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Jana Friedrichsen

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Wissenschaftszentrum Berlin für Sozialforschung gGmbH
Reichpietschufer 50
10785 Berlin
Germany
www.wzb.eu

Jana Friedrichsen
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Affiliation of the author:

Jana Friedrichsen
DIW Berlin and Humboldt-Universität zu Berlin

Wissenschaftszentrum Berlin für Sozialforschung gGmbH
Reichpietschufer 50
10785 Berlin
Germany
www.wzb.eu

Abstract

Signals Sell: Designing a Product Line when Consumers Have Social Image Concerns

by Jana Friedrichsen*

One important function of consumption is for consumers to show off their taste, virtue or wealth. While empirical observations suggest that producers take this into account, existing research has concentrated on analyzing the demand side. This paper investigates how a monopolist optimally designs its product line when consumers differ both in their taste for quality and their desire for a positive social image. The monopolist distorts qualities and prices to allocate images to consumers. It generically pools consumers with different tastes because high-taste consumers lend a positive image to the product of their choice and thereby increase the product's value to others. Often, average quality is lower than in a market without image concerns and there is underprovision as compared to the welfare-maximizing allocation. Although average quality is higher in a competitive market, welfare typically is not.

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

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1. Introduction

Consumption is about satisfaction of needs. Partly these needs are addressed by the physical nature of products: the mobile allows us to make calls and text, a wine tastes good, a car provides mobility and comfort, and so forth. But we also consume because we want to show off.[1] Only a few decades ago, consumers mostly showed off their wealth, trying to "keep up with the Joneses" by amassing as much new stuff as the neighbors. But when many goods are affordable to almost everyone around them, and wealth may have become a less desirable characteristic, consumers increasingly seek to advertise virtue or taste instead of pure wealth (Frick and Hauser, 2008; The Economist, 2010). Although producers certainly cater to this desire—several examples follow below—hardly any research has analyzed this response.[2] Moreover, the possibility that consumers buy to advertise another characteristic but wealth is typically ignored in the literature. This paper contributes to filling this gap by analyzing how a strategic firm adjusts the variety, qualities, and prices of its product line when individuals differ both in their valuations of quality and their desire for social image.[3]

To analyze the supply side response to image concerns, I set up a simple model of markets where consumers may derive utility from a product's quality as well as from the image associated with it. Types are binary in both dimensions but in contrast to existing research I do not impose any restrictions on the correlation. The image of a product emerges endogenously from the individual consumers' consumption decisions as a product's image is the conditional expectation of a consumer's taste for quality after purchases have been observed.[4]

Technology companies, wine makers, health clubs or hotel groups, fashion designers, and producers of luxury products segment their markets by offering products that appeal to different groups of people and their signaling desires. For instance, the fashion designer Armani differentiates its product line into three tiers, distinct in style and price, that are tailored to different sets of consumers (Amaldoss and Jain, 2010; Kotler and Keller, 2011, p. 320). Even though this differentiation may partially be motivated by differential tastes for quality in the first place, the three tiers are associated with different sets of customers and thereby public images. These images are themselves valued by customers and add to a product's physical value thereby justifying high price premia in the upper tiers. Mobile phones can also function as status goods (Abeele et al., 2014). Apple's iPhone, in particular, is in high demand partly for social positioning reasons (Arruda-Filho and Lennon, 2011), and the design of Apple's product line hints toward image concerns being addressed. Section 2.1 provides more detailed empirical applications and discusses where standard screening models that concentrate on the effects of heterogeneous

[1] Empirically, it is well-documented that consumers pay for demonstrating their wealth, taste, or preferences. See for instance Chao and Schor 1998; Charles et al. 2009; Heffetz 2011; Sexton and Sexton 2014. A possible mechanism to microfound such behavior is that being perceived as "good" increases an agent's matching opportunities and future payoffs (Pesendorfer, 1995; Rege, 2008).

[2] A large number of theoretical studies investigate how consumer behavior is affected by the desire to demonstrate wealth but do not allow for strategic responses on the supply side (Veblen, 1915; Ireland, 1994; Bagwell and Bernheim, 1996; Glazer and Konrad, 1996; Corneo and Jeanne, 1997). The only study that investigates strategic product design in this context, Rayo (2013), does not apply to the empirically relevant case that the desire to signal is heterogeneous across consumers and negatively correlated with the characteristic to be signaled. Section 8 provides a detailed discussion.

[3] The notion of quality is a general one here. For instance, quality can also refer to the extent to which production is environmentally friendly. Instead of image motivation or image concern (for similar use see for instance Ariely et al., 2009), others have used the terms signaling motivation, status concern, or conspicuous consumption. Sometimes the meaning is restricted to the signaling of wealth. Cabral (2005) suggests using "reputation" for situations "when agents believe a particular agent to be something." As this is uncommon in the relevant literature it is not used here.

[4] Consumption is conspicuous in that it provides evidence of the personal characteristic "taste for quality". 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 can have similar benefits as signaling "pecuniary strength."

tastes for quality are insufficient to entirely explain the observed market segmentation and price differences.

After discussing the empirical evidence, Sections 3 and 4 analyze image concerns in monopolistic markets. Monopoly captures an essential aspect of status goods, namely their inimitability, and could reflect a firm with market power when it comes to wine, luxuries, or technology. Alternatively, in the case of food items, we can think of a supermarket chain that is deciding which product qualities to slot within a certain category and which prices to charge. The analysis reveals that monopolists react to the heterogeneity of image concerns by designing a product line that always induces a partial pooling of consumers. The monopolist distorts product qualities and prices differently than what would be predicted by differences in quality valuations alone to induce this pooling. If the value of image is at an intermediate level, the monopolist offers a product of intermediate quality in addition to the low and high quality product he would offer in the absence of image concerns. The additional product offers prestige and symbolic benefits as well as intermediate quality and allows the monopolist to profitably screen consumers with respect to their willingness to pay a premium for image. Purely image-concerned consumers pool with purely quality-concerned consumers and buy this product, which can be interpreted as a "masstige" product (Truong et al., 2009; Heine, 2012). Therefore, in this scenario, later termed *image building*, fewer consumers decide in favor of the lowest quality than if image concerns were absent. The highest-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, average quality in the market may then decrease if the value of image increases. If image is very valuable, the monopolist offers only a low and an *exclusive* high quality product. Prices are set such that the high quality product is only bought by consumers who value image in addition to quality, whereas all others prefer the low quality product. Thus, average quality in the market decreases for sure as compared to a model without image concerns when image concerns become very strong.

In Section 5, I study a perfectly competitive setting. This allows me to disentangle the effects of strategic consumer behavior from those due to strategic supply. I show that firms operating in perfect competition cannot exploit image concerns to make positive profits. Still if the value of image is sufficiently high, image concerns remain relevant in a market where producers are price-takers, but the predicted distortions are different than in monopoly. As prices are driven down to marginal cost, consumers cannot use prices to signal their interest in quality—as a monopolist's product line would encourage them to do. Instead, consumers who value both image and quality buy inefficiently high quality, which serves as a *functional excuse* to separate from lower valuation consumers. Such a high quality product is too expensive for purely image-concerned consumers even if it is sold at marginal cost. Purely image-concerned consumers pool with purely quality-concerned consumers on a lower quality product that has the same quality level as the "high-quality" product by the monopolist. In contrast to this upward distortion in competitive qualities, monopoly induces separation by a downward distortion in quality. A key result is that quality is on average higher in competition than in monopoly. Welfare, however, is often higher in monopoly than in competition. The reason is that consumers buy excessive quality in the competitive market to acquire a good image. Producing these quality levels, and therefore this way of signaling, is inefficient. A monopolist allows for less wasteful signaling by restricting the product line. The policy implications therefore differ with respect to market structure. Although monopoly achieves product differentiation by a low-quality product, the introduction of a minimum quality standard is shown to weakly decrease welfare and consumer surplus. In a competitive market, the allocation is inefficient due to an upward distorted high-quality product: a luxury tax strictly increases welfare but does not in general yield a Pareto improvement.

The rest of the paper is structured as follows. In Section 2, I first discuss empirical examples where firm behavior is consistent with predictions of my model for heterogeneous image concerns. I also present empirical support of a negative correlation between intrinsic quality concerns and image motivation, which is the arguably most interesting case of my model. Then, I introduce the monopolistic model and discuss two benchmark cases in Section 3, and analyze the full model in Section 4. Section 5 then studies heterogeneous image concerns in a competitive market. Section 6 addresses welfare implications and possible policy interventions, and Section 7 presents generalizations and extensions. In Section 8, I discuss how my work relates to the literature before I conclude in Section 9. Proofs which are not included in the main text are contained in Appendix A. Appendix B provides supplementary material.

2. Empirical relevance of heterogeneous image concerns

2.1. Supply side caters to (heterogeneous) image concerns

Example 1: Apple and the iPhone The iPhone signals something about its owner and apparently, Apple's customers are willing to pay a substantial premium for this signal. The first generation of iPhones was marketed clearly as an exclusive product, of interest only to people who needed the phone's technological features and were willing to pay a premium for being among those first adopters (Arruda-Filho et al., 2010). While Apple has always targeted a market segment that is willing to buy into the brand prestige, the company has recently moved toward segmenting its market further. Until the iPhone 5, Apple introduced new iPhone models one at a time. The iPhone 5C and iPhone 5S, however, were introduced simultaneously. While the iPhone 5C lacks some features of the iPhone 5S (reduced quality), the signaling part is more prominent in form of the colorful casing. Offering these two version simultaneously allowed Apple to price-discriminate between those consumers who wanted to have the most high-end product and those who wanted to be seen with a new iPhone but were less interested in new features. Interestingly, Apple made sure that the different versions could be distinguished from each other through their design. The move to simultaneous versions occurred at a time when Apple's brand value and stock prices stagnated and even decreased. Apple's behavior could indicate a decreasing value of image, to which a masstige strategy was the answer in line with my model.[5]

Example 2: Bordeaux Wines The finest wine producers in France, particularly in the Bordeaux region, commonly offer a so-called "second label wine" in addition to their first label. The second wine is produced from grapes grown on the same estate, but it may be based on special plots or vines that are younger or do not perform as well. Depending on the quality of the vintage, a house may allocate a larger part or even all of the harvest to its second wine so as not to compromise the reputation of its *Grand vin.* While the quality difference may be small, the price differential is typically large. According to an empirical study by Ashenfelter (2008), there are two motivations for buying mature Bordeaux: interest in the wine itself and interest in the status symbol. In line with my theoretical analysis for the heterogeneous purchasing motives documented in Ashenfelter (2008), wine producers have adopted a two-tier product line. The *Grand vin* of superior quality receives an enormous image premium that is paid buy those who want a status symbol but also value the underlying quality. The lower quality second

[5]See `http://www.statista.com/statistics/326052/apple-brand-value/` and `http://finance.yahoo.com` for the numbers. In line with the brand value increasing again as indicated by increasing stock prices during 2014, Apple appears to go back to an exclusive market strategy with the newest generation. While most features are the same, the iPhone 6 Plus is larger and has much better power and battery than the iPhone 6. Thus, the iPhone 6 Plus is a rather different product than the iPhone 6 which is of typical size. In contrast, the functional differences between iPhone 5C and 5S are much smaller and appear to be more artificial. The simultaneous introduction of iPhone 6 and iPhone 6 Plus could be an attempt of classical price-discrimination along the dimension of features. For features and introduction dates of the iPhone see `http://en.wikipedia.org/wiki/IPhone`.

label wine appeals to those who are unwilling to pay a reputation premium for the *Grand vin* and choose the second label for its good quality-to-price ratio. But the second label wine also appeals to those who care mostly about the associated image, possibly because they are ignorant of the quality; they buy for the good image-to-price ratio. The image of a great wine maker's second label is considerably better than the image associated with an unknown producer's wine. Moreover, the (expected) quality of this wine is higher than that of the unknown wine.

Example 3: Hotel chains Hotels offer opportunities to meet people, and for some it is important what type of person they are perceived as in such encounters: Business hotel customers pay high rates in upper end hotels also to impress business contacts, and hotels appeal to images that are consistent with the signaling desires of their guests to increase customer satisfaction (Back, 2005). A hotel chain caters to image concerns by offering different hotel categories, sometimes under the same brand name. For instance, Accor has luxury hotels named Sofitel, Novotel and Mercure in the upscale range, Ibis Red and Ibis Styles in the Midscale, and Ibis Budget in the Economy range.[6] Across hotel categories, not only service quality but also the clientèle and the associated image differ, and hotels appear to be charging for it. Similar strategies can be observed for health clubs, which again are places where people do not only train but also meet.

Example 4: Socially Responsible Products It has become increasingly important to consumers that goods are ethically acceptable and sustainably produced. The market for organic products grew on average by more than 14% per year between 1999 and 2007 (Sahota, 2009), and Fairtrade sales experienced two-digit annual growth rates during recent years in many European markets (`http://www.fairtrade.net/annual-reports.html`). At the same time these goods are becoming status symbols (Kapferer, 2010; Frick and Hauser, 2008, p. 28). Empirical studies find that higher prices for green products can be partly explained by image concerns (e.g Casadesus-Masanell et al., 2009; Griskevicius et al., 2010; Sexton and Sexton, 2014). While there is much acceptance of the mainstreaming of responsible consumption, critical voices lament a dilution of the underlying principles as products are tailored to a broader audience (for instance Clark, 2011 and Stevens, 2011). According to my model, this observation is consistent with a discounter optimizing its product listings in response to rising image concerns:[7] To profit from image concerns and attract consumers who do not so much care about sustainable production per se, the discounter will offer an inferior version of a sustainable product, probably an own-brand product, in addition to the fully sustainable product, which can consequently be sold at a premium. In line with this, the independent German testing organization Stiftung Warentest has recently found that organge juice of the discounter Lidl's Fairglobe (Lidl's own-brand carrying the Fairtrade logo) does not satisfy basic requirements with respect to labor conditions and environment (Stiftung Warentest, 2014). Still, Lidl's Fairglobe products sell very well and have contributed to the increase in market size for Fairtrade products.

Also, the soft drinks "ChariTea" and "LemonAid" clearly appeal to non-consumption values through their names and the bottles are easily recognized even from a distance through their unusual design.[8] At a local German supermarket, a consumer will pay about 1.30 Euro for a 330ml bottle of ChariTea or LemonAid while a same-sized soft drink that fulfills comparable social and environmental standards sells at less than a Euro per 330ml bottle. This price differ-

[6] This is only one example. Among others, also Best Western Hotels, Choice Hotels, Hilton Worldwide, and Hyatt Hotels Corporation offer hotels in different categories targeting different sets of consumers. These are brand extensions in the form of vertical line extensions (Keller, 2015). Product and brand images have been shown to be crucial for such extensions (e.g. Kirmani et al., 1999). The marketing literature offers many empirical studies but little theoretical background for the estimated effects.

[7] In accordance with my model, producers engage in Corporate Social Responsibility (CSR) strategically (Kitzmueller and Shimshack, 2012): they green their production or tighten social standards to better tailor the products to individuals' demand for responsible products for profit-maximizing reasons. Producers and trading companies might of course themselves have intrinsic concerns for ethical production. This is not included in my model.

[8] These two drinks are advertised with "Drinking helps!". See `http://www.lemon-aid.de/` and Figure B1 in Appendix B.

ence cannot be justified by the 5 Cents donation per bottle to charitable projects alone.[9] Bars and Cafés where consumption is more visible and signaling desires more relevant (Griskevicius et al., 2007) are frequent outlets for these drinks, making image concerns the most plausible explanation for the price premium. Quality-based models would not predict higher popularity of responsible products in public spaces.

Recently, several long-standing firms in Fairtrade and organic production have introduced their own standards which lie above the one implemented in mainstream retailing.[10] This is compatible with my results and can thus be interpreted as a reaction to increased competition from discounters and supermarkets.[11] An increase in the valuations for Fairtrade and organic products would similarly predict an increase in top quality. However, if consumers value only quality, it is puzzling that the low-quality alternative is unchanged or even worsens: The joint occurrence of both events can be explained by quality concerns only if there are heterogeneous changes in preferences. In contrast, their joint occurrence exactly matches my predictions if consumers also have image concerns and the signaling value of sustainable consumption increases in response to increased public attention to environmental and social issues.

Example 5: Luxury Products Luxury products are typically bought because of the associated prestige as well as their intrinsic quality. Expressive purchase motives like status concerns increase their importance relative to intrinsic ones such as quality the more visibly a product is consumed (Hudders, 2012). Producers of luxury or premium products regularly face the challenge of increasing their market share through lower-priced lines while not jeopardizing the prestige of the company's products (Chen, 2013). One example to address this challenge is that producers segment the market for luxury handbags by offering "loud" and "quiet" bags. The loud ones carry a visible brand logo and tailor to consumers who want to signal affluence through their brand choice but lack connoisseurship. The quiet bags, in contrast, do not carry a visible brand logo such that they can be used for signaling only by those who know and value the subtle design and quality of the bag itself. According to Han et al. (2010), Gucci and Luis Vuitton sell quieter handbags and shoes at a price premium, and similarly, it is the lower-priced cars by Mercedes that carry a larger emblems. This is consistent with a market segmentation strategy where the premium consumers who are able to judge the product's quality and desire to signal their superiority are separated from those who either lack the knowledge for quality or are not willing to pay an image premium (note that even the larger emblem cars and the loud bags are usually of high quality).[12] A purely quality-based segmentation, in contrast, cannot explain the loud-quiet distinction. Alternatively, loud bags might be cheaper to compensate consumers for being ad-carriers for the respective brand. Given that many consumers want to be recognized as wearing the brand, this is unlikely to be the sole explanation for the observed patterns either.

Example 6: Cars Automobile manufacturers usually offer product lines, and social status has come to be associated more with particular vehicles than with the manufacturer itself. Luxury cars such as Lexus, Mercedes S-class, or Tesla offer not only increased comfort and safety to their owners as compared to less expensive variants from the same manufacturers, but they also confer status benefits. The associated status depends on price, style, and engineering of the

[9] Information regarding the donation cannot be found on the bottles or the shelves and not on the product's website either but only in an interview with the founders (Baurmann, 2013).

[10] 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 `http://www.ifoam.org/sub/faq.html`).

[11] Such coexistence of monopoly and competitive predictions may be observed if purchasing modes vary: some consumers choose first which quality they want to buy and select the outlet accordingly. This competitive element leads to excessive quality. Others first pick an outlet and then a quality within this outlet's portfolio. This monopoly element leads to the availability of lower quality products.

[12] Han et al. (2010) employ a consumer categorization that differs from the one used in this paper. In particular, they assume a distinction in connoissership which together with wealth and income determines the marginal utility from quality. Moreover, they assume that what the different consumers want to signal is not identical.

car but also on public opinion (Berger, 2001, p. 160). Moreover, Mercedes Benz introduced the BlueTEC and BlueEFFICIENCY label that additionally allow consumers to signal their concern for the environment in several categories of cars.[13] Mercedes thereby addresses signaling desires in several dimensions: wealth through size of the car and environmental preferences through the label (see Section 7.2).

2.2. Intrinsic motivation and image concerns correlate negatively

The predictions derived for the monopoly market are most interesting in the case where the intrinsic interest in quality and image concerns are uncorrelated or negatively correlated.[14] I am not aware of any study documenting a positive correlation even though it is not unreasonable to expect those with a high taste for quality care more about their reputation than others. On the other hand, those who highly value quality, know that they do and may have less of a benefit from demonstrating this to others. Those who value quality less may benefit more from being held for better-reputed quality lovers. Indeed, there is substantial evidence that intrinsic interest and image concerns are negatively correlated.

The cleanest evidence to my knowledge is a laboratory experiment by Friedrichsen and Engelmann (2013), in which we test whether intrinsically motivated individuals exhibit stronger or less pronounced image concerns when it comes to buying Fairtrade chocolate. We show that there is a negative relationship: those who do not value Fairtrade chocolate intrinsically, exhibit stronger image concerns.

A number of other studies provide indirect evidence of a negative correlation. For instance, Truong and McColl (2011) argue that the correlation between intrinsic purchasing motives and signaling is negative in the context of luxury consumption, and Vermeir and Verbeke (2006) present similar findings in the context of socially responsible consumption. Results by Riedl and Smeets (2015) indicate a negative correlation between intrinsic motivation and image concerns among financial investors. The authors combine experimental data on intrinsic social preferences of investors with administrative data about these investors' portfolios from a mutual fund and with survey data on the investors' motivations. Social preferences are found to predict investment in socially responsible mutual funds only if these are not associated with tax benefits. Moreover, the results suggest that "selfish" investors invest in socially responsible mutual funds without tax benefits for signaling reasons. No evidence for signaling motivations is found for those who are classified as pro-social. Field experimental evidence from Germany (Boyer et al., 2014; Dwenger et al., 2016) as well a an empirical analysis of Italian tax records (Filippin et al., 2013) indicate that those who are intrinsically motivated to pay taxes are less subject to image concerns.

3. Monopolistic quality provision and image concerns: Model and benchmarks

3.1. 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 types buy the respective product.

[13]See `http://www.mercedes-benz.com/fleet-CO2`.

[14]How much value is attributed to the image of being quality-concerned can depend on the social institutions in a society, modeled as matching patterns (Mailath and Postlewaite, 2006). Theoretically, agents may therefore differ in image concerns because they engage in types of interactions where the other's type is more payoff-relevant or less so.

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 taste for quality σ and their image concern ρ. The two-dimensional type (σ, ρ) is drawn from $\{\sigma_L, \sigma_H\} \times \{0,1\}$ with $\text{Prob}(\sigma = \sigma_H) = \beta$, $\text{Prob}(\rho = 1|\sigma = \sigma_H) = \alpha_s$, and $\text{Prob}(\rho = 1|\sigma = \sigma_L) = \alpha_n$. To simplify the exposition, I work with $\sigma_L = 0$ and $\sigma_H = 1$ in the main part of the paper. Section 7.1 discusses how this affects results. 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:

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

The parameter $\lambda > 0$ describes the value of image relative to the marginal utility from quality.[15] The image R of consumer (σ, ρ) is the expectation of his quality preference parameter σ conditional on his 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 3.3.

Table 1: Consumer types and their frequencies.

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

The **monopolist** offers a product line $\mathcal{M} \subset \mathbb{R}^2_{\geq 0}$ to maximize expected profit. Perfect price discrimination is impossible because consumers are privately informed about their types. The monopolist has prior beliefs about the distribution of of consumer types that are identical with the actual distribution. He chooses a product line such that consumers self-select (second-degree price discrimination). The monopolist cannot choose image directly, but takes into account which image will be associated with each of its products in equilibrium. Unit costs are assumed to be linear in quantity sold and convex increasing in quality, specifically $c(s) = \frac{1}{2}s^2$.[16]

Each consumer can choose a preferred product from the line 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 line $\mathcal{M}$.[17] If the monopolist allocates $(0,0)$ to a consumer type this means this type chooses the outside option.

