, \frac{(1 + \varepsilon)^2}{2})) \\
&\Leftrightarrow 1 + \lambda \frac{\beta(1 - \alpha_s)}{\beta(1 - \alpha_s) + q(1 - \beta)\alpha_n} - \frac{1}{2} < 1 + \varepsilon + \lambda - \frac{(1 + \varepsilon)^2}{2} \\
&\Leftrightarrow \varepsilon < \bar{\varepsilon} := \sqrt{2\lambda \frac{q(1 - \beta)\alpha_n}{\beta(1 - \alpha_s) + q(1 - \beta)\alpha_n}}
\end{aligned}$$

It follows from (20) and (21) that there is a continuum of separating equilibria  $(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2})$  such that  $\varepsilon \in [\underline{\varepsilon}, \bar{\varepsilon}]$ . For  $\varepsilon$  too low, type 01 prefers  $(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2})$  and separation breaks down (Condition 20). For  $\varepsilon$  too large the price needed to recover the production cost exceeds consumer's willingness to pay (Condition 21).

The following beliefs sustain  $(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2})$  as an equilibrium:

$$\mu(s, p) = \begin{cases} 1 & \text{if } (s, p) = (1 + \varepsilon, \frac{(1+\varepsilon)^2}{2}) \\ \frac{\beta(1 - \alpha_s)}{\beta(1 - \alpha_s) + q(1 - \beta)\alpha_n} & \text{if } (s, p) = (1, \frac{1}{2}) \\ 0 & \text{else.} \end{cases}$$

□

### Proof of Proposition 3

*Proof.* The first claim is trivial. For  $\lambda \leq \frac{1}{2}$ , type 01 does not want to buy. Thus,  $R(1, \frac{1}{2}) = 1$  and type 11 does need to separate to obtain a better image. Thus, the pooling equilibrium **standard good** is unique. For the second part, suppose  $\lambda > \frac{1}{2}$ . I first show that among the separating equilibria there is a unique equilibrium which is consistent with the Intuitive Criterion (formally, the model is not a proper signaling game but can be regarded as one, see Footnote 19). In this separating equilibrium  $\varepsilon = \underline{\varepsilon}$ . Then, I show that no pooling equilibrium is consistent with the Intuitive Criterion.

(i) The proof is by contradiction. Assume there is a separating equilibrium as derived in Lemma 5 with  $\varepsilon > \underline{\varepsilon}$ . Sustaining this equilibrium would require the belief on  $(1 + \underline{\varepsilon}, \frac{1 + \underline{\varepsilon}}{2})$  to be sufficiently low. A necessary condition for “sufficiently low” is  $\mu(1 + \underline{\varepsilon}, \frac{1 + \underline{\varepsilon}}{2}) < 1$ . However, type 00 would do worse by buying  $(1 + \underline{\varepsilon}, \frac{1 + \underline{\varepsilon}}{2})$  instead of choosing  $(0, 0)$  for any belief. Type 01 cannot profit from deviating to  $(1 + \underline{\varepsilon}, \frac{1 + \underline{\varepsilon}}{2})$  for any belief  $R(1 + \underline{\varepsilon}, \frac{1 + \underline{\varepsilon}}{2}) \in [0, 1]$  by definition of  $\underline{\varepsilon}$  (see the proof of Lemma 5, in particular Equation 21). Also type 10 is better off buying  $(1, \frac{1}{2})$  than anything else, independent of beliefs. Only type 11

can strictly profit from deviating from  $(1 + \varepsilon, \frac{1+\varepsilon}{2})$  to  $(1 + \underline{\varepsilon}, \frac{1+\underline{\varepsilon}}{2})$ . Thus, the only belief consistent with the Intuitive Criterion is  $\mu(1 + \underline{\varepsilon}, \frac{1+\underline{\varepsilon}}{2}) = 1$  for which type 11 is better off buying  $(1 + \underline{\varepsilon}, \frac{1+\underline{\varepsilon}}{2})$  than  $(1 + \varepsilon, \frac{1+\varepsilon}{2})$ .

The same argument goes through for all potentially separating equilibria, where  $s = 1 + \varepsilon$  and  $p > \frac{1+\varepsilon}{2}$ . The only separating equilibrium, which remains is  $(1, \frac{1}{2})$  and  $(1 + \underline{\varepsilon}, \frac{(1+\underline{\varepsilon})^2}{2})$  with participation behavior and beliefs as defined in Lemma 5.

(ii) Consider a pooling equilibrium where type 01 buys  $(1, \frac{1}{2})$  with probability  $q$  as defined in Equation 4 and with probability  $1 - q$  type 01 choose  $(0, 0)$  so that  $R(1, \frac{1}{2}) = \frac{\beta}{q(1-\beta)\alpha_n + \beta}$ . I show in the following that there always exists  $\varepsilon > 0$  such that type 11 profits from deviating to product  $(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2})$  if he beliefs this to be associated with  $R = 1$ , while type 01 cannot profit from deviating for any belief. But then, according to the Intuitive Criterion,  $R(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2}) = 1$  since for  $R(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2}) < 1$  we would assign positive probability to a type who would never gain from choosing this product.