3.2. The structure

The distribution of σ and ρ and the value of λ are common knowledge and so is the setup of the market interaction. Consumers have private information about their types. Quality is correctly

[15] Alternatively I could allow for (σ, ρ) 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 λ 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 $\lambda = \frac{\gamma}{1-\gamma}$.

[16] Specifying a functional form allows to obtain closed form solutions. The results are qualitatively the same with constant unit costs $c(s) = c$ (see Appendix B.9).

[17] In the following, taking $(0,0)$ will also be referred to as non-participation since this is its meaning. Strictly speaking all types participate by construction.

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:

(i) The monopolist offers a product line $\mathcal{M}$. Qualities and prices are observed by all consumers.

(ii) Types are drawn and each consumers privately learns his type $\sigma\rho$.

(iii) All consumers simultaneously choose a product $(s,p)_{\sigma\rho} \in \mathcal{M}$ which maximizes utility for their type.

(iv) Images associated with each product and payoffs realize.

In this model, the utility of a consumer does not only depend on his action but also on beliefs about his type. Thus, the game analyzed here falls into what is called *perception games* by Gradwohl and Smorodinsky (2014) and it is similar to *psychological games* (Geanakoplos et al., 1989) in which a player's utility depends on all players' actions and on the player's beliefs about others' strategy profiles. Formally, one can represent images as a consumer's perception of the beliefs that an implicit third player forms about his type after consumption decision have been executed. This inactive player may exists in reality or only in the consumer's imagination.

3.3. Equilibrium

In the presence of image concerns the product line 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 his 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 product line $\mathcal{M} \in \mathcal{P}(\mathbb{R}^2_{\geq 0})$ the choice correspondence $b_{\mathcal{M}} : \{0,1\}^2 \to \mathcal{M}$ states which product $(s,p) \in \mathcal{M}$ is chosen by consumer type $\sigma\rho$. For every product line $\mathcal{M}$ the belief function $\mu_{\mathcal{M}} : \mathcal{M} \to [0,1]$ 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 product line, the same product occurring in different product lines 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

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

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

(i) $b_{\mathcal{M}}(\sigma\rho) \in argmax_{(s,p)\in\mathcal{M}} \sigma s + \rho\lambda R(s,p) - p$ 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 product line $\mathcal{M}$, a correspondence $b_{\mathcal{M}}$ and a belief function $\mu_{\mathcal{M}}$ such that among the feasible product lines, $\mathcal{M}$ gives the highest profit to the producer given that for each feasible product line consumer behavior is consistent with equilibrium as defined in Definition 1.[18] 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. Furthermore, let the following tie-breaking rule hold for consumers who value quality but not image to facilitate the analysis.[19]

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).

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

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

For some product lines, a pure-strategy equilibrium in the consumption stage does not exist.

Example 1. *Suppose the monopolist offers $\mathcal{M} = \{(0,0),(1,1)\}$ and $\lambda \in (1, \frac{\beta+\alpha_n(1-\beta)}{\beta})$. 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. In any equilibrium in the consumption stage, type 01 randomizes between the two products.*

With a continuum of consumers, this randomization 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. While mixed strategies are required to prove existence of equilibrium in every subgame, the product lines for which only mixed-strategy equilibria exist are not profitable to the monopolist (see Appendix B.8). The following derivations therefore concentrate on the monopolist offering a product line which induces a pure-strategy equilibrium in the consumption stage.

[18] 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 ϵ cost for putting a product on the market to ensure that the monopolist offers only products which are accepted in equilibrium.

[19] Allowing the monopolist to select an equilibrium 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 Appendix B.7). In Appendix B, I also relax Assumption 1 and show that it does not qualitatively affect the results.

3.4. Benchmark cases: nobody or everyone values image

This section shows that homogeneous image concerns do not influence the production of quality. If either no consumer cares about image, or all consumers care about image, the monopolist faces only two consumer types: A fraction β of consumers value quality ($\sigma = 1$), the others do not.[20]

Lemma 2. *(No image concern) 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.*

Lemma 3. *(Homogeneous image concern) 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 products in equilibrium are $R(0, 0) = 0$ and $R(1, 1 + \lambda) = 1$.*

Without image concerns, consumer surplus equals 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. Homogeneous image concerns increase the utility of buying a product which is bought by good types and thereby increase the price a monopolist can charge for it without changing the allocation of quality. The prize increase corresponds exactly to the image gain and aggregate consumer surplus is zero. The image concern increases the monopolist's profits by $\beta\lambda$. If $p > s$, the monopolist charges an **image-premium**, which is justified through the consumers' willingness to pay for the image associated with the product.[21]

4. Monopoly with heterogeneous 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, $\beta, \alpha_s, \alpha_n \in (0, 1)$.*

4.1. The consumption stage

The four consumer types can theoretically split into groups in 15 different ways. But only four types of pure-strategy partitions in the consumption stage are consistent with profit maximization. Since in equilibrium, the monopolist maximizes its profits, it is without loss of generality that other partitions in the consumption stage are not characterized here. I begin the analysis with reducing the set of equilibrium candidates to those where partial pooling occurs.

Lemma 4. *A fully separating equilibrium does not exist.*

Proof. 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 $(0, 0)$. □

Moreover, pure image goods which would be bought by all image-concerned consumers irrespective of their quality concern are not viable.

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

[21] Lemmas 2 and 3 are easily generalized to allow for $0 < \sigma_L < \sigma_H$ or a continuous distribution of quality valuations. The optimal product line features the same qualities in the situation without and with homogeneous image concerns, and image concerns lead to price increases corresponding to the image gain provided by a specific product.

Lemma 5. *A pure image good equilibrium in which image-concerned consumers choose $(s, p) \neq (0, 0)$ and those unconcerned with image 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 which purely image-concerned consumers would not pay for.[22] 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. So the gain in image when choosing the image good is relatively low. In fact, the monopolist makes strictly higher profits by pooling the purely image-concerned with the purely quality-concerned consumers and those who value neither quality nor image (cf. exclusive good as will be described in Proposition 1). This deteriorates the image on the outside good and improves the image on the good sold.

Proposition 1 rules out all remaining but four specific product lines. 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 and optimal consumer behavior.

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

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	{10,11}	(1,1)	(λ, λ)			n.a.
mass	{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	{11}	$(1, 1+\lambda\frac{1-\beta}{1-\alpha_s\beta})$				

$\lambda_1 = \frac{\alpha_n(1-\beta)+\beta}{\beta}, \lambda_2 = \frac{\alpha_n(1-\beta)+(1-\alpha_s)\beta}{(1-\alpha_s)\beta}$

The **standard good** is identical to the separating product offer without image concerns (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** consumers who value neither quality nor image are excluded while all consumers who value at least one of the two characteristics buy the same product. The **image building** product line offers two distinct products, a lower quality, lower price version for consumers who value neither image nor quality and a premium version for image-concerned consumers with a taste for quality. The premium product offers higher quality and higher image at a higher price. If the value of image is large, the two products can even have the same quality and differ only in image and price. Prices are chosen strategically and induce consumers who value only image not to imitate those who value both quality and image. If the monopolist sells 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

[22] Note that the monopolist cannot profit from offering any positive quality for either of the two products. Either product is supposed to be bought by a consumer whose willingness to pay for quality is zero so that it cannot charge any positive price for quality.

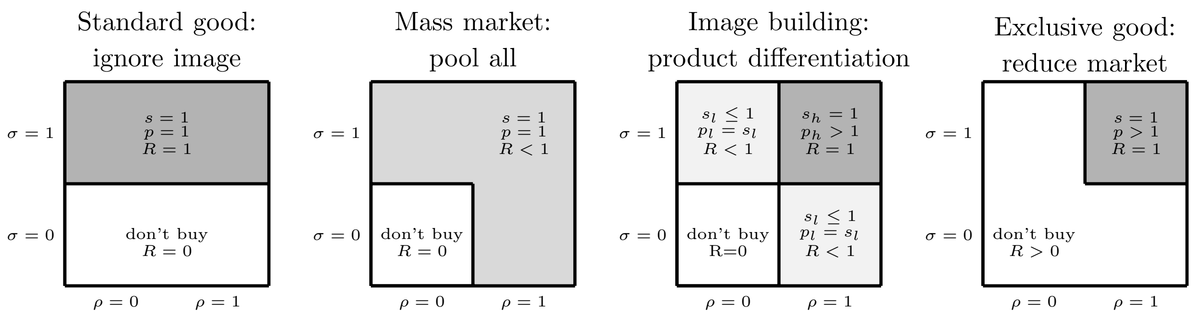

Figure 1: Possible market partitions in equilibrium (Proposition 1).

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 1.

4.2. Profit maximization

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

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* $\alpha_n < \frac{\beta(1+\alpha_s(\beta+\alpha_s\beta-3))^2}{4\alpha_s(1-\beta)^2}$, *then* $\tilde{\lambda}_m = \tilde{\tilde{\lambda}}_m$. *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 λ for each product line. The optimal product offer for each distribution of preferences and each value of image is derived by comparing profits across product lines. The profit-maximizing product line, optimal consumer behavior, and consistent beliefs together constitute the equilibrium of the complete game.

The mass market is always dominated by an image building product line. The latter allows to charge consumers a premium if they value image and quality without compromising too much on profits on the other consumers. The threshold values for λ depend on the parameters but holding fixed a parameter set, the equilibrium is a standard good for low λ, an exclusive good for high λ and possibly image building for intermediate values of λ.

Corollary 1. *The interval of* λ *where image building is optimal is empty only if image concerns and intrinsic motivation are positively correlated,* $\alpha_n < \alpha_s$.

Figure 2 illustrates the findings of Proposition 2. The underlying intuition is as follows. Image concerns only matter if they are intense enough. For λ 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 concerns (cf. Section 3.4).

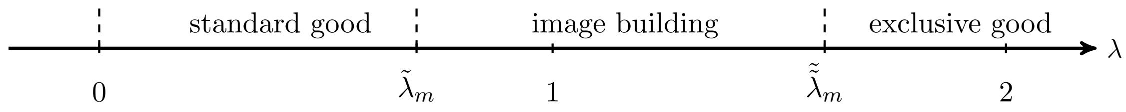

Figure 2: Equilibrium in monopoly.

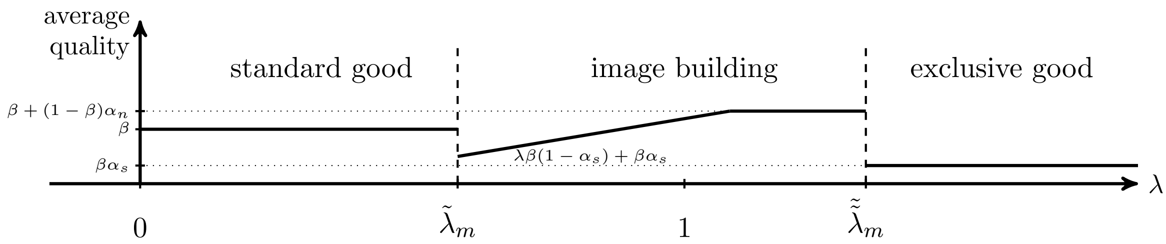

Figure 3: Average quality in a monopoly market. In the absence of image concerns, average quality equals β.

When image concerns become more important, λ increases, profits from image building and exclusive good increase in λ while standard good profits remain constant or even decrease. Thus, the monopolist profits from modifying the product line. For intermediate values of image concerns, 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[23], 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 concerns become 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.

Suppose we are interested in the quality of a randomly chosen product in the market. Each consumer who does not buy from the monopolist is assumed to consume the outside option, which is a product of zero quality. **Average quality** in the market is the sum of the fractions of consumers multiplied with the quality of the product that they buy in equilibrium. An implication of Proposition 2 is that average quality is not in general increasing in the value of image as illustrated in Figure 3. The reason is that changes in the value of image may induce the monopolist to offer a different product line which affects the average quality level due to a reduction in product quality (moving from standard good to image building) or due to a reduced share of the market being served by the monopolist (moving from image building to exclusive good).

Corollary 2. *There exist parameters such that an increase in the value of image λ decreases the average quality in the monopoly market.*

More comparative statics results are contained in Appendix B.1. Testable predictions that follow from the formal results are discussed below.

4.3. Testable predictions

First, we can compare a market without image concerns to one with image concerns but with the same fraction of intrinsically motivated consumers and the same market structure. Alternatively,

[23] 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.

we can investigate changes in the strength of image concerns, given that the distribution of preferences remains constant. This yields predictions 1 and 2. Second, we can analyze one particular market over time. If we can observe not only changes in qualities and prices but are able to get an idea of changes in the preference distribution, we obtain predictions 3 and 4.

Prediction 1. *As compared to a market without or with smaller image concerns, the model predicts a larger ratio between the variance in prices and the variance in qualities in the market that is subject to image concerns.*[24]

In both markets, the set of available qualities is predicted to be the same. But in the image market, at least the highest quality product is sold at a premium price but the lowest quality product is not. So the variance in prices goes up. If consumers have homogeneous image concerns or image concerns and taste for quality are perfectly positively correlated, Prediction 1 still applies.

In the wine market for example, the model would predict that for producers who are better-known and thereby have a higher signaling value λ, the spread in prices for a given set of qualities is larger than it is for a less well-known producers offering the same qualities.

Prediction 2. *Suppose image concerns are already reflected in the market. Then, an increase in the value of image, λ, either leads to an increase in prices and a weak increase in qualities for an unchanged number of products in the line, or the product line becomes shorter and only prices increase.*

In the special case where taste for quality and image concerns are perfectly positively correlated, the prediction is simply that an increase in the value of image leads to price changes whereas the set of available qualities is unaffected.

Prediction 3. *Increases in the fraction of image-concerned consumers, whether they are concerned with quality (α_s) or not (α_n),*

(i) trigger the monopolist to reduce quality and increase prices,

(ii) lead to an increase in profits,

(iii) but make individual consumers worse off.

Prediction 4. *As the share of quality-concerned consumers (β) increases, the monopolist raises both quality and prices.*

If image concerns and taste for quality are perfectly positively correlated, an increase in the share of image-concerned consumers leaves the set of available qualities unaffected. In a model without image concerns, qualities and prices would not react to changes in the fraction of quality-concerned consumers. Only the market share of high quality products would be affected.

5. 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 is, however, that for image concerns 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.

[24]Comparative statics with respect to the value of image can be directly read-off from Table 2.

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). In contrast, the monopolist induces separation through an additional product with lower quality (downward distortion).

5.1. A model of perfect competition

The consumer side is set up exactly as in Section 3. For the supply side, suppose 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 and is more general than assuming zero profits as is often done to model perfect competition.[25] 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

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

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).[26]

5.2. 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. His 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 outside good, the image of not buying is equal to zero unless any quality-concerned consumer also chooses this option.

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

Lemma 6. *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*

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

[25] The product design problem is assumed away on purpose in order to better understand how strategic product design contributes to the results in the monopoly case. The assumption precludes multi-product firms which could otherwise cross-subsidize products.

[26] Formally, the model does not have a receiver of signals and therefore is not a proper signaling game. This refinement is formulated in terms of best responses (Cho and Kreps, 1987). Here, formally no party acts upon the product choice but the images can be interpreted as a consumer's perception of an inactive third player's belief about his type. Then, the original logic of the refinement applies. See also Gradwohl and Smorodinsky (2014) for using the Intuitive Criterion in Perception Games.

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 $\frac{1}{2}$, 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 values of image $\lambda > \frac{1}{2}$, 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 single-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 $(1, \frac{1}{2})$.[27] 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 It is easy to see that partially separating equilibria must induce a consumer partition where purely quality-concerned and purely image-concerned consumers pool on the product $(1, \frac{1}{2})$, consumers who value both quality and image separate from the others by buying another product (s', p'), and those who value neither quality nor 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 $(s, p) \neq (1, \frac{1}{2})$. Then, 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.

Among the partially separating two-product equilibria, we can distinguish two classes: those where products are priced at marginal costs and those where prices exceed marginal costs.

Lemma 7. *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*

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

Consumers who value both quality and image buy $(1 + \varepsilon, \frac{(1+\varepsilon)^2}{2})$, a product which provides a **functional excuse** while being priced at marginal cost. 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.

[27] This type of randomization is consistent with Assumption 1 but never chosen by the monopolist.

Lemma 8. *For $\lambda > \frac{1}{2}$, we find $s \geq 1$ and $\eta > 0$ such that the two products $(1, \frac{1}{2})$ and $(s, \frac{1}{2}s^2+\eta)$ form a separating equilibrium with*

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

where purely image-concerned consumers buy with probability q and

$$q = \begin{cases} (2\lambda - 1)\frac{\beta\alpha_s}{(1-\beta)\alpha_n} & \text{if } \frac{1}{2} < \lambda \leq \frac{1}{2}\frac{(1-\alpha_s)\beta+q\alpha_n(1-\beta)}{(1-\alpha_s)\beta} \\ 1 & \text{if } \lambda > \frac{1}{2}\frac{(1-\alpha_s)\beta+q\alpha_n(1-\beta)}{(1-\alpha_s)\beta} \end{cases} \tag{6}$$

In this type of equilibrium, consumers who value image and quality pay a price premium above marginal costs to separate from purely image-concerned consumers. It turns out that this way of separating requires beliefs that are not consistent with a standard refinement.

5.3. Equilibrium refinement

There are generically multiple two-product equilibria. Furthermore, the single-product equilibrium from Lemma 6 also coexists with the two-product ones. I employ a refinement in the spirit of the Intuitive Criterion (IC) by Cho and Kreps (1987) to obtain a unique equilibrium prediction.[28] 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 single-product equilibria where purely image-concerned consumers buy positive quality. Figure 4 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 with $(s,p) = (1, \frac{1}{2})$ if $\lambda \leq \frac{1}{2}$.

(ii) functional excuse with $(s_L, p_L) = (1, \frac{1}{2})$ and $(s_H, p_H) = (1+\varepsilon, \frac{1}{2}(1+\varepsilon)^2)$ for $\varepsilon = \sqrt{1 + 2\lambda\frac{q(1-\beta)\alpha_n}{\beta(1-\alpha_s)+q(1-\beta)\alpha_n}} - 1$ if $\frac{1}{2} < \lambda$.

In functional excuse, the participation probability of purely image-concerned types is $q = (2\lambda - 1)\frac{((1-\alpha_s)\beta))}{(\alpha_n(1-\beta))}$ for $\frac{1}{2} \leq \lambda < \frac{1}{2}\frac{(1-\alpha_s)\beta+\alpha_n(1-\beta)}{(1-\alpha_s)\beta)}$, and $q = 1$ otherwise.

The first claim is trivial. For $\lambda < \frac{1}{2}$ purely image-concerned consumers prefer $(0,0)$ over buying the product $(1, \frac{1}{2})$ 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 $(1, \frac{1}{2})$ is $R(1, \frac{1}{2}) = 1$. Thus, consumers who value image and quality also choose $(1, \frac{1}{2})$. To prove the second claim, I first rule out all two-product equilibria but the one that separates at least cost to the consumers. Then, I show that the single-product equilibrium is inconsistent with the Intuitive Criterion for $\lambda > \frac{1}{2}$: Suppose we are in the single-product equilibrium. 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. Then, the associated image must be $R(1+\varepsilon, \frac{(1+\varepsilon)^2}{2}) = 1$. Otherwise we would assign positive probability to a type who would never gain from choosing this product. But then a consumer who values quality and image would always want to deviate.

[28] As argued in Footnote 26 my model can be interpreted as a signaling game by introducing a third inactive player. Then, the intuitive criterion applies in the conventional way.

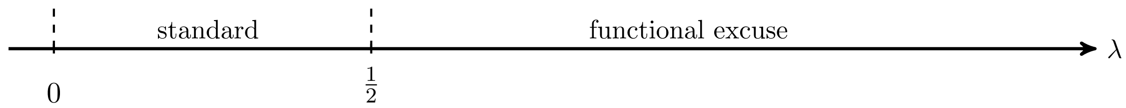

Figure 4: Competitive equilibrium satisfying the Intuitive Criterion.

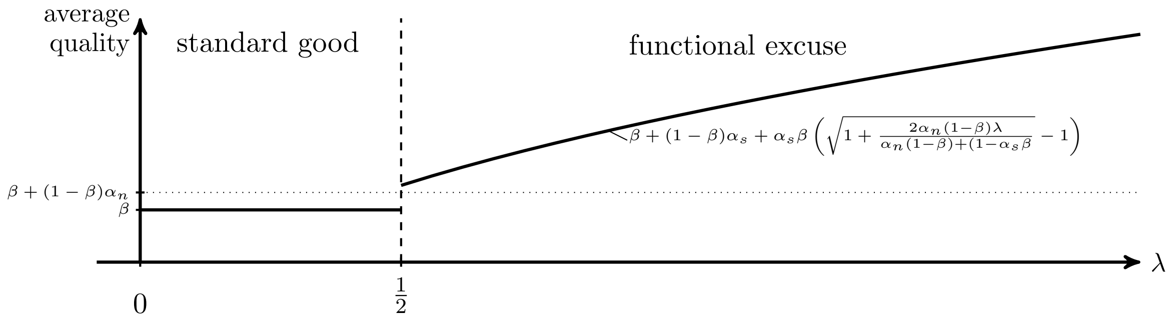

Figure 5: Average quality in a competitive market. In the absence of image concerns, average quality equals β.

If the intensity of image concerns is small, the equilibrium resembles the monopolistic **standard good** case: a product with quality $s = 1$ is bought by all consumers who value quality. Those who do not value quality pick the outside option, which 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 excessive 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 quality $s = 1$ and is bought by consumers who value either image or quality. The high quality product with $s > 1$ is not attractive for the purely image-concerned consumers due to its high price even at marginal cost pricing.[29]

Proposition 3 characterizes the competitive equilibrium as a function of the value of image λ. From this, one can compute average quality in the market. Figure 5 illustrates that the average quality level, which depends on the qualities sold to consumers as well as on the fractions of consumers who buy a given quality, is increasing in the value of image λ.

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 preference 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. 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.

[29]This result relies on 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.

5.4. Testable predictions

Prediction 5. *In a competitive market, (i) average quality is (weakly) higher than in monopoly, and (ii) average quality increases in the value of image* λ.

In contrast, in a model where image concerns are not taken into account, are assumed to be homogeneous across individuals, or perfectly positively correlated with tastes for quality, we would not predict average quality to be higher in a competitive setting than in monopoly.

Prediction 6. *In a competitive market, average quality increases in* α_s *and* α_n *and is non-monotone in* β.

In a model without image concerns, only an increase in β is predicted to trigger an increase in average quality due to an enlarged market share for the high-quality product.[30]

6. 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 not welfare neutral in market-based allocations.

6.1. Welfare-maximizing allocations

The analysis of profit-maximizing behavior focused on consumer partitions that can be sustained by incentive-compatible product lines. As the welfare-maximizing partition may not be incentive-compatible, more partitions have to be considered. In total, the four types of consumers can be grouped in 15 different ways. For the welfare analysis, I have analyzed all of these partitions. First, I identify the quality levels that maximize welfare for a given partition. Second, I compare welfare across partitions. The welfare measure is the aggregate consumer utility[31] generated by the quality allocations minus the cost of producing the respective quality levels.

Proposition 4. *Welfare is maximized by providing quality as if image concerns were absent if* $\lambda \leq \frac{1}{2}$. *If* $\lambda > \frac{1}{2}$, *welfare is maximized by providing zero quality to consumers who value neither quality nor image,* $s_L^w = \frac{(1-\alpha_s)\beta}{(1-\alpha_s)\beta+\alpha_n(1-\beta)}$ *to consumers who value either quality or image, and* $s_H^w = 1$ *to consumers who value both quality and image.*

Corollary 3. *Quality* s_L^w *is independent of the value of image,* λ. *The monopolist underprovides quality to purely image-concerned consumers and to purely quality-concerned consumers,* $s_L^m < s_L^w$, *for* $\lambda < 1$, *and overprovides it,* $s_L^m > s_L^w$, *for* $\lambda > 1$.

Corollary 4. *The competitive market implements the welfare optimum for* $\lambda \leq \frac{1}{2}$. *For* $\lambda > \frac{1}{2}$, *the competitive market, overprovides quality to all consumers but those who value neither image nor quality, i.e.* $s_L^w < s_L^c$ *and* $s_H^w < s_H^c$.

[30] Prediction 5 can be directly read off from Figures 3 and 5. The formal result behind Prediction 6 is proved in Appendix B.1.

[31] Note that in this special case with $\sigma_L = \rho_L = 0$, utility of unconcerned consumers equals zero. The results generalizes easily to $\sigma_L > 0$.

6.2. When does monopoly yield higher welfare than competition?

Even though the monopolist does not in general implement the welfare maximizing allocation, competition does in general not do better. The reason is that the monopolist can stabilize separation through its pricing while consumers use excessive quality to separate in competition. The former often yields higher welfare. For instance, monopoly yields higher welfare than competition if half of the population values quality, half is concerned with their image, the image concern is independent of the taste for quality, and image and quality are weighed equally in the utility function.

Proposition 5. *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 in monopoly, which yields image building, is* 0.5625 *whereas welfare in competition, which yields functional excuse, is* 0.478553.

Welfare in monopoly is continuous in λ 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. □

The result from Proposition 5 that the competitive market outcome may lead to lower welfare than monopoly does not depend on the refinement used in the competitive setting, and it does not depend on the equilibrium selection in monopoly either (see Appendix B.6 and B.7).

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. Whether consumers are better off in competition or monopoly depends on the consumer type and the product line offered by the monopolist.

Corollary 5. *Consumers who value quality always benefit from competition but there exist parameters such that consumers who value only image are better off in monopoly.*

Corollary 6. *If the monopolist offers an image building product line, all consumer types would be (weakly) better off in a competitive market.*

6.3. 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 that 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. Due to this change in equilibrium, quality regulation can trigger decreases in consumer surplus and in welfare.

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

A minimum quality standard as analyzed for the monopoly case does not bite in competition because qualities are already upward distorted. 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.

Proposition 7. *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 one in which 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 value quality and image might be worse off with a luxury tax than without it because the tax might exceed the private gain from regulation. The private gain is given by the reduction in price(=marginal cost) corrected for the reduction in quality.[32]

Whereas in a standard model without image concerns, all consumers would profit from the market becoming more competitive, my model predicts that consumers are differently affected. Moreover, the mentioned policy measures affect market participants differently. To investigate this in detail, one would need data about consumer satisfaction and purchasing motivations for a period where a market with image concerns becomes more competitive. Consumer surveys may be a reasonable source.

7. Extensions and robustness

7.1. Generalizing types

The main analysis concentrates on the simplified case with $\sigma_L = \rho_L = 0$ for two reasons. One is tractability but the more important one is that this simplification prevents quality distortions in the benchmark model without image concerns because the low quality valuation type is always excluded. If I modify the model such that $\sigma_L > 0$, the decision whether or not to exclude any consumer type becomes more delicate. Still, the results from before go through qualitatively: For low image concern, the product line looks the same as if image concerns were absent: two quality levels are offered. For intermediate image concerns, three different quality levels are offered, and consumers who have a low quality valuation and care about image pool with those who have a high valuation and do not value image on the product of intermediate quality. For high image concerns, two quality levels are sold, one exclusively to those who value image and quality, the other one to all other consumers.

These qualitative results are modified in that any type of product line as derived in the main analysis exists in two versions: one where consumers with the lowest willingness to pay are excluded, so that the product of lowest quality is $(0, 0)$, and one where they are served a product of positive quality, where the product of lowest quality is $(s_L, p_L) \neq (0, 0)$. Whether the product intended for the lowest type is equal to the outside option or not depends on the distribution of preferences, σ_L and σ_H but it does not depend on the strength of image concerns, λ, and exclusion does not need to occur.[33]

[32] The social gain is positive. A reduction in quality moves the quality level closer to first best and thereby narrows the gap between the consumers quality valuation and marginal cost. 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.

[33] Supplementary material regarding this generalization is available upon request. *For the review process, the respective files have been included in the submission as supplementary material.*

7.2. Heterogeneity in wealth

If consumers do not differ in intrinsic quality preferences but in wealth and desire to signal wealth rather than quality preferences, the model can be directly interpreted that way. In this reinterpretation, a higher willingness to pay for quality is a signal of wealth not quality preferences. While the model has been framed as one in which consumers have different tastes for quality which they want to signal, there is a dual interpretation in which consumers are heterogeneous in wealth and want to signal their wealth to other consumers. Heterogeneous tastes for quality in the indirect utility functions of the presented model can be derived from direct utility functions with identical reservation prices but income heterogeneity (see e.g. Peitz, 1995). In this setting, consumers with higher income (or higher wealth) value quality more. Put differently, the taste parameter σ in the indirect utility representation is a measure of the marginal intrinsic utility from quality relative to the marginal value of money.

If consumers were interested in signaling the compound of taste and income, the model itself would not have to change. However, the screening problem in which consumers also differ in their signaling motivation becomes potentially much more complicated because the compound of the two motivations can take on more than two different values. But this modification is likely to again yield partial pooling in equilibrium. The underlying intuition is the same as before: consumers with relatively high intrinsic motivation and wealth but with low image concern provide positive externalities to consumers with high image concern but relatively low intrinsic motivation and wealth such that surplus can be increased by pooling these types.

The problem becomes more complicated if instead the inferences regarding taste for quality and wealth enter utility with opposite signs. Bénabou and Tirole (2006) analyze a related problem in which agents choose their degree of prosocial behavior in the presence of image concerns and monetary incentives. In contrast to their setting, my paper focuses on a strategic supplier who interferes with the signal space. Providing a formal extension that incorporates the signal jamming intuition from Bénabou and Tirole (2006) is beyond the scope of this paper.[34]

Let me nonetheless provide some intuition on how inferences in my model would be affected by additional wealth heterogeneity. If intrinsic taste for quality and income are perfectly positively correlated, the dimensionality of the model remains the same but the spread in valuations increases. If the correlation is positive but imperfect, the image of having a high taste for quality associated with the purchase of a high quality product is diluted by the wealth confound but the basic intuitions of the model will still apply because purchasing higher quality remains a signal of having a high taste for quality. However, if the correlation between wealth and intrinsic taste for quality is negative, the inference about intrinsic preferences from purchases becomes increasingly blurred by wealth differences. In the extreme case of a perfect negative correlation, those with low intrinsic interest but high wealth may have the highest willingness to pay for quality and therefore, ceteris paribus, buy the highest quality product. If consumers care about being perceived as intrinsically interested in quality, such a situation would resemble one in which purchasing a high quality product is stigmatized (cf. Section 7.4). Those who care about their image are deterred from buying the high quality because the associated image is worse than the one of buying lower quality or not buying at all because the less wealthy who value quality cannot afford high quality. In such a situation, the monopolist will try and pool the wealthy with the quality-concerned consumers by lowering the price accordingly.

A simple way to capture the intuition from additional wealth heterogeneity, without explicitly modeling it, is to interpret λ as the product of the informativeness of the purchasing decision with respect to taste and the value of the social image as such. If the distribution of wealth and tastes are not aligned, a purchase is not very informative about tastes and thus, the realized utility from image is low, and vice versa.

[34] Bénabou and Tirole (2006) provide a solution for their model under the assumption that valuations are normally distributed and image concerns are independent from intrinsic motivation. The problem becomes significantly more complicated by introducing a strategic producer and by letting go of independence.

I find a different approach much more relevant though: If a consumer population is heterogeneous with respect to the three dimensions quality preferences, wealth, and image concern, the producer could differentiate its products in two quality dimensions, one that appeals to the intrinsic quality valuation and one that targets wealth alone. We observe this for instance in the car market, where different categories of cars target wealth but within each category cars differ in how environmentally friendly they are. Thus, the manufacturer also screens with respect to sustainability preferences. The formal analysis of optimally screening along multiple dimensions (other than image concerns) is again beyond the scope of this paper. See for instance Ketelaar and Szalay (2014) for recent progress in this direction.

7.3. Stigmatization of consumers with low quality concern

The analysis assumes that consumers derive positive utility from being considered as those who have a high taste for quality. An alternative possibility is that consumers experience negative utility from being considered as having a low taste for quality. The latter view is one of social pressure to which individuals want to conform. A modified model that includes the social pressure interpretation gives exactly the same predictions (see Appendix B.4). The welfare analysis, however, depends on the frame. Whereas higher visibility of behavior, reflected in a higher λ, increases consumer utility and welfare in the positive social image frame, consumer utility and welfare decrease in λ in the social pressure frame. If the mechanism at work is indeed social pressure, consumers may profit from policies that hinder inferences about individuals' purchasing motivations, for instance restrictions in the variety of products being sold.

7.4. High interest in quality is stigmatized

Suppose the model is as laid out in the monopolistic case in Section 4 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 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 describes a pattern of group behavior consistent with this interpretation.

Proposition 8. *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.

If quality is associated with stigma, the monopolist either reduces the price of quality or accepts to sell to fewer consumers 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.

7.5. Differing views on what gives a good image

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 my 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 lines 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.

7.6. 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 as 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). No-one, however, takes into account that his individual purchase has an impact on the aggregate level of provision of the public good.

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 3 and 5: If the social value per unit of quality is γ, the socially efficient provision level is $\beta + \gamma$ which is constant in λ but in general different from the market-based levels of provision. Still, under some conditions image concerns can help to move aggregate consumption of quality closer to the optimum so that the pessimistic perspective of Frank (2005) on positional goods might have to be reconsidered.[35]

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, λ, increases. Second, raising awareness can mean that the number of intrinsically motivated consumers, β, increases. Finally, it can mean that the fraction of consumers who value image - α_s, α_n, whether or not they value quality - increases. 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 2, however, this intuition is wrong; increases in image concerns can decrease the provision of quality.

8. Discussion of existing and new insights

8.1. Conspicuous consumption and status seeking in economic theory

The idea that individuals engage in consumption conspicuously goes back at least to Veblen (1915). While Becker's (1974) analysis of the influence of social interactions can be applied to understand status concerns in consumer behavior, Frank (1985) provides a more explicit formal

[35] Frank (2005) discusses how "positional externalities cause large and preventable welfare losses" by inducing people to spend too much. In my paper, images lead to positional externalities and quality is a positional good in the sense of Frank (2005). If image motivated spending helps to provide a public good, it is not pure waste of resources anymore and welfare effects become more complex.

analysis of how status seeking behavior affects the consumption of observable and unobservable goods. Since then, several studies have presented theoretical analyses of the distorting forces of status seeking behavior on patterns of consumption (Ireland, 1994; Bagwell and Bernheim, 1996; Corneo and Jeanne, 1997).[36] In line with these approaches, I model images as signals about a consumer's type. There is, however, also a strand in the literature that models the conspicuousness of a good as a consumption externality that depends only on the number of consumers (e.g. Buehler and Halbheer, 2012). Within this class of papers, some authors distinguish snobs who prefer to consume in a small group and followers who gain utility when more others consume the same product (Leibenstein, 1950; Amaldoss and Jain, 2011; Tereyagoglu and Veeraraghavan, 2012). Corneo and Jeanne (1997) show that the signaling approach is more general as a follower and a snob effect (Leibenstein, 1950) emerge endogenously.

Despite the length and breadth of this literature, only few studies analyze production and pricing decisions of strategic firms facing a population of conspicuous consumers. To the best of my knowledge, only in the model by Rayo (2013) the producer decides about a product line to profit from image concerns. Rayo (2013) extends a Mussa-Rosen type model of quality provision to allow for heterogeneous image concerns. In contrast to my model, he assumes that marginal utility from quality and image are proportional to each other which simplifies the monopolist's problem to a one-dimensional screening problem. The distortions in quality provision are identical to those well-known from the literature and image concerns influence solely the pricing schedule. Pooling occurs if and only if the monopolist's marginal revenue function is somewhere decreasing in consumer type.[37] My model illustrates a different reason for pooling, namely that marginal utilities in both dimensions are not aligned.[38]

Vikander (2011) allows for strategic producer behavior in a different way: keeping the product line fixed, he analyzes how a firm optimally chooses its advertising strategy to maximize profit from a population that differs in wealth and cares about status. Mazali and Rodrigues-Neto (2013) analyze how many different brands a monopolist wants to provide if consumers differ in ability that they want to signal to potential match partners. In their paper, brands are pure status goods and the focus is on the effect of fixed development costs. In addition, several papers focus on rationing strategies that foster status through artificial scarcity when consumers care about reference group effects (Amaldoss and Jain, 2008, 2010).[39] These models do not allow the producer to offer multiple quality-differentiated products. Moreover, Amaldoss and Jain (2008, 2010) distinguish consumers who are leaders and can purchase first from those who are followers, observe behavior, and desire to emulate leaders. Thus, the characteristics that identify a leader have to be observable.[40] Here, I am interested in second-degree price discrimination when consumers desire to signal an unobservable trait like taste, wealth, or prosociality so that this paper is complementary to those analyses.

The monopolist in my paper is designing a product line to influence how consumers sort into groups by purchasing different products. The products are associated with different images that are derived from the types of consumers who purchase them. Relatedly, Board (2009) investigates how a firm designs groups by setting a menu of access prices when agents care about peer effects and can self-select into their preferred group. One way to specify the peer effect is as the conditional expectation of an agent's type in a given group. An agent's utility

[36] Status seeking behavior has also been analysed as a motivation for charitable giving, a special variant of consumption (Glazer and Konrad, 1996; Harbaugh, 1998a,b).

[37] This corresponds to a violation of the often made assumption that the hazard rate of the type distribution is increasing. Bolton and Dewatripont (2004) discuss this phenomenon as "bunching and ironing" (p. 88ff).

[38] 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).

[39] Tereyagoglu and Veeraraghavan (2012) show that a firm may create scarcity by using an expensive source to commit to a low production volume.

[40] In a similar spirit, Kircher and Postlewaite (2008) analyze how consumer emulation leads firms to treat better-informed consumers better than others.

from the peer effect and his marginal contribution to the peer effect are assumed to be perfectly correlated. The paper offers interesting results on the way the peer technology and cost of group formation affect the optimal group structure and how it differs from the market outcome. In this paper, I am instead interested in quality decisions in the presence of a particular type of peer effect. Moreover, I am particularly interested in the consequences of an imperfect correlation between an agent's valuation of the peer effect, here the image concern, and his contribution to this peer effect as given by his taste for quality.

In contrast to classic conspicuous consumption models in which consumers signal their wealth by adjusting their purchased quantity freely (Ireland, 1994; Bagwell and Bernheim, 1996; Corneo and Jeanne, 1997), I assume unit demand. Thus, the effect of image concerns shows up in inefficient quality levels whereas status concerned consumers buy inefficient quantities in the classic setup. If image is not related to wealth but to other traits, however, signaling via quantity is unreasonable. Moreover, I assume that consumers also differ in their image concern and not only in their taste for quality as is the case in the classic models.

The utility function in my model is similar to the one used in Bernheim (1994) where intrinsic utility and image also enter utility additively. Apart from that, the models differ substantially. Bernheim (1994) assumes a continuous distribution over intrinsic preferences and imposes a homogeneous interest in status. In contrast, I work with only two different values for intrinsic preferences but with heterogeneous interests in image. Moreover, the focus of the analysis in Bernheim (1994) is how concerns for social esteem influence consumers' actions in a setup where the action space of consumers is unrestricted. The main point of my analysis is how the supply side reacts to consumers' status concerns and how it manipulates the signaling possibilities in the market. It thereby sheds light on a hitherto underresearched aspect of conspicuous consumption. Following Bernheim (1994) more closely, it would be an interesting further question to analyze institutional design in the presence of status concerns and conformity. In this line, for instance Daughety and Reinganum (2010) analyze when contributions to a public good should be observable or unobservable if agents are subject to social pressure.

8.2. Relation to (two-dimensional) screening models

My model also contributes to the literature on two-dimensional screening as it adds a second degree of preference heterogeneity to a conspicuous consumption model. Types are binary in both dimensions as in Armstrong and Rochet (1999). But in contrast to their paper, image as the additional product characteristic cannot be chosen freely in my model but product images must be consistent with consumers' purchasing choices so that already the first-best solutions of the models differ. By designing the product line, the monopolist influences which images are available in the market. As a consequence, pooling occurs generically and for reasons different from the bunching condition in existing (multi-dimensional) screening models (Rochet and Choné, 1998). Due to the heterogeneity in image concerns, allocating image is not a zero-sum game anymore. Pooling is 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. Several consumer types may bunch on the outside option, that is exclusion might involve pooling, but pooling also occurs on products with positive qualities. While exclusion is of additional interest in multi-dimensional models, the main analysis in my paper uses a setup, where exclusion occurs by design. As the lower valuations have been set to zero, the lowest type will never find it optimal to buy a product with a positive price and therefore will never be sold a product with positive quality. In the generalized model with $\sigma_H > \sigma_L > 0$, exclusion occurs endogenously (see Section 7.1).

A main result of the paper is that the monopolist reacts to image concern by offering a product of inferior quality in addition to its regular product line. This finding is reminiscent of the argument by Deneckere and McAfee (1996) that producers may segment a market by offering a damaged version in addition to the regular product. In Deneckere and McAfee (1996), the damaged product is more costly to produce than the high quality product so that the prediction that producers actually damage parts of their production is striking. In my model, the decrease in quality comes with a cost reduction to the producers and is thus less surprising. But in contrast to Deneckere and McAfee (1996) (which is itself closely related to the typical downward distortions found in screening models as for instance Mussa and Rosen, 1978), the intuition behind lowering the quality is different here. The product with lower quality compromises on quality to save production costs: The quality is chosen such that its value does not exceed that of the image because the price of the lower quality product cannot exceed the value of the associated image. On the other hand, pooling purely image-concerned with purely quality-concerned consumers "damages" the image associated with the lower quality product so as to keep it unattractive for those who care about image and quality.

9. 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 and the social image attached to it, I derive the optimal product line offered by a monopolist for any combination of the relative frequencies 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, the profit-maximizing product line is distorted to take consumers' signaling desire into account. Even though not justified by heterogeneous tastes for 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 at higher prices. In a competitive market, consumers' image concerns also induce differentiated product purchases. In contrast to the monopoly case, consumers use excessive quality as a functional excuse to separate from others and improve their image. The competitive outcome of separation via excessive quality is less efficient than separation in monopoly via strategic product line design. 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 caters 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 aggregate provision of the public good. Under competition, however, quality provision never decreases when image concerns increase. Even though competition leads to higher average consumption of quality, welfare may be lower than in monopoly if the cost of providing quality and the utility provided in form of image are taken into account.

The predictions for the monopoly case in my model depend on tastes for quality and image concerns are correlated. However, little research has investigated heterogeneity in image concerns. In related work (Friedrichsen and Engelmann, 2013), we find evidence for a negative relationship between intrinsic motivation and image concerns in Fairtrade consumption. Results in other studies, discussed above, also point toward negative correlations between the two motivations in the context of luxury consumption, organic purchases, financial investing, and tax evasion. This underlines the empirical relevance of the most interesting *image building* equilibrium. It corresponds to a masstige strategy as discussed in the marketing literature.

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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 $\sigma = 1$. Non-participation corresponds to the product $(0, 0)$, the image of which might be positive. I index images, qualities, and prices within a product line 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 1

Proof. Suppose the monopolist offers $\mathcal{M} \subset \mathbb{R}^2_{\geq 0}$. Denote by $(s, p)^*$ the product in $\mathcal{M}$ which maximizes $s - p$. Assume without loss of generality that the maximizer is unique.[41] Then type 10 buys this product. Note that unconcerned consumers who do value neither quality nor image,

[41] 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 product line, namely the one that yields a higher profit margin $p - \frac{1}{2}s^2$.

$\sigma = \rho = 0$ decide not to buy from the monopolist for 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 $(0,0)$. □

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 concerns, 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

$$\beta(1-s_1) = 0 \Rightarrow s_1^* = 1 \quad \text{and} \quad -\beta - (1-\beta)s_0 < 0 \Rightarrow s_0^* = 0.$$

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 product line 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 $\Pi^P = \beta\lambda < \Pi^S$. 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.[42] □

[42] 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 product line cannot be optimal for the monopolist so that I do not have to consider it further. The same argument applies

Proof of Lemma 5

Proof. Suppose to the contrary that the monopolist offers (s_P, p_P) to types 01 and 11, a different product $(s_{10}, p_{10}))$ and types 10 and 00 choose $(0,0)$.

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:

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

□

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 line $\mathcal{M}$. 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 lines 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 4 a product line 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 $p' = p_H$.

to equilibria where only a fraction of consumers coordinates. I discuss contracts which are robust against consumer coordination in Appendix B.7.

(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 product line $(0, 0)$, (s_L, p_L), (s_H, p_H) must yield higher profit.

The same arguments apply for several additional products. As it is not profitable to introduce one additional product into the two-product line, introducing several is not profitable either. □

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. Theoretically, there are 15 ways to split consumers into groups (see Proof of Proposition 4) but most are inconsistent with profit maximization. First, Lemma 2 states an equilibrium candidate which offers strictly positive profit under heterogeneous image concerns. Thus, 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 his image is zero but he only buys if he is pooled with type 10 or type 11. This also implies that a partition that isolates type 01 cannot be profit-maximizing. Fourth, types 10 and 11 cannot be profitably split from each other and separated from a pool of types 01 and 00 because they prefer the same quality-price combination which for both is associated with the ideal image. Moreover, Lemma 4 rules out full separation, and by Lemma 5 a pure image good does not exist in equilibrium.