Choose  $\varepsilon > 0$  such that  $\frac{\varepsilon}{2} < \lambda(1 - \frac{q(1-\beta)\alpha_n}{\beta(1-\alpha_s) + q(1-\beta)\alpha_n}) < \varepsilon + \frac{\varepsilon}{2}$ . Then, for the product  $(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2})$  the following holds:

(a) For the most favorable belief  $R(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2}) = 1$ , type 11 gains from separating:

$$U_{11}(1, \frac{1}{2}, R(1, \frac{1}{2})) < U_{11}(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2}, R = 1) \Leftrightarrow \frac{\varepsilon}{2} < \lambda(1 - \frac{q(1-\beta)\alpha_n}{\beta(1-\alpha_s) + q(1-\beta)\alpha_n})$$

(b) Type 01 cannot gain from deviating to  $(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2})$  even for the most favorable belief  $R(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2}) = 1$ :

$$U_{01}(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2}, \mu = 1) < U_{01}(1, \frac{1}{2}, R(1, \frac{1}{2})) \Leftrightarrow \lambda(1 - \frac{q(1-\beta)\alpha_n}{\beta(1-\alpha_s) + q(1-\beta)\alpha_n}) < \varepsilon + \frac{\varepsilon}{2}$$

□

## Proof of Lemma 6

*Proof.* Suppose the monopolist has to obey a MQS of  $\underline{s} = 1$ . Product offers in the standard good and the exclusive good are unaffected by the MQS. For the mass market (see Lemma A4) the monopolist then chooses  $s = \max\{1, \min\{1, \lambda R\}\} = 1$ . Prices are adjusted such that incentive compatibility is fulfilled. The optimal product offer is

$$(s, p) = \begin{cases} (1, \lambda R) & \text{if } \lambda \leq R^{-1} \\ (1, 1) & \text{if } \lambda > R^{-1} \end{cases}$$

For the image building menu (see Lemma A5) the monopolist cannot decrease quality below 1 and chooses  $s_L = \max\{1, \min\{1, \lambda R_L\}\} = 1$ . Incentive compatibility requires that the price for the high quality product is adjusted upwards. For  $\lambda < R_L^{-1}$ , the price for the low quality product lies below its quality since otherwise the purely image-concerned consumer would not buy. This yields optimal product offers as

$$(s_L, p_L) = \begin{cases} (1, \lambda R_L) & \text{if } \lambda \leq R_L^{-1} \\ (1, 1) & \text{if } \lambda > R_L^{-1} \end{cases} \quad (s_H, p_H) = \begin{cases} (1, \lambda) & \text{if } \lambda \leq R_L^{-1} \\ (1, 1 + \lambda(1 - R_L)) & \text{if } \lambda > R_L^{-1} \end{cases}$$

From this I compute profits for each consumer partition. For any set of parameters, the equilibrium with regulation is given by the offer which maximizes profits. Then, I compute consumer surplus for each equilibrium, and also welfare as the sum of consumers surplus and profit. I compare consumer surplus and welfare with regulation with results from Section 5. The proof is completed by Examples 3 and 4:

**Example 3.** Suppose  $\alpha_n = \frac{3}{4}, \alpha_s = \frac{1}{48}, \beta = \frac{13}{64}, \lambda = 3$ . With and without regulation, the monopolist offers an image building menu. The introduction of the MQS  $\underline{s} = 1$  decreases profits from 0.38484 to 0.20898 but increases consumer surplus from 0.00317 to 0.05414. The former effect is stronger: Welfare is 0.38801 without regulation and only 0.26312 with the MQS.

**Example 4.** Suppose  $\alpha_n = \frac{3}{4096}, \alpha_s = \frac{1}{224}, \beta = \frac{1}{4096}, \lambda = 2$ . The monopolist offers an image building menu without regulation and an exclusive good in the presence of the MQS  $\underline{s} = 1$ . Consumer surplus decreases from  $5.43230 \times 10^{-7}$  without regulation to  $3.56475 \times 10^{-7}$  with the MQS. Profit also decreases. Welfare decreases from 0.00037 without regulation to  $3.08073 \times 10^{-6}$  with regulation.

□

## Proof of Corollary 6

*Proof.* Any one-product equilibrium features  $s = 1$  and is unaffected. Suppose we are in a two-product equilibrium. By Proposition 3 the product chosen by type 11 in this equilibrium is characterized by  $\tilde{s} = \sqrt{1 + \frac{2\alpha_n(1-\beta)\lambda}{\alpha_n(1-\beta) + (1-\alpha_s)\beta}} > 1$ .  $MC(\tilde{s}) = \frac{1}{2} + \frac{\alpha_n(1-\beta)\lambda}{\alpha_n(1-\beta) + (1-\alpha_s)\beta}$  is just high enough to ensure that type 01 prefers to buy  $(1, \frac{1}{2})$ .