Finally, types 01 and 11 cannot be pooled without type 10. Suppose to the contrary that the monopolist offers (s_P, p_P) to types 01 and 11, a different product $(s_{10}, p_{10})) \neq (0, 0)$ to type 10 and type 00 chooses $(0, 0)$. 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. Therefore type 01 and type 11 choose the same product *only* if type 10 chooses the same product. □

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 is not feasible anymore. Hindering type 01 from buying would require a quality so high that profit is negative. □

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 λ. 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 $s = 1$. □

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

$$p_H \leq p_L + \lambda \frac{\alpha_n(1-\beta)}{(1-\alpha_s)\beta + \alpha_n(1-\beta)} + s_H - s_L \tag{7}$$

Participation of 10 and 01 requires $p_L \leq \min\{\lambda R_L, s_L\}$. Incentive compatibility needs $s_L - p_L \geq s_H - p_H$ 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, (7) 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 $s_L > \lambda R_L$. Consider an alternative product $(s', p') = (\lambda R_L, \lambda R_L)$ of lower quality but 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 $s_L > \lambda R_L$, $\Delta\Pi > 0$. 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 λ 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 $p_1 = 1 + \lambda\frac{1-\beta}{1-\alpha_s\beta}$. □

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

Proof of Proposition 2

Proof. I first characterize the profit functions, then exclude mass market from consideration, and finally compare profits across the remaining equilibrium candidates.

Lemma A7. *Profits from standard good, image building, and exclusive good are continuous in λ. (i) Profit in standard good (Π^S) is constant for $\lambda < 1$ and decreasing and concave for $\lambda \geq 1$. (ii) Profit in image building (Π^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 (Π^E) is linearly increasing.*

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

$$\Pi^S = \begin{cases} \frac{\beta}{2} & \text{if } \lambda \leq 1 \\ \beta\left(\lambda - \frac{\lambda^2}{2}\right) & \text{otherwise} \end{cases} \tag{8}$$

$$\Pi^I = \begin{cases} \frac{\beta\left(\alpha_n(1-\beta)(\alpha_s+2\lambda)+(1-\alpha_s)\beta\left(\alpha_s(1-\lambda)^2+(2-\lambda)\lambda\right)\right)}{2\alpha_n+2(1-\alpha_n-\alpha_s)\beta} & \text{if } \lambda \leq \lambda_2 \\ \frac{1}{2}(\beta+\alpha_n(1-\beta)) + \frac{\alpha_n\alpha_s(1-\beta)\beta\lambda}{(1-\alpha_s)\beta+\alpha_n(1-\beta)} & \text{otherwise} \end{cases} \tag{9}$$

$$\Pi^E = \alpha_s\beta\left(\frac{1}{2} + \frac{(1-(1-\alpha_s)\beta-\alpha_s\beta)\lambda}{1-\alpha_s\beta}\right) \tag{10}$$

From these I derive

$$\frac{\partial \Pi^S}{\partial \lambda} = \begin{cases} 0 & \text{if } \lambda \leq 1 \\ \beta(1-\lambda) < 0 & \text{if } \lambda \geq 1 \end{cases} \qquad \frac{\partial^2 \Pi^S}{\partial \lambda^2} = \begin{cases} 0 & \text{if } \lambda \leq 1 \\ -\beta < 0 & \text{if } \lambda \geq 1 \end{cases}$$

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

$$\frac{\partial \Pi^E}{\partial \lambda} = \frac{\alpha_s(1-\beta)\beta}{1-\alpha_s\beta} > 0 \qquad \frac{\partial^2 \Pi^E}{\partial \lambda^2} = 0$$

□

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. From Lemma A4, profit in mass market is

$$\Pi^M = \begin{cases} \frac{1}{2}\beta\lambda\left(2 - \frac{\beta\lambda}{\beta+\alpha_n(1-\beta)}\right) & \text{if } \lambda \leq \lambda_1 \\ \frac{1}{2}(\alpha_n(1-\beta)+\beta) & \text{otherwise} \end{cases} \tag{11}$$

Suppose $\lambda \leq \lambda_1$. Rearranging profits $\Pi^I - \Pi^M$ as given in equations 9 and 11, yields

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

Since A>0 and B<0, $\Pi^I - \Pi^M$ does not have a real root but $\Pi^I > \Pi^M$ for all $\lambda \geq 0$.
Suppose $\lambda_1 < \lambda \leq \lambda_2$.

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

The LHS is a downward-opening parabolic function in λ whose roots 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 $\lambda \geq 1$, Π^S is decreasing in λ, Π^M is increasing in λ, and at $\lambda = 1$ $\Pi^M > \Pi^S$ (equations 8 and 11). By Lemma A8 Π^M is never maximal and therefore $\tilde{\lambda}_m < 1$. Suppose now $\lambda < 1$. Rearranging terms gives

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

Tis 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 have

$$\Pi^S \geq \Pi^I \text{ if } \lambda \leq \lambda^{(1)} = 1 + \frac{\alpha_n(1-\beta)}{(1-\alpha_s)^2\beta} - \frac{\sqrt{\alpha_n(1-\beta)(\alpha_n(1-\beta)+(1-\alpha_s)^2(1+\alpha_s)\beta)}}{(1-\alpha_s)^2\beta} =: \lambda_{SI} \tag{12}$$

Using the respective profit functions from equations 8 and 10 I obtain

$$\Pi^S \geq \Pi^E \text{ if } \lambda \leq \frac{(1-\alpha_s)(1-\alpha_s\beta)}{2\alpha_s(1-\beta)} =: \lambda_{SE} \tag{13}$$

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 (12) and (13) I compute

$$\lambda_{SE} \leq \lambda_{SI} \quad \Leftrightarrow \quad \alpha_s > \tfrac{1}{3} \text{ and } \beta < \tfrac{3\alpha_s - 1}{\alpha_s + \alpha_s^2} \text{ and } \alpha_n \leq \tfrac{\beta(1+\alpha_s(\beta+\alpha_s\beta-3))^2}{4\alpha_s(1-\beta)^2} \tag{14}$$

and thus have

$$\tilde{\lambda}_m \quad := \quad \begin{cases} \frac{(1-\alpha_s)(1-\alpha_s\beta)}{2\alpha_s(1-\beta)} & \text{if 14 holds} \\ 1 + \frac{\alpha_n(1-\beta)}{(1-\alpha_s)^2\beta} - \frac{\sqrt{\alpha_n(1-\beta)(\alpha_n(1-\beta)+(1-\alpha_s)^2(1+\alpha_s)\beta)}}{(1-\alpha_s)^2\beta} & \text{otherwise} \end{cases}$$

Derivation of $\tilde{\tilde{\lambda}}_m$:
Suppose $\lambda \leq \lambda_2$.

$$\Pi^I \geq \Pi^E \Leftrightarrow \lambda^2 - \lambda 2 \frac{\beta(1-\alpha_s) + (1-\beta)\alpha_n - \beta\alpha_s(1-\beta\alpha_s)}{\beta(1-\alpha_s)(1-\beta\alpha_s)} \leq 0 \tag{15}$$

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

$$\lambda_{\text{IE,low}} := \lambda^{(2)} = 2\frac{\beta(1-\alpha_s) + (1-\beta)\alpha_n - \beta\alpha_s(1-\beta\alpha_s)}{\beta(1-\alpha_s)(1-\beta\alpha_s)} \tag{16}$$

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

$$\Pi^I \geq \Pi^E \Leftrightarrow \lambda \leq \frac{1}{2}\frac{(\beta(1-\alpha_s) + (1-\beta)\alpha_n)^2(1-\beta\alpha_s)}{(1-\alpha_s)\beta^2\alpha_s(1-\beta)(1-\alpha_n)} =: \lambda_{\text{IE,high}} \tag{17}$$

Π^I is concave in λ for $\lambda \leq \lambda_2$, linear thereafter and Π^E is linear in λ for all values of λ (Lemma A7). Furthermore, we see that $\Pi^E|_{\lambda=0} < \Pi^I|_{\lambda=0}$. Thus, Π^I crosses Π^E only once and from above. Therefore, the region of λ where image building is optimal, is an interval. With $\lambda_{\text{IE,low}}$ and $\lambda_{\text{IE,high}}$ as defined in equations 16 and 17 we have

$$\begin{gathered} \lambda_{\text{IE,high}} \geq \lambda_2 \Rightarrow \lambda_{\text{IE,low}} \geq \lambda_2, \text{ and } \lambda_{\text{IE,low}} \leq \lambda_2 \Rightarrow \lambda_{\text{IE,high}} \leq \lambda_2 \\ \text{and } \lambda_{SE} \leq \lambda_{SI} \Rightarrow \lambda_{\text{IE,low}} \leq \lambda_{SI} \end{gathered} \tag{18}$$

Using (14) and (18), I define

$$\tilde{\tilde{\lambda}}_m \quad = \quad \begin{cases} \lambda_{SE} & \text{if (14) holds} \\ \lambda_{\text{IE,low}} & \text{if } \lambda_{\text{IE,low}} \leq \lambda_2 \text{ and } \neg\text{(14) holds} \\ \lambda_{\text{IE,high}} & \text{if } \lambda_{\text{IE,high}} \geq \lambda_2 \text{ and } \neg\text{(14) hold} \end{cases} \tag{19}$$

□

Proof of Corollary 1:

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 β, 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 6

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

Moreover, 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 $(1, \frac{1}{2})$ and $(0, 0)$. In equilibrium only a fraction q of the purely image-concerned consumers buy $(1, \frac{1}{2})$. The associated image is then $R(1, \frac{1}{2}, q) = \frac{\beta}{q(1-\beta)\alpha_n+\beta}$. The indifference condition for purely image-concerned consumers pins down its participation probability q and thereby the associated image uniquely:

$$\lambda\frac{\beta}{q(1-\beta)\alpha_n+\beta} = \frac{1}{2} \quad \Leftrightarrow \quad q = (2\lambda-1)\frac{\beta\alpha_s}{(2-\beta)\alpha_n} \tag{20}$$

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 $(s', p') \neq (1, \frac{1}{2})$. □

Proof of Lemma 7

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

$$\begin{aligned} &U_{01}(1, \frac{1}{2}, R(1, \frac{1}{2})) > U_{01}(1+\varepsilon, \frac{(1+\varepsilon)^2}{2}, R(1+\varepsilon, \frac{(1+\varepsilon)^2}{2})) \\ &\Leftrightarrow \lambda\frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s)+q(1-\beta)\alpha_n} - \frac{1}{2} > \lambda - \frac{(1+\varepsilon)^2}{2} \\ &\Leftrightarrow \varepsilon > \underline{\varepsilon} := \sqrt{1+2\lambda\frac{q(1-\beta)\alpha_n}{\beta(1-\alpha_s)+q(1-\beta)\alpha_n}} - 1 \end{aligned} \tag{21}$$

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

$$\begin{aligned} &U_{11}(1, \frac{1}{2}, R(1, \frac{1}{2})) < U_{11}(1+\varepsilon, \frac{(1+\varepsilon)^2}{2}, R(1+\varepsilon, \frac{(1+\varepsilon)^2}{2})) \\ &\Leftrightarrow 1+\lambda\frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s)+q(1-\beta)\alpha_n} - \frac{1}{2} < 1+\varepsilon+\lambda - \frac{(1+\varepsilon)^2}{2} \\ &\Leftrightarrow \varepsilon < \bar{\varepsilon} := \sqrt{2\lambda\frac{q(1-\beta)\alpha_n}{\beta(1-\alpha_s)+q(1-\beta)\alpha_n}} \end{aligned} \tag{22}$$

It follows from (21) and (22) that there is a continuum of separating equilibria $(1+\varepsilon, \frac{(1+\varepsilon)^2}{2})$ such that $\varepsilon \in [\underline{\varepsilon}, \bar{\varepsilon}]$.

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 Lemma 8

Proof. Suppose two products $(1, \frac{1}{2})$ and $(1, \frac{1}{2}+\eta)$ constitute a partially separating equilibrium: type 11 buys $(s, \frac{1}{2}s^2+\eta)$, 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 6. 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 $R(s, \frac{1}{2}s^2+\eta) = 1$. 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 $(s, \frac{1}{2}s^2+\eta)$ in the proposed equilibrium if

$$\begin{aligned} (23)\quad & U_{01}(1, \frac{1}{2}, R(1, \frac{1}{2})) \geq U_{01}(s, \frac{1}{2}s^2+\eta, R(s, \frac{1}{2}s^2+\eta)) \\ & \Leftrightarrow \lambda \frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s)+q(1-\beta)\alpha_n} - \frac{1}{2} \geq \lambda - \frac{1}{2}s^2 - \eta \\ & \Leftrightarrow \eta \geq \underline{\eta} := \lambda \frac{q(1-\beta)\alpha_n}{\beta(1-\alpha_s)+q(1-\beta)\alpha_n} + \frac{1}{2}(1-s^2) \end{aligned}$$

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 6.

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

$$\begin{aligned} (24)\quad & U_{11}(1, \frac{1}{2}, R(1, \frac{1}{2})) \leq U_{11}(s, \frac{1}{2}s^2+\eta, R(s, \frac{1}{2}s^2+\eta)) \\ & \Leftrightarrow 1 + \lambda \frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s)+q(1-\beta)\alpha_n} - \frac{1}{2} \leq s + \lambda - \frac{1}{2}s^2 - \eta \\ & \Leftrightarrow \eta \leq \bar{\eta} := \lambda \frac{q(1-\beta)\alpha_n}{\beta(1-\alpha_s)+q(1-\beta)\alpha_n} + (s-1) + \frac{1}{2}(1-s^2) \end{aligned}$$

It follows from (23) and (24) that there is a continuum separating equilibria (for $s = 1$, a unique equilibrium) with two products: $(1, \frac{1}{2})$ is bought by type 10 and type 01, $(s, \frac{1}{2}s^2+\eta)$ with $s > 1$ and $\eta \in (\underline{\eta}, \bar{\eta})$ is bought by type 11, and type 00 chooses the outside good $(0,0)$. The following beliefs sustain this as an equilibrium:

$$\mu(s,p) = \begin{cases} 1 & \text{if } (s,p) = (s, \frac{1}{2}s^2+\eta) \text{ with } s > 1, \quad \eta \in (\underline{\eta}, \bar{\eta}) \\ \frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s)+q(1-\beta)\alpha_n} & \text{if } (s,p) = (1, \frac{1}{2}) \\ 0 & \text{else.} \end{cases}$$

With these beliefs, any other product—associated with zero image—is less attractive to consumer type 11 and 01 than $(1, \frac{1}{2})$. □

Proof of Proposition 3

Proof. For the second part, suppose $\lambda > \frac{1}{2}$. I first show that among the separating equilibria a unique one is consistent with the Intuitive Criterion (IC). In this separating equilibrium $\varepsilon = \underline{\varepsilon}$. Then, I show that no pooling equilibrium is consistent with IC.

(i) The proof is by contradiction. Assume there is a separating equilibrium as derived in Lemma 7 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 7, in particular Equation 22). 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 $p > \frac{1+\underline{\varepsilon}}{2}$. 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 7.

(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:

$$U_{11}(1, \tfrac{1}{2}, R(1, \tfrac{1}{2})) < U_{11}(1+\varepsilon, \tfrac{(1+\varepsilon)^2}{2}, R=1) \Leftrightarrow \tfrac{\varepsilon}{2} < \lambda(1 - \tfrac{q(1-\beta)\alpha_n}{\beta(1-\alpha_s)+q(1-\beta)\alpha_n}) \tag{25}$$

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

$$U_{01}(1+\varepsilon, \tfrac{(1+\varepsilon)^2}{2}, \mu=1) < U_{01}(1, \tfrac{1}{2}, R(1, \tfrac{1}{2})) \Leftrightarrow \lambda(1 - \tfrac{q(1-\beta)\alpha_n}{\beta(1-\alpha_s)+q(1-\beta)\alpha_n}) < \varepsilon + \tfrac{\varepsilon}{2} \tag{26}$$

□

Proof of Proposition 4

Proof. If incentive compatibility and profit maximization do not have to be considered, the population of four types of consumers can be partitioned in 15 different ways:

One group: **1.** $\{00, 01, 10, 11\}$ (full pooling): Maximizing the welfare function with respect to qualities yields $s = \beta$. Welfare is

$$W_1 = \alpha_n(1-\beta)\left(\lambda\beta - \tfrac{1}{2}\beta^2\right) + \alpha_s\beta\left(\lambda\beta - \tfrac{1}{2}\beta^2 + \beta\right) + (1-\alpha_s)\beta\left(\beta - \tfrac{1}{2}\beta^2\right) - \tfrac{1}{2}(1-\alpha\text{n})(1-\beta)\beta^2. \tag{27}$$

Two groups: 2. $\{00,01\},\{10,11\}$ (standard good): Maximizing the welfare function with respect to qualities yields $s_L=0$, $s_H=1$. Welfare is

$$W_2=\alpha_s\beta\left(\lambda+\tfrac{1}{2}\right)+(1-\alpha_s)\beta\tfrac{1}{2}. \tag{28}$$

3. $\{00,10\},\{01,11\}$ (image good): Maximizing the welfare function with respect to qualities yields $s_L=\frac{(1-\alpha_s)\beta}{1-\alpha_n(1-\beta)-\alpha_s\beta}$ and $s_H=\frac{\alpha_s\beta}{\alpha_n(1-\beta)+\alpha_s\beta}$. Welfare is

$$\begin{aligned}W_3= {}&\alpha_s\beta\left(-\tfrac{\alpha_s^2\beta^2}{2(\alpha_n(1-\beta)+\alpha_s\beta)^2}+\tfrac{\alpha_s\beta\lambda}{\alpha_n(1-\beta)+\alpha_s\beta}+\tfrac{\alpha_s\beta}{\alpha_n(1-\beta)+\alpha_s\beta}\right)\\ &+\alpha_n(1-\beta)\left(\tfrac{\alpha_s\beta\lambda}{\alpha_n(1-\beta)+\alpha_s\beta}-\tfrac{\alpha_s^2\beta^2}{2(\alpha_n(1-\beta)+\alpha_s\beta)^2}\right)-(1-\alpha_n)(1-\beta)\tfrac{(1-\alpha_s)^2\beta^2}{2(\alpha_n(1-\beta)+\alpha_s\beta-1)^2}\\ &+(1-\alpha_s)\beta\left(\tfrac{(1-\alpha_s)\beta}{1-\alpha_n(1-\beta)-\alpha_s\beta}-\tfrac{(1-\alpha_s)^2\beta^2}{2(1-\alpha_n(1-\beta)-\alpha_s\beta)^2}\right).\end{aligned} \tag{29}$$

4. $\{00,01,10\},\{11\}$ (exclusive good): Maximizing the welfare function with respect to qualities yields $s_L=\frac{(1-\alpha_s)\beta}{1-\alpha_s\beta}$, $s_H=1$. Welfare is

$$\begin{aligned}W_4= {}&\alpha_s\beta\left(\lambda+\tfrac{1}{2}\right)+\alpha_n(1-\beta)\left(\tfrac{(1-\alpha_s)\beta\lambda}{1-\beta+(1-\alpha_s)\beta}-\tfrac{(1-\alpha_s)^2\beta^2}{2(1-\alpha_s\beta)^2}\right)\\ &-(1-\alpha_n)(1-\beta)\tfrac{(1-\alpha_s)^2\beta^2}{2(1-\alpha_s\beta)^2}+(1-\alpha_s)\beta\left(\tfrac{(1-\alpha_s)\beta}{1-\alpha_s\beta}-\tfrac{(1-\alpha_s)^2\beta^2}{2(1-\alpha_s\beta)^2}\right).\end{aligned} \tag{30}$$

5. $\{00\},\{01,10,11\}$ (mass market): Maximizing the welfare function with respect to qualities yields $s_L=0$, $s_H=\frac{\beta}{\alpha_n(1-\beta)+\beta}$. Welfare is

$$\begin{aligned}W_5= {}&\alpha_s\beta\left(-\tfrac{\beta^2}{2\alpha_n(1-\beta)+\beta)^2}+\tfrac{\beta\lambda}{\alpha_n(1-\beta)+\beta}+\tfrac{\beta}{(1-\alpha_n)\beta+\beta}\right)\\ &+(1-\alpha_s)\beta\left(\tfrac{\beta^2}{2\alpha_n(1-\beta)+\beta)^2}-\tfrac{\beta}{\alpha_n(1-\beta)+\beta}\right)+\alpha_n(1-\beta)\left(\tfrac{\beta\lambda}{\alpha_n(1-\beta)+\beta}-\tfrac{\beta^2}{2\alpha_n(1-\beta)+\beta)^2}\right).\end{aligned} \tag{31}$$

6. $\{10\},\{00,01,11\}$ (other 1): Maximizing the welfare function with respect to qualities yields $s_L=\frac{\alpha_s\beta}{1-\beta(1-\alpha_s)}$ and $s_H=1$. Welfare is

$$\begin{aligned}W_6={}&\alpha_n(1-\beta)\left(\tfrac{\alpha_s\beta\lambda}{1-\beta(1-\alpha_s)}-\tfrac{\alpha_s^2\beta^2}{2(1-\beta(1-\alpha_s))^2}\right)-\tfrac{(1-\alpha_n)\alpha_s^2(1-\beta)\beta^2}{2(1-\beta(1-\alpha_s))^2}\\ &+\alpha_s\beta\left(-\tfrac{\alpha_s^2\beta^2}{2(1-\beta(1-\alpha_s))^2}+\tfrac{\alpha_s\beta\lambda}{1-\beta(1-\alpha_s)}+\tfrac{\alpha_s\beta}{1-\beta(1-\alpha_s)}\right)+\tfrac{1}{2}(1-\alpha_s)\beta.\end{aligned} \tag{32}$$

7. $\{01\},\{00,10,11\}$ (other 2): Maximizing the welfare function with respect to qualities yields $s_L=0$ and $s_H=\frac{\beta}{1-\alpha_n(1-\beta)}$. Welfare is

$$\begin{aligned}W_7= {}&\alpha_s\beta\left(\tfrac{\beta\lambda}{(1-\alpha_n)(1-\beta)+\beta}+\tfrac{\beta}{1-\alpha_n(1-\beta)}-\tfrac{\beta^2}{2(1-\alpha_n(1-\beta))^2}\right)\\ &+(1-\alpha_s)\beta\left(\tfrac{\beta}{1-\alpha_n(1-\beta)}-\tfrac{\beta^2}{2(1-\alpha_n(1-\beta))^2}\right)-\tfrac{(1-\alpha_n)(1-\beta)\beta^2}{2(1-\alpha_n(1-\beta))^2}.\end{aligned} \tag{33}$$

8. $\{00,11\},\{01,10\}$ (other 3): Maximizing the welfare function with respect to qualities yields $s_L=\frac{(1-\alpha_s)\beta}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}$ and $s_H=\frac{\alpha_s\beta}{1-\alpha_n(1-\beta)-\beta(1-\alpha_s)}$. Welfare is

$$\begin{aligned}W_8= {}&\alpha_n(1-\beta)\left(\tfrac{(1-\alpha_s)\beta\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}-\tfrac{(\alpha_s-1)^2\beta^2}{2(\alpha_n\beta-\alpha_n+\alpha_s\beta-\beta)^2}\right)\\ &+(1-\alpha_s)\beta\left(\tfrac{(\alpha_s-1)\beta}{\alpha_n\beta-\alpha_n+\alpha_s\beta-\beta}-\tfrac{(\alpha_s-1)^2\beta^2}{2(\alpha_n\beta-\alpha_n+\alpha_s\beta-\beta)^2}\right)-\tfrac{(1-\alpha_n)\alpha_s^2(1-\beta)\beta^2}{2(1-\alpha_n(1-\beta)-\beta(1-\alpha_s))^2}\\ &+\alpha_s\beta\left(\tfrac{\alpha_s\beta\lambda}{(1-\alpha_n)(1-\beta)+\alpha_s\beta}+\tfrac{\alpha_s\beta}{1-\alpha_n(1-\beta)-\beta(1-\alpha_s)}-\tfrac{\alpha_s^2\beta^2}{2(1-\alpha_n(1-\beta)-\beta(1-\alpha_s))^2}\right).\end{aligned} \tag{34}$$

Three groups: 9. $\{00\},\{01,10\},\{11\}$ (image building): Maximizing the welfare function with respect to qualities yields $s_L=0$,$s_M=\frac{(1-\alpha_s)\beta}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}$, and $s_H=1$. Welfare is

$$(35)\quad W_9 = \alpha_n(1-\beta)\left(\tfrac{(1-\alpha_s)\beta\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}-\tfrac{(1-\alpha_s)^2\beta^2}{2(\alpha_n(1-\beta)+(1-\alpha_s)\beta)^2}\right)$$
$$+(1-\alpha_s)\beta\left(\tfrac{(1-\alpha_s)\beta}{\alpha_n(1-\beta)+\beta(1-\alpha_s)}-\tfrac{(1-\alpha_s)^2\beta^2}{2(\alpha_n(1-\beta)+(1-\alpha_s)\beta)^2}\right)+\alpha_s\beta\left(\lambda+\tfrac{1}{2}\right).$$

10. $\{10\},\{00,01\},\{11\}$ (other 5): Maximizing the welfare function with respect to qualities yields $s_L=0$, $s_M=s_H=1$. Welfare is

$$W_{10}=\alpha_s\beta\left(\lambda+\frac{1}{2}\right)+\frac{1}{2}(1-\alpha_s)\beta. \tag{36}$$

11. $\{01\},\{10,11\},\{00\}$ (other 6): Maximizing the welfare function with respect to qualities yields $s_L=s_M=0$, $s_H=1$. Welfare is

$$W_{11}=\alpha_s\beta\left(\lambda+\tfrac{1}{2}\right)+\tfrac{1}{2}(1-\alpha_s)\beta. \tag{37}$$

12. $\{10\},\{00,11\},\{01\}$ (other 7): Maximizing the welfare function with respect to qualities yields $s_L=0$, $s_M=\frac{\alpha_s\beta}{1-\alpha_n(1-\beta)-\beta(1-\alpha_s)}$, $s_H=1$. Welfare is

$$(38)\quad W_{12}=\alpha_s\beta\left(-\tfrac{\alpha_s^2\beta^2}{2(\alpha_n\beta-\alpha_n+\alpha_s\beta-\beta+1)^2}+\tfrac{\alpha_s\beta\lambda}{(1-\alpha_n)(1-\beta)+\alpha_s\beta}+\tfrac{\alpha_s\beta}{\alpha_n\beta-\alpha_n+\alpha_s\beta-\beta+1}\right)$$
$$-\tfrac{(1-\alpha_n)\alpha_s^2(1-\beta)\beta^2}{2(\alpha_n\beta-\alpha_n+\alpha_s\beta-\beta+1)^2}+\tfrac{1}{2}(1-\alpha_s)\beta.$$

13. $\{11\},\{10,00\},\{01\}$ (other 8): Maximizing the welfare function with respect to qualities yields $s_L=0$, $s_M=\frac{(1-\alpha_s)\beta}{1-\alpha_n(1-\beta)-\alpha_s\beta}$, $s_H=1$. Welfare is

$$(39)\quad W_{13}=-\tfrac{(1-\alpha_n)(1-\alpha_s)^2(1-\beta)\beta^2}{2(1-\alpha_n(1-\beta)-\alpha_s\beta)^2}+\alpha_s\beta\left(\lambda+\tfrac{1}{2}\right)$$
$$+(1-\alpha_s)\beta\left(\tfrac{(1-\alpha_s)\beta}{1-\alpha_n(1-\beta)-\alpha_s\beta}-\tfrac{(1-\alpha_s)^2\beta^2}{2(1-\alpha_n(1-\beta)-\alpha_s\beta)^2}\right).$$

14. $\{10\},\{01,11\},\{00\}$ (other 9): Maximizing the welfare function with respect to qualities yields $s_L=0$, $s_M=\frac{\alpha_s\beta}{\alpha_n(1-\beta)+\alpha_s\beta}$, $s_H=1$. Welfare is

$$(40)\quad W_{14}=\alpha_s\beta\left(\tfrac{\alpha_s\beta\lambda}{\alpha_n(1-\beta)+\alpha_s\beta}+\tfrac{\alpha_s\beta}{\alpha_n(1-\beta)+\alpha_s\beta}-\tfrac{\alpha_s^2\beta^2}{2(\alpha_n(1-\beta)+\alpha_s\beta)^2}\right)$$
$$+\alpha_n(1-\beta)\left(\tfrac{\alpha_s\beta\lambda}{\alpha_n(1-\beta)+\alpha_s\beta}-\tfrac{\alpha_s^2\beta^2}{2(\alpha_n(1-\beta)+\alpha_s\beta)^2}\right)+\tfrac{1}{2}(1-\alpha_s)\beta.$$

Four groups: 15. $\{00\},\{01\},\{10\},\{11\}$ (full separation): In this setting, optimal qualities are obviously $s_{00}=0$, $s_{01}=0$, $s_{10}=1$, $s_{11}=1$. Welfare is

$$W_{15}=\beta\left(\alpha_s\lambda+\tfrac{1}{2}\right). \tag{41}$$

Rearranging terms reveals that $W_2>W_3$, $W_2>W_{15}$, $W_2>W_6$, $W_2>W_7$, $W_2>W_{10}$, $W_2>W_{11}$, $W_2>W_{12}$, $W_2>W_{13}$, $W_2>W_{14}$, $W_9>W_8$, $W_9>W_5>W_1$, and $W_9>W_4$, so that the only two candidates for welfare maximization are partitions 2 and 9.

$$W_2>W_9\Leftrightarrow\frac{\alpha_n(\alpha_s-1)(\beta-1)\beta(1-2\lambda)}{2\beta(\alpha_n+\alpha_s-1)-2\alpha_n}\Leftrightarrow\lambda>\frac{1}{2} \tag{42}$$

□

Proof of Corollary 3

Proof. According to the welfare maximizing allocation, consumers who value either quality or image are provided with $s_L^w = \frac{(1-\alpha s)\beta}{\alpha n(1-\beta)+(1-\alpha s)\beta}$ but the profit-maximizing allocation is $s_L^m = \frac{(1-\alpha s)\beta\lambda}{\alpha n(1-\beta)+(1-\alpha s)\beta}$. It is $s_L^w > s_L^m \Leftrightarrow \lambda < 1$. □

Proof of Corollary 4

Proof. The first part is obvious from Proposition 3 and 4. Suppose that $\lambda > \frac{1}{2}$. In the competitive allocation, consumers who value either quality or image purchase a product with $s_L^c = 1$. The welfare-maximizing allocation is $s_L^w = \frac{(1-\alpha s)\beta}{\alpha n(1-\beta)+(1-\alpha s)\beta} < 1$. Consumers who care about both image and quality purchase a product with $s_H^c > 1 = s_H^w$. □

Proof of Corollary 5

Proof. Purely image-concerned consumers either buy quality s at price $p = s$ or choose $(0, 0)$ in monopoly. Both yield zero surplus, whereas they receive surplus $\frac{1}{2}$ in competition from buying $(1, \frac{1}{2})$ for all λ.

For consumers who value image and quality, surplus in monopoly is

$$\mathrm{CS}_{11}^{\mathrm{mon}} = \begin{cases} \lambda & \text{if } \lambda < \tilde{\lambda}_m \\ \lambda\frac{(1-\alpha_s)\beta}{(1-\alpha_s)\beta+\alpha_n(1-\beta)} & \text{if } \tilde{\lambda}_m < \lambda < \tilde{\tilde{\lambda}}_m \\ \lambda\frac{(1-\alpha_s)\beta}{(1-\alpha_s)\beta+1-\beta} & \text{if } \lambda > \tilde{\tilde{\lambda}}_m \end{cases} \tag{43}$$

In competition, surplus to consumers who value image and quality is

$$\mathrm{CS}_{11}^{\mathrm{comp}} = \begin{cases} \lambda + \frac{1}{2} & \text{if } \lambda \leq \frac{1}{2} \\ \lambda + (s - \frac{s^2}{2}) \text{ with } s = \sqrt{1 + 2\lambda\frac{(1-\beta)\alpha_n}{(1-\beta)\alpha_n+\beta(1-\alpha_s)}} & \text{if } \lambda > \frac{1}{2} \end{cases} \tag{44}$$

Thus, for type 11 consumers monopoly surplus is highest in image building and competitive surplus is lowest in functional excuse with full participation of types 01. Therefore, I only evaluate this most extreme case.

$$\mathrm{CS}_{11}^{\mathrm{mon}} - \mathrm{CS}_{11}^{\mathrm{comp}} = \frac{1}{2} - \sqrt{1 + 2\lambda\frac{\alpha_n(1-\beta)\lambda}{(1-\alpha_s)\beta + \alpha_n(1-\beta)}} \leq 0 \text{ for all } \lambda > 0 \tag{45}$$

Even in this case, competition yields higher surplus to types 11. So they are always better off with competition.

Consumers who value only image can be worse off under competition as demonstrated by the following example. Apart from jump points at $\lambda \in \{\tilde{\lambda}_m, \tilde{\tilde{\lambda}}_m, \frac{\alpha_n(1-\beta)+(1-\alpha_s)\beta}{(1-\alpha_s)\beta}\}$, the surplus to consumers who value only image, is continuous in λ and is continuous in other parameters. Thus, the example is generic.

Example 3. *Suppose* $\alpha_s = 0.625, \alpha_n = 0.25, \beta = 0.625$, *and* $\lambda = 1.5$. *Then, surplus to purely image-concerned consumers is* 0.576923 *in monopoly, which yields an exclusive good. The surplus purely image-concerned consumers is only* 0.571429 *in competition, where functional excuse obtains.*

□

Proof of Corollary 6

Proof. Consumers who value neither image nor quality obtain a surplus of 0 in either case. Consumers who value quality profit from competition as proven in Corollary 5.

For consumers who value only image obtain, surplus in monopoly is

$$\mathrm{CS}_{01}^{\mathrm{mon}} = \begin{cases} 0 & \text{if } \lambda < \tilde{\lambda}_m \\ 0 & \text{if } \tilde{\lambda}_m < \lambda < \tilde{\tilde{\lambda}}_m \text{ and } \lambda \leq \lambda_1 \\ \lambda \frac{((1-\alpha_s)\beta)}{\alpha_n(1-\beta)+(1-\alpha_s)\beta} - 1 & \text{if } \tilde{\lambda}_m < \lambda < \tilde{\tilde{\lambda}}_m \text{ and } \lambda > \lambda_1 \\ \lambda \frac{((1-\alpha_s)\beta)}{1-\alpha_s\beta} & \text{if } \lambda > \tilde{\tilde{\lambda}}_m \end{cases}$$

In competition, surplus to this consumer type is

$$\mathrm{CS}_{01}^{\mathrm{comp}} = \begin{cases} 0 & \text{if } \lambda \leq \frac{1}{2} \\ \lambda \frac{((1-\alpha_s)\beta)}{\alpha_n(1-\beta)+(1-\alpha_s)\beta} - \frac{1}{2} & \text{if } \lambda > \frac{1}{2} \end{cases}$$

If image building would give positive surplus to consumers who value only image, competition leads to the functional excuse equilibrium:

$$\lambda \frac{((1-\alpha_s)\beta)}{\alpha_n(1-\beta)+(1-\alpha_s)\beta} > 1 \tag{46}$$

$$\Leftrightarrow \quad \lambda > \frac{\alpha_n(1-\beta)+(1-\alpha_s)\beta}{(1-\alpha_s)\beta} > \frac{1}{2} \tag{47}$$

For $\lambda \leq \lambda_1$, image building yields zero surplus to consumers who value only image so that functional excuse does clearly better. Also for $\lambda > \lambda_1$, surplus to purely image-concerned consumers from image building is always lower than that from functional excuse: $\mathrm{CS}_{01}^{\mathrm{mon}} - \mathrm{CS}_{01}^{\mathrm{comp}} = -\frac{1}{2}$.

□

Proof of Proposition 6

Proof. Suppose the monopolist has to obey a MQS of $\underline{s} = 1$. Products 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 product line (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 $\lambda < R^{-1}$, the price for the low quality product lies below its quality since otherwise the purely image-concerned consumer would not buy. This yields the optimal product line 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 6. The proof is completed by Examples 4 and 5:

Example 4. *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 product line. 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 5. *Suppose* $\alpha_n = \frac{3}{4096}, \alpha_s = \frac{1}{224}, \beta = \frac{1}{4096}, \lambda = 2$. *The monopolist offers an image building product line without regulation and an exclusive good in the presence of the MQS* $\underline{s} = 1$. *Consumer surplus decreases from* 5.43230×10^{-7} *without regulation to* 3.56475×10^{-7} *with the MQS. Profit also decreases. Welfare decreases from* 0.00037 *without regulation to* 3.08073×10^{-6} *with regulation.*

□

Proof of Proposition 7

Proof. Any single-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

$$t(s,p) = \begin{cases} 0 & \text{if } s \leq 1 \\ \lambda \frac{\alpha_n(1-\beta)}{\alpha_n(1-\beta)+(1-\alpha_s)\beta} & \text{if } s > 1 \text{ and } s \neq 1+\varepsilon \\ \lambda \frac{\alpha_n(1-\beta)}{\alpha_n(1-\beta)+(1-\alpha_s)\beta} - \varepsilon^2 & \text{if } s = 1+\varepsilon \end{cases} \tag{48}$$

Then, type 11 is best off choosing $(1+\varepsilon, MC(1+\varepsilon))$ and paying the associated tax. Assuming separation holds, his 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 aggregate 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 ε 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. □

Proof of Proposition 8

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 quality and consumers who additionally value image—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. □

B. Supplementary material

Figure B1: Design of bottles for LemonAid and ChariTea.

B.1. Formal comparative statics results

Increases in the fraction of image-concerned consumers, whether they occur among those concerned with quality (α_s) or among those who do not value quality (α_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 (β) increases, the monopolist raises both quality (as long as it still below $s = 1$) and prices.

Corollary B1. *Suppose the monopolist offers (s_L, p_L) and (s_H, p_H) as an image building product line with $p_H > p_L$.*

(i) If $\lambda < \frac{\alpha_n(1-\beta)+\beta}{\beta}$, s_L, p_L, p_H, and $p_H - p_L$ increase in β. Otherwise, only p_H and $p_H - p_L$ increase in β.

(ii) If $\lambda < \frac{\alpha_n(1-\beta)+(1-\alpha_s)\beta}{(1-\alpha_s)\beta}$, s_L and p_L decrease, and $s_H - s_L$, p_H, and $p_H - p_L$ increase in α_s and α_n. Otherwise, only p_H and $p_H - p_L$ increase α_s and α_n.

Suppose (s, p) is an exclusive good offer. Then, p increases in β and α_s, and is independent of α_n. Quality s is independent of preferences.

Proof. This follows directly from taking the respective derivatives of qualities and prices as defined in Table 2 in the main body of the paper. □

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. More generally, the standard good is offered more often if the share of consumers who experience utility from quality directly (β) increases. However, if instead the fraction of consumers who buy a product only for its image (α_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. Figure B2 shows a typical example for how the equilibrium thresholds in monopoly depend on the fraction of intrinsically motivated consumers and demonstrates the relevance of the image building product line.

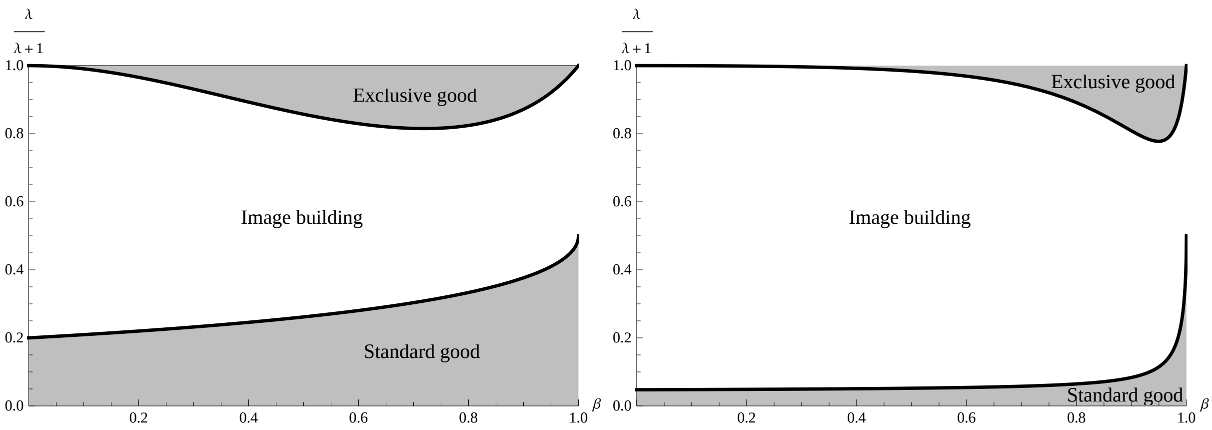

Figure B2: Equilibrium thresholds in monopoly for $\alpha_s = \alpha_n = 0.5$ (left panel) and $\alpha_s = \alpha_n = 0.9$ (right panel). The value of image is rescaled as $\frac{\lambda}{\lambda+1} \in [0, 1]$ which is the weight on image in the utility function.

Proposition B1. *Monopoly offers (i) standard good more often if β increases, (ii) standard good less often if α_s or α_n increases, (iii) image building more often if α_n increases, and (iv) exclusive good less often if α_n increases.*

Proof. Suppose image building does not occur. Then, $\tilde{\lambda}_m = \tilde{\tilde{\lambda}}_m = \lambda_{SE} = \frac{(1-\alpha_s)(1-\alpha_s\beta)}{2\alpha_s(1-\beta)}$ as defined in Equation 13 in the main body of the paper. The derivatives are

$$\frac{\partial \tilde{\lambda}_m}{\partial \beta} = \frac{(1-\alpha_s)^2}{2\alpha_s(1-\beta)^2} > 0, \quad \frac{\partial \tilde{\lambda}_m}{\partial \alpha_s} = -\frac{1-\alpha_s^2\beta}{2\alpha_s^2(1-\beta)} < 0, \quad \frac{\partial \tilde{\lambda}_m}{\partial \alpha_n} = 0$$

Suppose image building does occur, $\tilde{\lambda}_m < \tilde{\tilde{\lambda}}_m$ For $\tilde{\lambda}_m$ and $\tilde{\tilde{\lambda}}_m$ as defined in equations 15 and 19 in the main body of the paper, we find

$$\begin{aligned}
\frac{\partial \tilde{\lambda}_m}{\partial \beta} &= \frac{\alpha_n\left(2\alpha_n(1-\beta)+(1-\alpha_s)^2(1+\alpha_s)\beta-2\sqrt{\alpha_n(1-\beta)(\alpha_n(1-\beta)+(1-\alpha_s)^2(1+\alpha_s)\beta)}\right)}{2(1-\alpha_s)^2\beta^2\sqrt{\alpha_n(1-\beta)(\alpha_n(1-\beta)+(1-\alpha_s)^2(1+\alpha_s)\beta)}} > 0 \\
\frac{\partial \tilde{\lambda}_m}{\partial \alpha_s} &= -\frac{\alpha_n(1-\beta)\left(4\alpha_n(1-\beta)+(1-\alpha_s)^2(3+\alpha_s)\beta-4\sqrt{\alpha_n(1-\beta)(\alpha_n(1-\beta)+(1-\alpha_s)^2(1+\alpha_s)\beta)}\right)}{2(1-\alpha_s)^3\beta\sqrt{\alpha_n(1-\beta)(\alpha_n(1-\beta)+(1-\alpha_s)^2(1+\alpha_s)\beta)}} < 0 \\
\frac{\partial \tilde{\lambda}_m}{\partial \alpha_n} &= -\frac{(1-\beta)\left(2\alpha_n(1-\beta)+(1-\alpha_s)^2(1+\alpha_s)\beta-2\sqrt{\alpha_n(1-\beta)(\alpha_n(1-\beta)+(1-\alpha_s)^2(1+\alpha_s)\beta)}\right)}{2(1-\alpha_s)^2\beta\sqrt{\alpha_n(1-\beta)(\alpha_n(1-\beta)+(1-\alpha_s)^2(1+\alpha_s)\beta)}} < 0
\end{aligned}$$

Independent of whether $\tilde{\tilde{\lambda}}_m = \lambda_{\text{IE,low}}$ or $\tilde{\tilde{\lambda}}_m = \lambda_{\text{IE,high}}$, $\tilde{\tilde{\lambda}}_m$ increases in α_n.

$$\frac{\partial \tilde{\tilde{\lambda}}_m}{\partial \alpha_n} = \begin{cases} 2\left(\frac{1}{\beta-\alpha_s\beta} - \frac{1}{1-\alpha_s\beta}\right) & \text{if } \tilde{\tilde{\lambda}}_m = \lambda_{\text{IE,low}} \\ \frac{(1-\alpha_s\beta)(2-\alpha_n(1-\beta)-(1+\alpha_s)\beta)(\alpha_n+(1-\alpha_n-\alpha_s)\beta)}{2(1-\alpha_n)^2(1-\alpha_s)\alpha_s(1-\beta)\beta^2} & \text{if } \tilde{\tilde{\lambda}}_m = \lambda_{\text{IE,high}} \end{cases}$$

and therefore

$$\frac{\partial \tilde{\tilde{\lambda}}_m}{\partial \alpha_n} > 0$$

The signs of the derivatives of $\tilde{\tilde{\lambda}}_m$ with respect to α_s and β are ambiguous. I consider the different formula for $\tilde{\tilde{\lambda}}_m$ one after the other.