Choose  $0 < \varepsilon < \sqrt{1 + \frac{2\alpha_n(1-\beta)\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}} - 1$ . For each product  $(s, p)$  set the tax to

$$(22) \quad t(s, p) = \begin{cases} 0 & \text{if } s \leq 1 \\ \lambda \frac{\alpha_n(1-\beta)}{\alpha_n(1-\beta)+(1-\alpha_s)\beta} & \text{if } s > 1 \text{ and } s \neq 1 + \varepsilon \\ \lambda \frac{\alpha_n(1-\beta)}{\alpha_n(1-\beta)+(1-\alpha_s)\beta} - \varepsilon^2 & \text{if } s = 1 + \varepsilon \end{cases}$$

Then, type 11 is best off choosing  $(1 + \varepsilon, MC(1 + \varepsilon))$  and paying the associated tax. Assuming separation holds, her utility is then  $U_{11}(1 + \varepsilon, MC(1 + \varepsilon), t) = \frac{1}{2} + \lambda \frac{(1-\alpha_s)\beta}{\alpha_n(1-\beta)+(1-\alpha_s)\beta} + \frac{1}{2}\varepsilon^2$ . This is greater than utility would be from choosing  $(1, \frac{1}{2})$  which equals  $\frac{1}{2} + \lambda \frac{(1-\alpha_s)\beta}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}$ . Moreover, for any other quality level  $s > 1$ ,  $s - \frac{1}{2}s^2 < \frac{1}{2}$  and type 11 derives strictly lower utility  $U_{11}(s, MC(s), t) = \frac{1}{2} + \lambda \frac{(1-\alpha_s)\beta}{\alpha_n(1-\beta)+(1-\alpha_s)\beta} + s - \frac{1}{2}s^2 - \frac{1}{2}$  from choosing it than from choosing  $(1, \frac{1}{2})$ . Type 01 does not want to mimic type 11 since  $U_{01}(1, \frac{1}{2}) = \lambda \frac{(1-\alpha_s)\beta}{\alpha_n(1-\beta)+(1-\alpha_s)\beta} - \frac{1}{2} > \lambda \frac{(1-\alpha_s)\beta}{\alpha_n(1-\beta)+(1-\alpha_s)\beta} - \frac{1}{2} + \frac{1}{2}\varepsilon^2 - \varepsilon = U_{01}(1 + \varepsilon, MC(1 + \varepsilon), t)$ . Thus, separation indeed holds.

Since separation is unchanged, the allocation of image remains the same and welfare increases by the increased efficiency in production because the quality which type 11 chooses now  $1 + \varepsilon$  is smaller than  $\tilde{s}$  by construction.

The tax income does not directly affect welfare but is a transit item since it is subtracted from surplus of type 11 consumers. Thus, it can be seen that there always exists a welfare improving tax scheme. However, not necessarily everyone is better off. The tax does not affect choices by types 00, 01, and 10 and thereby does not affect their surplus either. Type 11 is affected, though. If the functional excuse  $\tilde{s}$  is relatively small,  $\tilde{s} < 3$ , type 11 is hurt by the luxury tax even though welfare increases. The reason is that the tax can be larger than the per unit increase in net surplus. Since taxes cancel out in welfare this implies an increase in total welfare but consumers of type 11 are still worse off so that the tax does not constitute a Pareto improvement.

In the absence of the tax, type 11 would choose  $\tilde{s} = \sqrt{1 + \frac{2\alpha_n(1-\beta)\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}} > 1$  at a price  $p = MC(\tilde{s}) = \frac{1}{2} + \frac{\alpha_n(1-\beta)\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}$  which yields utility  $U_{11}(\tilde{s}, MC(\tilde{s})) = \tilde{s} + \lambda - \frac{1}{2}\tilde{s}^2$ . Utility with taxation is higher if the following holds:

$$\frac{1}{2} + \lambda \frac{(1-\alpha_s)\beta}{\alpha_n(1-\beta)+(1-\alpha_s)\beta} + \frac{1}{2}\varepsilon^2 > \tilde{s} + \lambda - \frac{1}{2}\tilde{s}^2$$

From the definition of  $\tilde{s}$  we know that  $\lambda - \frac{1}{2}\tilde{s}^2 = \lambda \frac{(1-\alpha_s)\beta}{\alpha_n(1-\beta)+(1-\alpha_s)\beta} - \frac{1}{2}$  so that the former is equivalent to  $\varepsilon^2 > 2(\tilde{s} - 1)$  which is only true if  $\varepsilon > \sqrt{2(\tilde{s} - 1)} > 0$ . This requirement

on  $\varepsilon$  can be fulfilled whenever

$$\sqrt{2(\tilde{s} - 1)} < \tilde{s} - 1 \Rightarrow 2\tilde{s} - 2 < \tilde{s}^2 - 2\tilde{s} + 1 \Leftrightarrow \tilde{s}^2 - 4\tilde{s} + 3 > 0$$

Given  $\tilde{s} > 1$  by definition, this inequality is fulfilled for all  $\tilde{s} > 3$ . Thus, a welfare-improving tax that also constitutes a Pareto improvement exists, whenever  $\tilde{s} > 3$ .

To ensure that consumer surplus remains unchanged but choices are unaffected or increases, a more complicated tax scheme has to be put in place which redistributes the tax income to all consumers in a lumpsum way. It is not clear that such a scheme always exists.  $\square$

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