Case 1: $\tilde{\tilde{\lambda}} = \lambda_{IE,low}$

$$\begin{aligned}
\frac{\partial \lambda_{\text{IE,low}}}{\partial \beta} &> 0 \quad \text{if } \frac{\alpha_s\beta^2 - \alpha_s^2\beta^2}{1 - 2\alpha_s\beta + \alpha_s\beta^2} > \alpha_n \\
\frac{\partial \lambda_{\text{IE,low}}}{\partial \alpha_s} &> 0 \quad \text{if } \alpha_n > \frac{\beta - \alpha_s^2\beta^2}{1 + \beta - 2\alpha_s\beta}
\end{aligned}$$

Case 2: $\tilde{\tilde{\lambda}} = \lambda_{IE,high}$

$$\begin{aligned}
\frac{\partial \lambda_{\text{IE,high}}}{\partial \beta} &= \frac{(\alpha_n+(1-\alpha_n-\alpha_s)\beta)\big((1-\alpha_s)^2\beta^2+\alpha_n(1-\beta)(2-\beta-\alpha_s\beta)\big)}{2(1-\alpha_n)(1-\alpha_s)\alpha_s(1-\beta)^2\beta^3} \\
\frac{\partial \lambda_{\text{IE,high}}}{\partial \alpha_s} &= -\frac{(\alpha_n+(1-\alpha_n-\alpha_s)\beta)\big((1-\alpha_s)\beta\big(1-\alpha_s^2\beta\big)+\alpha_n(1-\beta)(1-\alpha_s(2-\alpha_s\beta))\big)}{2(1-\alpha_n)(1-\alpha_s)^2\alpha_s^2(1-\beta)\beta^2}
\end{aligned}$$

$$\frac{\partial \lambda_{\text{IE,high}}}{\partial \beta} > 0$$

$$\begin{aligned}
&\text{if } \Big(\alpha_n < \tfrac{1-2\alpha_s+\alpha_s^2}{1+\alpha_s} \text{ and } \tfrac{3\alpha_n+\alpha_n\alpha_s}{2(-1+\alpha_n+2\alpha_s+\alpha_n\alpha_s-\alpha_s^2)} + \tfrac{1}{2}\sqrt{\tfrac{8\alpha_n+\alpha_n^2-16\alpha_n\alpha_s-2\alpha_n^2\alpha_s+8\alpha_n\alpha_s^2+\alpha_n^2\alpha_s^2}{(-1+\alpha_n+2\alpha_s+\alpha_n\alpha_s-\alpha_s^2)^2}} < \beta\Big) \\
&\text{or } \Big(\alpha_n = \tfrac{1-2\alpha_s+\alpha_s^2}{1+\alpha_s} \text{ and } \tfrac{2}{3+\alpha_s} < \beta\Big) \\
&\text{or } \Big(\tfrac{1-2\alpha_s+\alpha_s^2}{1+\alpha_s} < \alpha_n \text{ and } \tfrac{3\alpha_n+\alpha_n\alpha_s}{2(-1+\alpha_n+2\alpha_s+\alpha_n\alpha_s-\alpha_s^2)} - \tfrac{1}{2}\sqrt{\tfrac{8\alpha_n+\alpha_n^2-16\alpha_n\alpha_s-2\alpha_n^2\alpha_s+8\alpha_n\alpha_s^2+\alpha_n^2\alpha_s^2}{(-1+\alpha_n+2\alpha_s+\alpha_n\alpha_s-\alpha_s^2)^2}} < \beta\Big)
\end{aligned}$$

$$\frac{\partial \lambda_{\text{IE,high}}}{\partial \alpha_s} > 0$$

$$\text{if } \tfrac{1}{2} < \alpha_s \text{ and } \beta < \tfrac{1-2\alpha_s}{-2\alpha_s+\alpha_s^2} \text{ and } \tfrac{\beta-\alpha_s\beta-\alpha_s^2\beta^2+\alpha_s^3\beta^2}{-1+2\alpha_s+\beta-2\alpha_s\beta-\alpha_s^2\beta+\alpha_s^2\beta^2} < \alpha_n$$

□

Corollary B2. *Suppose competition yields a functional excuse equilibrium, where consumers who value image and quality buy (s,p). Then, s decreases in β and increases in α_s and α_n. Average quality increases in α_s and α_n and is non-monotone in β.*

Proof. From Proposition 3 in the main body of the paper, we know that in functional excuse

$$(s,p) = \left(\sqrt{1 + \frac{2\alpha_n(1-\beta)\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}}, \frac{1}{2} + \frac{\alpha_n(1-\beta)\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}\right)$$

if purely image concerned consumers buy $(1, \frac{1}{2})$ with probability one. From this I derive

$$\begin{aligned}
\frac{\partial s}{\partial \beta} &= \frac{-\frac{2\alpha_n(1-\alpha_n-\alpha_s)(1-\beta)\lambda}{(\alpha_n(1-\beta)+(1-\alpha_s)\beta)^2} - \frac{2\alpha_n\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}}{2\sqrt{1+\frac{2\alpha_n(1-\beta)\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}}} < 0 \\
\frac{\partial s}{\partial \alpha_s} &= \frac{\alpha_n(1-\beta)\beta\lambda}{(\alpha_n(1-\beta)+(1-\alpha_s)\beta)^2\sqrt{1+\frac{2\alpha_n(1-\beta)\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}}} > 0 \\
\frac{\partial s}{\partial \alpha_n} &= \frac{-\frac{2\alpha_n(1-\beta)^2\lambda}{(\alpha_n(1-\beta)+(1-\alpha_s)\beta)^2} + \frac{2(1-\beta)\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}}{2\sqrt{1+\frac{2\alpha_n(1-\beta)\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}}} > 0
\end{aligned}$$

With the separating products $(1, \frac{1}{2})$ and (s, p) as defined above, average quality in functional excuse is computed as

$$S_{\text{average}} = \alpha_n(1-\beta) + (1-\alpha_s)\beta + \alpha_s\beta\sqrt{1 + \frac{2\alpha_n(1-\beta)\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}}$$

From this I obtain

$$\begin{aligned}
\frac{\partial S_{\text{average}}}{\partial \beta} &= 1-\alpha_n-\alpha_s+\frac{\alpha_n(-1+\alpha_s)\alpha_s\beta\lambda}{(\alpha_n+\beta-(\alpha_n+\alpha_s)\beta)^2\sqrt{1+\frac{2\alpha_n(-1+\beta)\lambda}{-\alpha_n+(-1+\alpha_n+\alpha_s)\beta}}} \\
&\quad +\alpha_s\sqrt{1+\frac{2\alpha_n(-1+\beta)\lambda}{-\alpha_n+(-1+\alpha_n+\alpha_s)\beta}} \lesseqgtr 0 \\
\frac{\partial S_{\text{average}}}{\partial \alpha_s} &= \frac{\alpha_n\alpha_s(1-\beta)\beta^2\lambda}{(\alpha_n(1-\beta)+(1-\alpha_s)\beta)^2\sqrt{1+\frac{2\alpha_n(1-\beta)\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}}} \\
&\quad +\beta(\sqrt{1+\frac{2\alpha_n(1-\beta)\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}}-1) > 0 \\
\frac{\partial S_{\text{average}}}{\partial \alpha_n} &= 1-\beta+\frac{\alpha_s\beta\left(-\frac{2\alpha_n(1-\beta)^2\lambda}{(\alpha_n(1-\beta)+(1-\alpha_s)\beta)^2}+\frac{2(1-\beta)\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}\right)}{2\sqrt{1+\frac{2\alpha_n(1-\beta)\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}}} > 0
\end{aligned}$$

□

B.2. Generalizing types

The main analysis concentrates on the simplified case with $\sigma_L = \rho_L = 0$ for two reasons. One is tractability but the more important one is that this simplification prevents quality distortions in the benchmark model without image concerns because the low quality valuation type is always excluded. If I modify the model such that $\sigma_L > 0$, the decision whether or not to exclude any consumer type becomes more delicate. Still, the results from before go through qualitatively: For low image concern, the product line looks the same as if image concerns were absent: two quality levels are offered. For intermediate image concerns, three different quality levels are offered, and consumers who have a low quality valuation and care about image pool with those who have a high valuation and do not value image on the product of intermediate quality. For high image concerns, two quality levels are sold, one exclusively to those who value image and quality, the other one to all other consumers.

These qualitative results are modified in that any type of product line as derived in the main analysis exists in two versions: one where consumers with the lowest willingness to pay are excluded, so that the product of lowest quality is $(0, 0)$, and one where they are served a product of positive quality, where the product of lowest quality is $(s_L, p_L) \neq (0, 0)$. Whether the product intended for the lowest type is equal to the outside option or not depends on the distribution of preferences, σ_L and σ_H but it does not depend on the strength of image concerns, λ, and exclusion does not need to occur.[43]

B.3. Heterogeneity in wealth

If consumers do not differ in intrinsic quality preferences but in wealth and desire to signal wealth rather than quality preferences, the model can be directly interpreted that way. In this reinterpretation, a higher willingness to pay for quality is a signal of wealth not quality preferences. While the model has been framed as one in which consumers have different tastes for quality which they want to signal, there is a dual interpretation in which consumers are heterogeneous in wealth and want to signal their wealth to other consumers. Heterogeneous

[43]Supplementary material regarding this generalization is available on the author's homepage or upon request.

tastes for quality in the indirect utility functions of the presented model can be derived from direct utility functions with identical reservation prices but income heterogeneity (see e.g. Peitz, 1995). In this setting, consumers with higher income (or higher wealth) value quality more. Put differently, the taste parameter σ in the indirect utility representation is a measure of the marginal intrinsic utility from quality relative to the marginal value of money.

If consumers were interested in signaling the compound of taste and income, the model itself would not have to change. However, the screening problem in which consumers also differ in their signaling motivation becomes potentially much more complicated because the compound of the two motivations can take on more than two different values. But this modification is likely to again yield partial pooling in equilibrium. The underlying intuition is the same as before: consumers with relatively high intrinsic motivation and wealth but with low image concern provide positive externalities to consumers with high image concern but relatively low intrinsic motivation and wealth such that surplus can be increased by pooling these types.

The problem becomes more complicated if instead the inferences regarding taste for quality and wealth enter utility with opposite signs. Bénabou and Tirole (2006) analyze a related problem in which agents choose their degree of prosocial behavior in the presence of image concerns and monetary incentives. In contrast to their setting, my paper focuses on a strategic supplier who interferes with the signal space. Providing a formal extension that incorporates the signal jamming intuition from Bénabou and Tirole (2006) is beyond the scope of this paper.[44]

Let me nonetheless provide some intuition on how inferences in my model would be affected by additional wealth heterogeneity. If intrinsic taste for quality and income are perfectly positively correlated, the dimensionality of the model remains the same but the spread in valuations increases. If the correlation is positive but imperfect, the image of having a high taste for quality associated with the purchase of a high quality product is diluted by the wealth confound but the basic intuitions of the model will still apply because purchasing higher quality remains a signal of having a high taste for quality. However, if the correlation between wealth and intrinsic taste for quality is negative, the inference about intrinsic preferences from purchases becomes increasingly blurred by wealth differences. In the extreme case of a perfect negative correlation, those with low intrinsic interest but high wealth may have the highest willingness to pay for quality and therefore, ceteris paribus, buy the highest quality product. If consumers care about being perceived as intrinsically interested in quality, such a situation would resemble one in which purchasing a high quality product is stigmatized (cf. Section 7.4). Those who care about their image are deterred from buying the high quality because the associated image is worse than the one of buying lower quality or not buying at all because the less wealthy who value quality cannot afford high quality. In such a situation, the monopolist will try and pool the wealthy with the quality-concerned consumers by lowering the price accordingly.

A simple way to capture the intuition from additional wealth heterogeneity, without explicitly modeling it, is to interpret λ as the product of the informativeness of the purchasing decision with respect to taste and the value of the social image as such. If the distribution of wealth and tastes are not aligned, a purchase is not very informative about tastes and thus, the realized utility from image is low, and vice versa.

I find a different approach much more relevant though: If a consumer population is heterogeneous with respect to the three dimensions quality preferences, wealth, and image concern, the producer could differentiate its products in two quality dimensions, one that appeals to the intrinsic quality valuation and one that targets wealth alone. We observe this for instance in the car market, where different categories of cars target wealth but within each category cars differ in how environmentally friendly they are. Thus, the manufacturer also screens with respect to sustainability preferences. The formal analysis of optimally screening along multiple dimensions

[44] Bénabou and Tirole (2006) provide a solution for their model under the assumption that valuations are normally distributed and image concerns are independent from intrinsic motivation. The problem becomes significantly more complicated by introducing a strategic producer and by letting go of independence.

(other than image concerns) is again beyond the scope of this paper. See for instance Ketelaar and Szalay (2014) for recent progress in this direction.

B.4. Equivalence between social image and social pressure formulation

Let consumers differ in their interest σ in quality (intrinsic motivation). Suppose consumers experience negative utility from being seen as consumers who have a low taste for quality, that is they experience social pressure not to consumer low quality. Denote the inference that enters utility by Q. Let consumers also differ in their susceptibility to social pressure ρ. The two-dimensional type (σ, ρ) is drawn from $\{\sigma_L, \sigma_H\} \times \{0, 1\}$ with $\text{Prob}(\sigma = \sigma_H) = \beta$, $\text{Prob}(\rho = 1|\sigma = \sigma_H) = \alpha_s$, and $\text{Prob}(\rho = 1|\sigma = \sigma_L) = \alpha_n$.

For a consumer of type $\sigma\rho$, utility takes the form:

$$V_{\sigma\rho}(s, p, Q) = \sigma s - \rho\lambda Q - p \tag{B1}$$

The term Q realized by a consumer (σ, ρ) is the probability that she has a low taste for quality conditional on his purchasing decision. Let the model be set up exactly as above on the monopolist's side, and use the notation from above.

For any product line $\mathcal{M}$, the term Q is derived from the posterior belief $\nu_{\mathcal{M}}$ that a consumer has low taste for quality. This conditional probability is given by

$$\nu_{\mathcal{M}}(s, p) = \frac{\sum_{\rho=0,1} \text{Prob}(0, \rho)\text{Prob}(b_{\mathcal{M}}(0\rho) = (s, p))}{\sum_{\sigma=0,1} \sum_{\rho=0,1} \text{Prob}(\sigma, \rho)\text{Prob}(b_{\mathcal{M}}(\sigma\rho) = (s, p))} \tag{B2}$$

and we obtain for any product line and for each product within a line:

$$Q(s, p, \mathcal{M}) = E[\sigma = 0|b_{\mathcal{M}}(\sigma\rho) = (s, p)] = \nu_{\mathcal{M}}(s, p)$$

The belief $\nu_{\mathcal{M}}$ satisfies (B2) if (s, p) is chosen with positive probability and $\nu_{\mathcal{M}} \in [0, 1]$ otherwise (Bayesian Inference).

Proposition B2. *The solution to the monopolist's problem are equivalent for the utility functions as stated in equation (1) in the main body of the paper and equation (B1).*

Proof. I show that the participation and incentive compatibility constraints of the two problems coincide.

First note that

$$Q(s, p, \mathcal{M}) = 1 - R(s, p, \mathcal{M}) \tag{B3}$$

$$\Rightarrow \quad V_{\sigma\rho}(s, p, Q) = U_{\sigma\rho,R}(s, p) - \lambda\rho \tag{B4}$$

Note further that this relationship holds also true for the images R and Q associated with the outside option $(0, 0)$.

Consider the participation constraint of consumer type $\sigma\rho$:

$$\begin{aligned}
& V_{\sigma\rho}(s, p, Q(s, p)) \geq -\lambda\rho Q(0, 0) \\
\Leftrightarrow \quad & \sigma s - \rho\lambda Q(s, p) - p \geq -\lambda\rho Q \\
\Leftrightarrow \quad & \sigma s - \rho\lambda(1 - R(s, p)) - p \geq -\lambda\rho(1 - R(0, 0)) \\
\Leftrightarrow \quad & U_{\sigma\rho}(s, p, R(s, p)) \geq \lambda\rho R(0, 0)
\end{aligned}$$

Consider the incentive compatibility constraint between products (s, p) and (s', p') of consumer type $\sigma\rho$:

$$\begin{aligned}
& V_{\sigma\rho}(s,p,Q(s,p)) \geq V_{\sigma\rho}(s',p',Q(s',p')) \\
\Leftrightarrow \quad & \sigma s - \rho\lambda Q(s,p) - p \geq \sigma s' - \rho\lambda Q(s',p') - p' \\
\Leftrightarrow \quad & \sigma s - \rho\lambda(1 - R(s,p)) - p \geq \sigma s' - \rho\lambda(1 - R(s',p')) - p' \\
\Leftrightarrow \quad & U_{\sigma\rho}(s,p,R(s,p)) \geq U_{\sigma\rho}(s',p',R(s',p'))
\end{aligned}$$

□

B.5. Selecting the welfare-maximizing competitive equilibrium

Comparing the competitive market outcome to the welfare-maximizing allocation, we observe that the competitive allocation implements the optimal partition of consumers but not in the most efficient way. But the welfare comparison between monopoly and competition does not depend on the Intuitive Criterion selecting a particularly bad equilibrium. 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.

Lemma B9. *The competitive equilibrium which yields the highest welfare is*

(i) standard good for $\lambda \leq \frac{1}{2}$

(ii) image building with $s_l = s_h = 1$ *for* $\lambda > \frac{1}{2}$.

(a) for $\frac{1}{2} < \lambda < \frac{1}{2}\frac{\beta(1-\alpha_s)+(1-\beta)\alpha_n}{\beta(1-\alpha_s)}$*, purely image-concerned consumers participate with probability* $q = (2\lambda-1)\frac{\beta}{(1-\beta)\alpha_n}$ *and prices are* $p_l = \frac{1}{2}$, $p_h = \frac{1}{2}+\lambda(1-\frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s)+q(1-\beta)\alpha_n})$.

(b) for $\lambda \geq \frac{1}{2}\frac{\beta(1-\alpha_s)+(1-\beta)\alpha_n}{\beta(1-\alpha_s)}$*, purely image-concerned consumers participate with probability one and prices are* $p_l = \frac{1}{2}$, $p_h = \frac{1}{2} + \lambda(1 - \frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s)+(1-\beta)\alpha_n})$.

Proof. I have shown that for $\lambda < \frac{1}{2}$, the equilibrium in the competitive setup is unique. Thus, the respective equilibrium, the standard good, where consumers with $\sigma = 1$ buy quality $s = 1$ at price $p = \frac{1}{2}$ and consumers with $\sigma = 0$ choose the outside option $(0,0)$ is also the welfare maximizing equilibrium in the competitive market for $\lambda < \frac{1}{2}$.

For $\lambda > \frac{1}{2}$, the standard good cannot be sustained as in equilibrium anymore. A continuum of partially separating equilibria (purely image-concerned and purely quality interested buyers buy the same product and those who value both characteristics separate by buying another product) and pooling equilibria (consumers who value at least one of the tow characteristics quality and image buy the same product, no other product is sold) coexist (see Lemmas 6, 7, and 8 in the main body of the paper). Since for a given partition of consumers, prices do not affect welfare, I can exclude the pooling equilibria (with full and partial participation of purely image-concerned consumers) from consideration according to Proposition 4 in the main body of the paper. Among the partially separating equilibria, the welfare maximizing equilibrium allocates quality $s_L = 1$ to consumers who care about either quality or image and quality $s_H = 1$ to consumers who value image and quality because $s = 1$ maximizes efficiency in production. Separation is ensured through setting prices $pL < pH$ and beliefs appropriately.

For simplicity, I assume in the following, that beliefs on all products (s,p) not bought in equilibrium are zero, $\mu(s,p) = 0$. In any partially separating equilibrium with participation probability q for purely image-concerned consumers, beliefs are $\mu(s_L,p_L) = \frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s)+q(1-\beta)\alpha_n}$ and $\mu(s_H,p_H) = 1$. It follows from Lemma 8 in the main body of the paper that $p_L = \frac{1}{2}$ and $p_H = \frac{1}{2} + \lambda\frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s)+q(1-\beta)\alpha_n}$.

The participation probability of consumers who only care for quality is determined by the value of image. For $\lambda \leq \frac{1}{2}$, no purely image-concerned consumer wants to participate, for $\lambda >$

$\frac{1}{2}\frac{\beta(1-\alpha_s)+(1-\beta)\alpha_n}{\beta(1-\alpha_s)}$, all purely image-concerned consumers prefer to participate. For intermediate values of λ, the indifference condition of these consumer types pins down the participation probability as $q = (2\lambda - 1)\frac{\beta}{(1-\beta)\alpha_n}$. $\square$

The following examples show that Proposition 5 from the main body of the paper extends to a setting where I select the competitive equilibrium which yields the highest attainable welfare in competition.

Example B6. *Suppose $\lambda = 1.71875$, $\beta = 0.484375$, $\alpha_s = 0.853859$, and $\alpha_n = \frac{1}{3}$. Then, $\tilde{\lambda}_m = \tilde{\tilde{\lambda}}_m = 0.0973251 < \lambda$. Thus, monopoly offers the exclusive good which yields welfare $W^E = 0.953308$. Welfare from the best competitive equilibrium for these parameters is only $W^{s_{ep-all}} = 0.953278$.*

Example B7. *Suppose $\lambda = 0.75$, $\beta = 0.5$, $\alpha_s = 0.0208333$, and $\alpha_n = 0.5$. Then, $\tilde{\lambda}_m = 0.5 < \lambda < \tilde{\tilde{\lambda}}_m = 212.276$. Thus, monopoly implements image building which yields welfare $W^E = 0.289058$. In competition, the best welfare equilibrium for these parameters is a partially separating equilibrium. Purely image-concerned consumers participate with probability $q = 0.755319$ and welfare is only $W^{s_{ep-part}} = 0.257813$.*

B.6. Consumers play against monopolist's plan

If the monopolist offers an image building product line or an exclusive good as derived above, the consumer game has two equilibria. One where the consumers behave as intended by the monopolist and one where consumers coordinate against him. The second case leads to the product not being optimal anymore for the monopolist so that one equilibrium condition is violated. If consumers are anticipated to deviate, an alternative product offer can be derived that induces a unique equilibrium in the ensuing consumer game.

Lemma B10. *Suppose consumers can coordinate and choose a product different from the one the monopolist intended they buy. In the **adjusted image building** product line, the monopolist maximizes profits by offering*

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

Proof. If the monopolist offers two products as derived for the image building product line in the main part, the ensuing subgame among consumers has two equilibria. One, where consumers sort onto the two products as intended by the monopolist, and a second one, where consumer types 01, 10, and 11 all buy the lower quality product and nobody buys the high quality product. In this equilibrium, types 01 and 11 are better off than in the separating equilibrium, while profits to the monopolist are lower. The adapted product line leaves an appropriately higher rent to type 11 to deter this deviation. The non-deviation constraint is

$$p_H = s_H - s_L + p_L + \lambda(R(s_H)|_{sep} - R(s_L)|_{pool})$$

With optimal quality choices, the optimal low quality price and plugging in for images this becomes

$$p_H = 1 + \lambda \frac{\alpha_n(1-\beta)}{\beta + \alpha_n(1-\beta)}.$$

$\square$

Lemma B11. *Suppose consumers can coordinate and choose a product different from the one the monopolist intended they buy. In the* ***adjusted exclusive market****, the monopolist maximizes profits by offering*

$$(s, p) = (1, 1 + \lambda(1 - \beta)).$$

Proof. If the monopolist offers an exclusive good, the consumption stage again has two equilibria. Instead of actually buying the exclusive good, types 11 could collectively deviate from the monopolist's plan and not buy at all. This would increase the image associated with not buying such that types 11 and 01 are better off than if the exclusive good was bought by type 11. The monopolist would have preferred to offer a product which is immune to such deviations. This requires that the following constraint holds:

$$p_H = s_H + \lambda(R(s_H)|_{sep} - R(s_L)|_{pool}) = 1 + \lambda(1 - \beta)$$

□

If consumers play their preferred equilibrium in both cases where there is multiplicity, the monopolist adjusts its behavior and in equilibrium never offers the ambiguous products but the deviation-proof versions.

Proposition B3. *Suppose consumers can coordinate and choose a product different from the one the monopolist intended they buy. There exist $0 < \tilde{\lambda}_m^{adj} \leq \tilde{\tilde{\lambda}}_m^{adj}$ such that the profit-maximizing product offer of a monopolistic producer is given by*

(i) standard good if $\lambda \leq \tilde{\lambda}_m^{adj}$.

(ii) adjusted image building if $\tilde{\lambda}_m^{adj} \leq \lambda \leq \tilde{\tilde{\lambda}}_m^{adj}$.

(iii) adjusted exclusive good if $\lambda \geq \tilde{\tilde{\lambda}}_m^{adj}$.

Proof. From Lemmas B2 and B3, I compute the following profit functions.

$$\Pi^{I,\text{adj}} = \begin{cases} \frac{1}{2}\beta\left(\alpha_s + 2\lambda - \frac{2\alpha_s\beta\lambda}{\alpha_n+\beta-\alpha_n\beta} + \frac{(-1+\alpha_s)^2\beta\lambda^2}{-\alpha_n+(-1+\alpha_n+\alpha_s)\beta}\right) & \text{if } \lambda \leq \lambda_2 \\ \frac{1}{2}(\alpha_n(1-\beta) + (1-\alpha_s)\beta) + \alpha_s\beta\left(\frac{1}{2} + \frac{\alpha_n(1-\beta)\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta+\alpha_s\beta}\right) & \text{if } \lambda > \lambda_2 \end{cases}$$

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

Note that profits in standard good and mass market are unchanged as the respective products are unchanged. These are stated in Equations 8 and 11 in the main body of the paper.

Results for the overall equilibrium are qualitatively the same as derived above. I proceed as follows.

First, one can show that image building gives always at least the same profit as mass market, $\Pi^I \geq \Pi^M$, and therefore mass market does not have to be considered further.

Second, the standard good maximizes profits for low λ:

$$\Pi^S > \Pi^{I,\text{adj}} \Leftrightarrow \lambda < \lambda_{SI}^{\text{adj}}$$

where

$$\text{(B5)}\ \lambda_{SI}^{\text{adj}} := \frac{(\alpha_n(1-\beta)+\beta(1-\alpha_s)^2}{(1-\alpha_s)^2(\beta+\alpha_n(1-\beta)} - \frac{\sqrt{\alpha_n(1-\beta)(\alpha_n(1-\beta)+(1-\alpha_s)\beta)(\alpha_n^2(1-\beta)^2+\alpha_n(2-(3-\alpha_s)\alpha_s^2)(1-\beta)\beta+(1-\alpha_s)^2(1+2\alpha_s)\beta^2)}}{(1-\alpha_s)^2(\alpha_n(1-\beta)+\beta)\beta}$$

and

$$\Pi^S > \Pi^{E,\text{adj}} \Leftrightarrow \lambda < \frac{1-\alpha_s}{2\alpha_s(1-\beta)} =: \lambda_{SE}^{\text{adj}} \tag{B6}$$

Define the threshold $\tilde{\lambda}^{\text{adj}}$ as the minimum of the two

$$\tilde{\lambda}^{\text{adj}} := \min\{\lambda_{SE}^{\text{adj}}, \lambda_{SI}^{\text{adj}}\} \tag{B7}$$

A sufficient condition for image building determining the threshold is that image concerns are more prevalent for those not intrinsically interested in quality, $\alpha_n > \alpha_s$.

Next, I derive the value of image for which exclusive good gives higher profit than image building. Since image building is determined piecewise, two cases have to be considered

$$\Pi^{E,\text{adj}} > \Pi^{I,\text{adj}} \text{ if } \begin{cases} \lambda > \lambda_{\text{IE,low}}^{\text{adj}} & \text{if } \lambda < \lambda_2 \\ \lambda > \lambda_{\text{IE,high}}^{\text{adj}} & \text{if } \lambda > \lambda_2 \end{cases}$$

where

$$\lambda_{\text{IE,low}}^{\text{adj}} := \frac{2(\alpha_n(1-\beta)+(1-\alpha_s)\beta)(\alpha_n(1-\alpha_s(1-\beta))(1-\beta)-(1-\alpha_s(2-\beta))\beta)}{(1-\alpha_s)^2(\alpha_n(1-\beta)+\beta)\beta} \tag{B8}$$

and

$$\lambda_{\text{IE,high}}^{\text{adj}} := \frac{(\alpha_n(1-\beta)+\beta)(\alpha_n(1-\beta)+(1-\alpha_s)\beta)}{2(1-\alpha_n)\alpha_s(1-\beta)\beta^2} \tag{B9}$$

One can show that

$$\lambda_{\text{IE,low}}^{\text{adj}} < \lambda_2 \Rightarrow \lambda_{\text{IE,high}}^{\text{adj}} < \lambda_2 \text{ and } \lambda_{\text{IE,high}}^{\text{adj}} > \lambda_2 \Rightarrow \lambda_{\text{IE,low}}^{\text{adj}} > \lambda_2$$

by noting that the profit functions for image building is continuous and weakly concave whereas the profit function for exclusive good is linearly increasing. Thus, if image building maximizes profit for some λ, it maximizes profit for an interval of values for λ. If image building is not optimal for any value of λ, the threshold to exclusive good is given by $\lambda_{SE}^{\text{adj}}$. Using the definitions from Equations B6, B7, B8, and B9, I obtain

$$\tilde{\tilde{\lambda}}^{\text{adj}} := \begin{cases} \lambda_{SE}^{\text{adj}} & \text{if } \tilde{\lambda}^{\text{adj}} = \lambda_{SE}^{\text{adj}} \\ \lambda_{\text{IE,low}}^{\text{adj}} & \text{if } \lambda < \lambda_2 \text{ and } \tilde{\lambda}^{\text{adj}} = \lambda_{SI}^{\text{adj}} \\ \lambda_{\text{IE,high}}^{\text{adj}} & \text{if } \lambda > \lambda_2 \text{ and } \tilde{\lambda}^{\text{adj}} = \lambda_{SI}^{\text{adj}} \end{cases} \tag{B10}$$

Qualitatively, the equilibrium is exactly what I have shown by focusing on the equilibrium preferred by the monopolist.

□

While consumers intend to do better by coordinating against the monopolist, the adjustment of the product line may be detrimental to consumer surplus. The following numerical example illustrates the case.

Example B8. *Suppose the parameters take the following values: $\beta = 0.00170898$, $\alpha_n = 0.00012207$, $\alpha_s = 0.314941$, and $\lambda = 1.28931$. Then, the thresholds derived above are $\tilde{\lambda}^{adj} = \lambda_{SI}^{adj} = 0.67984 < 1.08887 = \lambda_{SE}^{adj}$, $\tilde{\tilde{\lambda}}^{adj} = \lambda_{IE,high}^{adj} = 1.28879 > 1.10409 = \lambda_2$. Thus, if consumers coordinated against the monopolist would offer an exclusive good. Corresponding consumer surplus is $CS^{E,adj} = 1.369983^{-6}$. If instead, consumers follows the prescriptions by the monopolist, the thresholds are $\tilde{\lambda} = \lambda_{SI} = 0.67984 < 1.08887 = \lambda_{SE}$, $\tilde{\tilde{\lambda}} = \lambda_{IE,high} = 1.32751 > 1.10409 = \lambda_2$.*

If unconstrained by consumers's coordination, the monopolist would still offer an image building product line. Consumer surplus would be $CS^I = 0.000629$.

Using the computations on the welfare-maximizing competitive equilibrium (see Lemma B1), it turns out that there still exist parameter constellations such that monopoly gives higher welfare than competition.

Example B9. *Suppose the following values:* $\alpha_s = 0.0625$, $\alpha_n = 0.109375$, $\beta = 0.0546875$, $\lambda = 1$. *Then,* $\tilde{\lambda}^{adj} = \lambda^{adj}_{SI} = 0.522462 < 7.93388 = \lambda^{adj}_{SE}$, $\tilde{\tilde{\lambda}}^{adj} = \lambda^{adj}_{IE,high} = 77.6802$, *and* $\lambda_2 = 3.01667$. *Monopoly implements an image building product line which yields welfare* $W^{I,adj} = 0.047899$. *The welfare-maximizing equilibrium in competition is a partially separating equilibrium with partial participation and yields only welfare* $W^{sep\text{-}part} = 0.030762$.

Example B10. *Suppose the following parameter values* $\alpha_s = 0.852661$, $\alpha_n = 0.335938$, $\beta = 0.486328$, $\lambda = 1.70703$. *Then,* $\tilde{\lambda}^{adj} = \tilde{\tilde{\lambda}}^{adj} = \lambda^{adj}_{SE} = 0.1682 < 0.201117 = \lambda^{adj}_{SI}$. *Monopoly implements and exclusive good and yields welfare* $W^{E,adj} = 0.951257$. *Competition in the welfare-maximizing equilibrium yields a partially separating equilibrium with full participation of purely image concerned consumers (*$\lambda > 1.70411 = \frac{1}{2}R_L^{-1}$*) and thereby only lower welfare of* $W^{sep\text{-}all} = 0.951172$.

B.7. The role of Assumption 1

In the main text, I have derived the optimal product offer under the assumption that consumers do not randomize but if indifferent between buying a product and not participating always purchase the product (Assumption 1 in the main body of the paper). In this subsection I first show that the equilibrium under Assumption 1 is indeed in pure strategies. Second, I derive the optimal product offer without this tie-breaking assumption and illustrate that the result from the main text remain qualitatively unchanged.

B.7.1. The equilibrium under Assumption 1 is in pure strategies

Proposition B4. *Under Assumption 1, the profit maximizing product line induces an equilibrium in pure strategies in the consumption stage.*

Proof of Proposition B5:

Proof. By Lemma A1, the monopolist offers at most two products and the non-participation option. Using this result, I first proof that randomization in single-product lines is not profitable (Lemma B4). Then, I show that in two-product lines, randomization between products is not profitable either (Lemma B5). Finally, I show, that randomization by type 01 or 11 in two-product lines is also not profitable (Lemmas B6 and B7). Randomization by type 10 has been excluded through Assumption 1.

Lemma B12. *Suppose the monopolist maximizes profits by offering one product* $(s, p) \neq (0, 0)$. *Then, the offer induces a pure-strategy equilibrium in the consumer game.*

Proof. Suppose the monopolist offers $(s, p) \neq (0, 0)$. Since otherwise profit is zero, at least some consumers of type 10 or type 11 buy (s, p) and $p > \frac{1}{2}s^2$.

(i) Suppose consumer type 11 buys (s, p) with probability q and $(0, 0)$ with probability $1 - q$. For given price and quality, profit increases in q since $p - \frac{1}{2}s^2 > 0$. Further, the image associated with (s, p) (with $(0, 0)$) increases (decreases) in q. Thus, the price which can be maximally charged increases in q. Therefore, the monopolist maximizes profit for $q = 1$. The same argument holds for type 10.

(ii) Suppose consumer type 01 buys (s,p) with probability q and $(0,0)$ with probability $1-q$. Without loss of generality assume that type 11 and 10 buy (s,p) with probability 1 and type 00 chooses $(0,0)$. Then, $R(s,p) = \frac{\beta}{q\alpha_n(1-\beta)+\beta}$ and $R(0,0) = 0$. Indifference requires

$$\lambda R(s,p) = p \Leftrightarrow q = \frac{\beta(\lambda - p)}{\alpha_n(1-\beta)p}$$

By the same arguments as in Lemma A5 in the Appendix, I obtain the profit maximizing product as

$$(s,p) = \begin{cases} (\frac{\beta\lambda}{\beta+\alpha_n q(1-\beta)}, \frac{\beta\lambda}{\beta+\alpha_n q(1-\beta)}) & \text{if } \lambda < R(s,p)^{-1} \\ (1,1) & \text{else.} \end{cases}$$

The corresponding profit is increasing in q

$$\Pi = \begin{cases} \frac{1}{2}\beta\lambda\left(2 + \frac{\beta\lambda}{\alpha_n q(-1+\beta)-\beta}\right) & \text{if } \lambda < R(s,p)^{-1} \\ \frac{1}{2}(\beta + \alpha_n(q - q\beta)) & \text{else.} \end{cases} \quad \text{and} \quad \frac{\partial \Pi}{\partial q} > 0$$

□

Suppose the monopolist offers a product line which maximizes profits within the set of offers that induce a pure-strategy equilibrium in the consumption stage. According to Proposition 1 in the Appendix, the offer takes the form of an "image building" product line where types 00 choose $(0,0)$, types 10 and 01 buy (s_L, p_L), and type 11 buys (s_H, p_H) and $s_L \leq s_H$. To simplify notation, define $\Delta R = R(s_H, p_H) - R(s_L, p_L)$.

Furthermore, the following set of conditions will be helpful in subsequent derivations:

$$\begin{aligned}
&(\text{IC}_{10}) && s_H - p_H \leq s_L - p_L \\
&(\text{IC}_{01}) && \lambda R(s_H, p_H) - p_H \leq \lambda R(s_L, p_L) - p_L \\
&(\text{PC}_{01}) && \lambda R(s_L, p_L) - p_L \geq \lambda R(0,0) \\
&(\text{PC}_{10}) && s_L - p_L \geq 0 \\
&(\text{IC}_{11}) && s_H + \lambda R(s_H, p_H) - p_H \geq s_L + \lambda R(s_L, p_L) - p_L \\
&(\text{PC}_{11}) && s_H + \lambda R(s_H, p_H) - p_H \geq \lambda R(0,0)
\end{aligned}$$

The images $R(s_H, p_H)$, $R(s_L, p_L)$, and $R(0,0)$ will be stated separately in each case. Additional conditions which will be detailed where necessary. It is easily verified that PC_{11} is automatically fulfilled whenever the other constraints hold.

Lemma B13. *Suppose the monopolist maximizes profits by offering two products $(s_L, p_L) \neq (s_H, p_H)$, $(s_i, p_i) \neq (0,0)$ for $i = L, H$. Then, consumers do not randomize over (s_L, p_L) and (s_H, p_H).*

Proof. **(i)** Suppose type 10 buys (s_H, p_H) with probability q and (s_L, p_L) with probability $1-q$. Suppose that type 01 buys (s_L, p_L) and type 11 buys (s_H, p_H). Then $R(s_H, p_H) = 1$, $R(s_L, p_L) = \frac{(1-q)(1-\alpha_s)\beta}{(1-q)(1-\alpha_s)\beta+\alpha_n(1-\beta)}$, and $R(0,0) = 0$ and IC_{01}, IC_{11}, PC_{01}, and PC_{10} have to hold. Additionally, IC_{10} has to hold with equality to keep type 10 indifferent between the two products. From the two participation constraints PC_{10} and PC_{01} I obtain $p_L = \min\{s_L, \lambda R(s_L, p_L)\}$. By the same arguments as in Lemma A5 in the appendix this implies $s_L = \min\{1, \lambda R(s_L, p_L)\}$, and $s_L = p_L$. Then, from IC_{10} follows $s_H = p_H$. Using this in IC_{01} I obtain

$$\text{(B11)} \qquad s_H - s_L \geq \lambda \Delta R$$

If unconstrained, the monopolist would like to sell $s_L = s_H = 1$. Thus, (B11) binds at the optimum and $s_H = s_L + \lambda\Delta R$. The corresponding profit is

$$\begin{aligned}\Pi &= (q(1-\alpha_s)\beta + \alpha_s\beta)(s_L + \lambda\Delta R - \tfrac{1}{2}(s_L+\lambda\Delta R)^2) \\ &\quad +((1-q)(1-\alpha_s)\beta + \alpha_n(1-\beta))(s_L - \tfrac{1}{2}s_L^2)\end{aligned}$$

with optimal quality choices

$$\begin{aligned} s_L &= \max\{0, 1 - \frac{q(1-\alpha_s)\beta+\alpha_s\beta}{\beta+\alpha_n(1-\beta)}\lambda\Delta R\} < 1 \\ s_H &= \begin{cases}\lambda\Delta R & \text{if } s_L = 0 \\ 1 + \frac{(1-q)(1-\alpha_s)\beta+\alpha_n(1-\beta)}{\beta+\alpha_n(1-\beta)}\lambda\Delta R & \text{if } s_L > 0\end{cases}\end{aligned}$$

For $s_L = p_L = 0$, types 11 and 10 buy $s_H = p_H = 1$ and type 01 pools with type 00 on the outside option $(0,0)$; no randomization takes place $q = 1$. For $\lambda < (\Delta R)^{-1}\frac{\alpha_n(1-\beta)+\beta}{q(1-\alpha_s)\beta+\alpha_s\beta}$, I obtain $s_L > 0$ and profit is

$$\text{(B12)} \qquad \begin{aligned}\Pi &= \frac{1}{2}(\alpha_n(1-\beta)+\beta) \\ &\quad - \frac{\alpha_n^2(1-\beta)^2(q(1-\alpha_s)\beta+\alpha_s\beta)\lambda^2}{2(\alpha_n(1-\beta)+(1-q)(1-\alpha_s)\beta)(\alpha_n(1-\beta)+\beta)}\end{aligned}$$

Profit from (B12) is maximal at $q = 0$; at the optimum, no randomization takes place.

(ii) Suppose type 01 buys (s_H, p_H) with probability q and (s_L, p_L) with probability $1-q$. Suppose further that type 10 buys (s_L, p_L) and type 11 buys (s_H, p_H). Then $R(s_H, p_H) = \frac{\alpha_s\beta}{q\alpha_n(1-\beta)+\alpha_s\beta}$, $R(s_L, p_L) = \frac{(1-\alpha_s)\beta}{(1-q)\alpha_n(1-\beta)+(1-\alpha_s)\beta}$, and $R(0,0) = 0$. Conditions IC_{10}, IC_{11}, PC_{01}, and PC_{10} have to hold. Additionally, IC_{01} has to hold with equality for type 01 to remain indifferent: $p_H = p_L + \lambda\Delta R$.

Note that this product line is only feasible as long as

$$R(s_H, p_H) \geq R(s_L, p_L) \Leftrightarrow q \leq \frac{\alpha_s\beta}{\alpha_s\beta + (1-\alpha_s)\beta}$$

In analogy to the proof of Lemma A5 in the appendix, I find

$$p_L = \min\{\lambda R(s_L, p_L), s_L\} \text{ and } s_L = \min\{\lambda R(s_L, p_L), 1\}$$

I distinguish two cases:

Case 1: Suppose $\lambda < R(s_L, p_L)^{-1}$. Then, $s_L = \lambda R(s_L, p_L) = p_L$. From IC_{01} I obtain $p_H = \lambda R(s_H, p_H)$ and from IC_{10} $s_H \leq \lambda R(s_H, p_H)$. Profit is increasing in s_H for $s_H \leq 1$. Thus, we obtain $s_H = \min\{1, \lambda R(s_H, p_H)\}$. I plug in the derived values into the profit function and simplify profits:

$$\text{(B13)} \quad \Pi = \begin{cases}\beta\lambda + \frac{\left(q\alpha_n(1-\beta)((1-\alpha_s)\beta-\alpha_s\beta)\beta+\alpha_s\beta\left((1-\alpha_s)^2\beta^2+(\alpha_n(1-\beta)+(1-\alpha_s)\beta)\alpha_s\beta\right)\right)\lambda^2}{2((-1+q)\alpha_n(1-\beta)-(1-\alpha_s)\beta)(q\alpha_n(1-\beta)+\alpha_s\beta)} \\ \quad \text{if } \lambda < R(s_H, p_H)^{-1} \\ \frac{1}{2}\left(-q\alpha_n(1-\beta) + \alpha_s\beta(-1+2\lambda) + (1-\alpha_s)\beta\lambda\left(2 - \frac{(1-\alpha_s)\beta\lambda}{(1-q)\alpha_n(1-\beta)+(1-\alpha_s)\beta}\right)\right) \\ \quad \text{if } R(s_H, p_H)^{-1} < \lambda < R(s_L, p_L)^{-1}\end{cases}$$

I maximize profit according to (B13) with respect to the probability q that type 01 buys (s_H, p_H) and obtain

$$q^* = \begin{cases} \alpha_s \text{ if } \lambda < R(s_H,p_H)^{-1} \\ \frac{1}{2}\left(1 + \frac{(1-\alpha_s)\beta\left(\alpha_n(1-\beta)+(1-\alpha_s)\beta+(1-\alpha_s)\beta\lambda^2\right)}{\alpha_n(1-\beta)(\alpha_n(1-\beta)+(1-\alpha_s)\beta)} - \sqrt{\frac{((\alpha_n(1-\beta)+(1-\alpha_s)^2\beta)^2+(1-\alpha_s)^2\beta^2\lambda^2)^2}{\alpha_n^2(1-\beta)^2(\alpha_n(1-\beta)+(1-\alpha_s)\beta)^2}}\right) \\ \quad \text{if } R(s_H,p_H)^{-1} < \lambda < R(s_L,p_L)^{-1} \end{cases}$$

Profit at q^* is

$$\Pi = \begin{cases} \frac{1}{2}\beta\lambda\left(2 - \frac{\beta\lambda}{\alpha_n(1-\beta)+\beta}\right) \\ \quad \text{if } \lambda < R(s_H,p_H)^{-1} \\ \alpha_s\beta\left(-\frac{1}{2}+\lambda\right) + \frac{1}{2}(1-\alpha_s)\beta\lambda\left(2 - \frac{(1-\alpha_s)\beta\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)\beta}\right) \\ \quad \text{if } R(s_H,p_H)^{-1} < \lambda < R(s_L,p_L)^{-1} \end{cases}$$

and never exceeds profit from a deterministic image building product line as derived in Lemmas A5 and A7 and stated in equation 8 in the appendix.

Case 2: Suppose $\lambda \geq R(s_L,p_L)^{-1}$. Since $R(s_L,p_L) < R(s_H,p_H)$ this implies $\lambda > R(s_H,p_H)^{-1}$. Due to the quadratic cost function profit is decreasing in qualities s_i for $s_i > 1, i = L, H$. Therefore, the monopolist sets $s_L = s_H = 1$. This yields $p_L = 1$ and $p_H = 1 + \lambda\Delta R$. Profit is then

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

This profit is maximal at $q = 0$ and the monopolist does not profit from randomization.

(iii) It is easy to see that profits do not increase either if type 11 randomizes between the high and the low quality product. Suppose type 11 is indifferent between (s_L,p_L) and (s_H,p_H). If a fraction $1-q$ of type 11 buys (s_L,p_L) this increases the associated image. However, if the monopolist increases p_L in response to the image increase, types 10 stop buying (s_L,p_L) unless he also increases s_L. But an increase in s_L makes the low quality product more attractive to type 11, thereby breaking the indifference of type 11.[45] Therefore, p_L and s_L remain unchanged. Having type 11 buy the low quality decreases profits since $p_H - \frac{1}{2}s_H^2 > p_L - \frac{1}{2}s_L^2$ due to the image-premium charged from type 11. □

Lemma B14. *Suppose the monopolist maximizes profits by offering two products* $(s_L,p_L) \neq (s_H,p_H)$, $(s_i,p_i) \neq (0,0)$ *for* $i = L, H$. *Then, consumer type* 01 *does not randomize over* (s_L,p_L) *and* $(0,0)$.

Proof. Let q denote the probability that type 01 buys (s_L,p_L) and with $(1-q)$ he takes $(0,0)$. Suppose only type 11 buys (s_H,p_H). Then $R(s_L,p_L) = \frac{(1-\alpha_s)\beta}{(1-\alpha_s)\beta+q\alpha_n(1-\beta)}$ and $R(s_H,p_H) = 1$.

For type 01 to mix between (s_L,p_L) and $(0,0)$, PC_{01} has to bind. Together with PC_{10} this gives $s_L \geq \lambda R(s_L,p_L) = p_L$. Since quality is costly to produce the monopolist sets $s_L = \lambda R(s_L,p_L)$.

Using this in IC_{11} yields

$$p_H \leq p_L + s_H - s_L + \lambda\Delta R = s_H + \lambda\Delta R. \tag{B14}$$

Under profit maximization constraint B14 binds. The monopolist maximizes profits by setting $s_H = 1$ and

$$(s_L,p_L) = (\lambda R(s_L,p_L), \lambda R(s_L,p_L)) \quad \text{and} \quad (s_H,p_H) = (1, 1+\lambda\Delta R).$$

[45] The monopolist can increase s_H to sustain indifference but this does quite obviously not increase profits either.

The corresponding profit increases in q:

$$\begin{aligned}\Pi &= \tfrac{\alpha_s\beta}{2} + \tfrac{q\alpha_n(1-\beta)\alpha_s\beta\lambda}{(1-\alpha_s)\beta+q\alpha_n(1-\beta)} \\ &\quad +(q\alpha_n(1-\beta)+(1-\alpha_s)\beta)\left(\tfrac{(1-\alpha_s)\beta\lambda}{(1-\alpha_s)\beta+q\alpha_n(1-\beta)} - \tfrac{(1-\alpha_s)^2\beta^2\lambda^2}{2(q\alpha_n(1-\beta)+(1-\alpha_s)\beta)^2}\right) \\ \frac{\partial\Pi}{\partial q} &= \frac{\alpha_n(1-\alpha_s)(1-\beta)\beta^2(2\alpha_s+(1-\alpha_s)\lambda)\lambda}{2(\alpha_n q(1-\beta)+(1-\alpha_s)\beta)^2} > 0.\end{aligned}$$

□

Lemma B15. *Suppose the monopolist maximizes profits by offering two products* $(s_L, p_L) \neq (s_H, p_H)$, $(s_i, p_i) \neq (0,0)$ *for* $i = L, H$. *Then, consumer type* 11 *does not randomize over any product and* $(0,0)$.

Proof. Let q denote the probability of type 11 buying (s_H, p_H) and by $(1-q)$ the probability of her choosing $(0,0)$. Denote by $\gamma_{10}^i, \gamma_{01}^i$ the fractions of the population which are of type 10 and 01, respectively, and buy product i for $i \in \{L, H\}$. The required indifference in PC_{11} implies

$$\begin{aligned}p_H &= \lambda(R(s_H,p_H) - R(0,0)) + s_H \\ &= \lambda(1 - \frac{(1-q)\alpha_s\beta}{(1-q)\alpha_s\beta + (1-\beta)\alpha_n(1-\gamma_{01}^L-\gamma_{01}^H) + (1-\alpha_s)\beta(1-\gamma_{10}^L-\gamma_{10}^H)}) + s_H\end{aligned}$$

The price p_H increases in q and so do per-unit profits from sales of (s_H, p_H). Furthermore, profits from selling (s_L, p_L) also increase in q since analogous to Lemma A5 in the appendix:

$$\begin{aligned}p_L &= s_L \\ &= \min\{1, \lambda(\tfrac{(1-\alpha_s)\beta\gamma_{10}^L}{(1-\alpha_s)\beta\gamma_{10}^L+(1-\beta)\alpha_n\gamma_{01}^L} - \tfrac{(1-q)\alpha_s\beta}{(1-q)\alpha_s\beta+(1-\beta)\alpha_n(1-\gamma_{01}^L-\gamma_{01}^H)+(1-\alpha_s)\beta(1-\gamma_{10}^L-\gamma_{10}^H)})\}\end{aligned}$$

and thus p_L and s_L increase in q. Finally, at the margin type 11 buying (s_H, p_H) contributes $p_H - \frac{1}{2}s_H^2 > 0$ to profits so that the monopolist looses from type 11 not buying directly. □

Thus, I have shown that randomization of types 01 or 11 is not profitable. By Assumption 1 type 10 does not randomize. This completes the proof. □

B.7.2. Without Assumption 1 qualitatively similar results obtain but inducing consumers to randomize may be profitable

To investigate the problem without Assumption 1, I fist prove the generalization of Lemma B4.

Lemma B16. *Suppose the monopolist maximizes profits by offering one product* $(s, p) \neq (0,0)$. *Then type 10 does not randomize between* (s, p) *and* $(0,0)$.

Proof. Let q denote the probability of type 10 buying the high quality product and $1-q$ the probability that type 10 chooses $(0,0)$. Suppose $q \in (0,1)$. Type 10 finds it profitable to randomize in this way if and only if $s = p$. The profit maximizing quality choice is then $s = 1$ and profits from sales of (s,p) are $(q(1-\alpha_s)\beta + \alpha_s\beta)(s_H - \frac{1}{2}s_H^2) = \frac{1}{2}(q(1-\alpha_s)\beta + \alpha_s\beta)$ and increasing in q. Thus, $q \in \{0,1\}$ and type 10 does not randomize. □

The next lemma characterizes a possibly profitable 2-product line where type 10 randomizes between the lower quality product and not participating. I call this **image building with randomization** because of its similarity to the image building product line.

Lemma B17. *There exists a stochastic mechanism where two products with positive quality are offered and type* 10 *randomizes over buying the lower quality product and not participating and a set of parameters such that this mechanism maximizes monopoly profits.*

Proof. Suppose a product line with two positive quality products $(s_L, p_L), (s_H, p_H)$ is offered and that type 10 randomizes over buying the lower of the two qualities, s_L, and not buying at all. Denote by q the probability that type 10 buys the lower quality product; $1-q$ is the probability that type 10 does not buy.

When type 10 does not always participate, the image of non-participation increases whereas the image associated with the lower quality product decreases. The proposed structure is only feasible as long as the image associated with the lower quality product is greater than the image associated with not buying since only the difference between the two, multiplied by the value of image λ is the price which can be charged for this product.

The image of the lower quality product is higher than the one for non-participation as long as

$$R(s_L, p_L) \geq R(0,0) \Leftrightarrow q \geq \alpha_n$$

Thus, for $\alpha_n = 1$ the only admissible product line of this type has $q = 1$ and randomization of type 10 does not have to be considered.

Analogous to the derivation of the pure strategy image building product line, I derive that the products with randomization take the following form:

$$s_H = 1 \text{ and } s_L = \begin{cases} \lambda\left(\frac{(1-\alpha_s)q\beta}{\alpha_n(1-\beta)+(1-\alpha_s)q\beta} - \frac{(1-\alpha_s)(1-q)\beta}{1-\alpha_n(1-\beta)-\alpha_s\beta-(1-\alpha_s)q\beta}\right) \\ \text{if } \lambda < (R_L - R(0))^{-1} \\ 1 \text{ else} \end{cases}$$

$$p_H = 1 + \lambda\frac{\alpha_n(1-\beta)}{q(1-\alpha_s)\beta + \alpha_n(1-\beta)} \text{ and } p_L = s_L$$

Suppose this product line is feasible, i.e. $q \geq \alpha_n$. Profit from image building with randomization is then

(B15)

$$\Pi_{I\text{rand}} = \begin{cases} \frac{\alpha_s\beta}{2} + \frac{\alpha_n\alpha_s(1-\beta)\beta\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)q\beta} \\ +(\alpha_n(1-\beta)+(1-\alpha_s)q\beta)\{\left(\frac{(1-\alpha_s)q\beta}{\alpha_n(1-\beta)+(1-\alpha_s)q\beta} - \frac{(1-\alpha_s)(1-q)\beta}{1-\alpha_n(1-\beta)-\alpha_s\beta-(1-\alpha_s)q\beta}\right)\lambda \\ -\frac{1}{2}\left(\frac{(1-\alpha_s)q\beta}{\alpha_n(1-\beta)+(1-\alpha_s)q\beta} - \frac{(1-\alpha_s)(1-q)\beta}{1-\alpha_n(1-\beta)-\alpha_s\beta-(1-\alpha_s)q\beta}\right)^2\lambda^2\} \\ \text{if } \lambda < (R_L - R(0))^{-1} \\ \\ \frac{1}{2}(\alpha_n(1-\beta)+\alpha_s\beta+(1-\alpha_s)q\beta) + \frac{\alpha_n\alpha_s(1-\beta)\beta\lambda}{\alpha_n(1-\beta)+(1-\alpha_s)q\beta} \\ \text{else} \end{cases}$$

I conclude the proof by an example in which image building with randomization gives higher profit than any pure strategy mechanism.

Example B11. ***Profitable randomization:*** *Suppose we have $\alpha_{10} = \frac{1}{32}, \alpha_{01} = \frac{379}{4096}, \alpha_{11} = \frac{1}{16}, \lambda = \frac{21}{4}, q = \frac{3}{4}$. Plugging in reveals that the relevant constraints onλ and q are satisfied. I have shown before that for λ large enough, as is the case here, neither the standard good nor the mass market have to be considered (see Lemma A8 in the appendix and Proposition 2 in the paper).*

Profits corresponding to the example are $\Pi_{Irand} = \frac{1365977}{3891200} = 0.351043, \Pi_{Idet} = \frac{468531}{1384448} = 0.338424, \Pi_E = \frac{223}{640} = 0.348438$ with Π_{Irand} being the largest.

□

Corollary B3. *Inducing partial participation of type* 10 *allows to sell two different quality levels for higher values of image than under full participation.*

Proof. In general, the threshold above which both qualities are equal to one is $(R_L - R(0))^{-1}$. Since partial participation decreases R_L and increases $R(0)$, the threshold increases (as long as the participation probability is admissible, see above). $\square$

It is instructive that we find an example in the case where $s_L = 1 = p_L < \lambda R_L$ in the deterministic image building. In this case, the value of image is so large that the purely image concerned consumer 01 earns a rent when buying the lower quality product. Having type 10 only partially participate reduces the image associated with the lower quality product. This lowers not only the rent to type 01 but also the rent which has to be left to type 11. By inducing type 10 to only partially participate, the monopolist can increase the price charged on the higher quality product without having to adjust price and quality of the lower quality product. Thus, when participation changes at the margin, profit on those still buying goes up.

Suppose such a mixed-strategy image building product line is optimal. The structure of this product line is the same as in the pure strategy image building apart from the fact that some type 10 consumers do not buy anything and image as well as quality of the lower quality product deteriorate. While average quality changes, this type of equilibrium does not give fundamentally different insights than what we learn from the pure strategy equilibria. Qualitatively, the only profitable randomization induces an image building product line but does not change the intuition of the results.

The following proposition characterizes the equilibrium without Assumption 1. The result is illustrated in Figure B3

Proposition B5. *Suppose $\alpha_n, \alpha_s, \beta$ and $q \in (\alpha_n, 1)$ are such that profit from* ***image building with randomization*** *is strictly higher than profit from any other product line for some $\lambda > 0$. If such q exists, there are $\hat{\lambda}(q) < \tilde{\lambda}_m < \hat{\hat{\lambda}}(q)$ such that image building with randomization gives highest profits for all $\lambda \in [\hat{\lambda}(q), \hat{\hat{\lambda}}(q)]$.*

Proof. Profit from image building with randomization is given in B15 where

$$(R_L - R(0))^{-1} = \frac{(1 - \alpha_n(1-\beta) - \alpha_s(1-q)\beta - q\beta)(\alpha_n(1-\beta) + (1-\alpha_s)q\beta)}{(1-\alpha_s)(1-\alpha_n)(1-\beta)\beta}$$

is the inverse of the image premium from buying low quality instead of not buying at all.

It is easily verified that the profit function from image building with mixing is continuous, increasing, and concave in λ for $\lambda \leq (R_L - R(0))^{-1}$ and linearly increasing for $\lambda > (R_L - R(0))^{-1}$.

I have shown in Lemma A7 that profit from image building in pure strategies is continuous, increasing, and concave in λ for $\lambda \leq \lambda_2$ and linearly increasing for $\lambda > \lambda_2$.

Both product lines give the same profit for $\lambda = 0$, $\Pi^I|_{\lambda=0} = \Pi^{\text{mix}}|_{\lambda=0}$. Furthermore, if $\tilde{\lambda}_m > \lambda_2$ the slope from profit with mixing is always greater than the slope from profit with image building:

$$\frac{\partial \Pi^I}{\partial \lambda}|_{\lambda=\tilde{\lambda}_m} < \frac{\partial \Pi^{\text{mix}}}{\partial \lambda}|_{\lambda=\tilde{\lambda}_m}$$

Moreover, the slope from profit with mixing is lower than the slope from profit with exclusive good when evaluated at $\lambda = (R_L - R(0))^{-1}$.

This can be seen relatively easily by assuming that $\lambda \geq (R_L - R(0))^{-1}$ such that also three profit functions are linear. Profit from exclusive good and deterministic image building are linear for any $\lambda > \lambda_2$ and $\lambda_2 < (R_L - R(0))^{-1}$. Since, profit from mixing is linear for $\lambda > (R_L - R(0))^{-1}$, concave for smaller λ, and continuous in λ, the slope for any smaller λ is only greater such that the first inequality still holds.

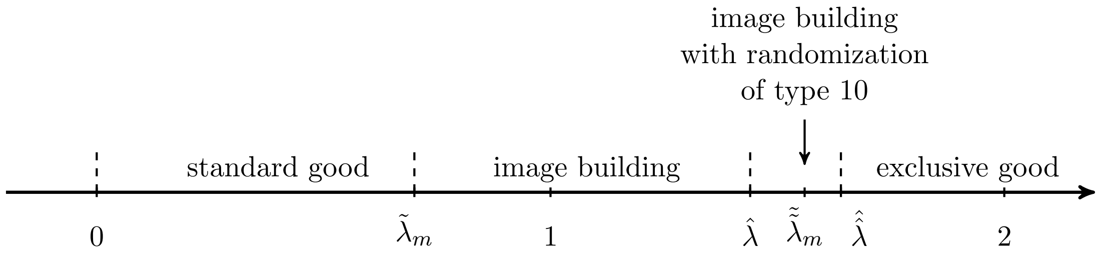

Figure B3: Equilibrium in monopoly without Assumption 1.

The case where $\tilde{\lambda}_m < \lambda_2$ is more complicated since then only profit from exclusive good is linear. However, we know that profit from mixing and profit from image building are concave and that at $\lambda = 0$, both give the same profit. Furthermore, one can show that for $\lambda < \lambda_2$ the following holds:

$$\frac{\partial^2 \Pi^{\text{mix}}}{\partial \lambda^2} \geq \frac{\partial^2 \Pi^I}{\partial \lambda^2}$$

Since $\frac{\partial^2 \Pi^{\text{mix}}}{\partial \lambda^2} < 0$ and $\frac{\partial^2 \Pi^I}{\partial \lambda^2} < 0$ this means that the slope of profit from image building is decreasing faster than the slope from profit with mixing. From this we know that if for some $\lambda > 0$ profit from mixing is higher than profit from image building and $\frac{\partial \Pi^I}{\partial \lambda}|_\lambda < \frac{\partial \Pi^{\text{mix}}}{\partial \lambda}|_\lambda$, then mixing will give higher profit than image building for all $\lambda' > \lambda$ subject to the assumption that $\lambda' < \lambda_2$.

Since for $\lambda = 0$ profits are equal, this implies that profit from mixing and profit from deterministic image building cross at most once for $\lambda < \lambda_2$ with profit from image building with randomization coming from below (and additionally the two product lines give the same profit for $\lambda = 0$).

Combining the two insights for $\lambda < \lambda_2$ and $\lambda > \lambda_2$, I have shown that if mixing is best for some $\lambda > 0$, then there exist $q \in (\alpha_n, 1)$ and $\hat{\lambda}(q) < \hat{\hat{\lambda}}(q)$ such that mixing with an induced participation probability q for type 10 maximizes profit for $\lambda \in [\hat{\lambda}(q), \hat{\hat{\lambda}}(q)]$.

In the first part, I have shown that the slope of mixing for $\lambda > \tilde{\lambda}_m$ is lower than the slope of exclusive good profits. Thus, if profits haven't intersected before, they will not do so later. Thus, I have also shown that $\hat{\lambda}(q) < \tilde{\tilde{\lambda}}_m < \hat{\hat{\lambda}}(q)$. □

B.8. Constant unit cost

Suppose the unit cost is constant in quality, $c(s) = c > 0$ and utility from obtaining quality s is equal to s. Suppose further that quality cannot exceed 1, e.g. because quality is the fraction of high quality inputs into the final good. I assume that producing quality is cheap enough relative to the value of image and the type distribution for it being profitable to sell to engage in product differentiation and where marginal utility from quality exceeds its marginal cost, i.e. $c < \max\{1, \lambda \frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s)+(1-\beta)\alpha_n}\}$.

As in the setup with quadratic costs of quality, there are four possible sortings in the coordination game among consumers. Optimal products which sustain these equilibria are presented in Table B1.

I derive the optimal products as follows:

Standard good (sg): If $\lambda < 1$, type 01 does not want to buy at the monopoly price $p = 1$ even for maximal image $R = 1$. If $\lambda > 1$, however, separation requires: $\lambda R(s_{sg}, p_{sg}) < p_{sg}$ and $s_{sg} \geq p_{sg}$. Since profit is increasing in p_{sg} and thus in s_{sg}, set $s_{sg} = 1$ and $p_{sg} = s_{sg}$. Separation is then sustainable if and only if $\lambda R(s_{sg}, p_{sg}) < 1 \Leftrightarrow \lambda < 1$.

product line	group	products: (quality,price)			
Image value		$\lambda \leq 1$	$1 < \lambda \leq \lambda_1$	$\lambda_1 < \lambda \leq \lambda_2$	$\lambda_2 < \lambda$
standard	00,01	(0,0)	-		
good	10,11	(1,1)	-		
mass	00	(0,0)		(0,0)	
market	01,10,11	$(1, \lambda \frac{\beta}{\beta+(1-\beta)\alpha_n})$		(1,1)	
image	00	(0,0)			(0,0)
building	01,10	$(\lambda \frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s)+(1-\beta)\alpha_n}, \lambda \frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s)+(1-\beta)\alpha_n})$			(1,1)
	11	$(1,1+\lambda \frac{(1-\beta)\alpha_n}{\beta(1-\alpha_s)+(1-\beta)\alpha_n})$			$(1,1+\lambda \frac{(1-\beta)\alpha_n}{\beta(1-\alpha_s)+(1-\beta)\alpha_n})$
exclusive	00,01,10	(0,0)			
good	11	$(1,1+\lambda \frac{1-\beta}{1-\beta\alpha_s})$			

Table B1: Characterization of possible product lines with constant unit cost

Mass market (mm): Denote the product for the mass market by (s_{mm}, p_{mm}). Types 10 and 01 buy if $p \leq \min\{s, \lambda R(s_{mm}, p_{mm})\}$. It is $R(s_{mm}, p_{mm}) = \frac{\alpha_{11}+\alpha_{10}}{\alpha_{01}+\beta}$. Then, since there is no separation, $s_{mm} = 1$. Note that for $\lambda > \lambda_1$, $\lambda \frac{\beta}{\beta+(1-\beta)\alpha_n} > 1$ and thus price is not bound by valuation of type 01 for image anymore, and therefore $p = 1$.

Image building: Denote by (s_H, p_H) and (s_I, p_I) the high and the lower quality product in this product line. Images are given through the sorting. To gain the most from separation, high quality must be set at its maximum, $s_H = 1$, and price is set at the highest value which is still incentive compatible, $p_H = p_L + (s_H - s_L) + \lambda(R(s_H, p_H) - R(s_I - p_I)) = 1 + \lambda \frac{(1-\beta)\alpha_n}{\beta(1-\alpha_s)+(1-\beta)\alpha_n}$. For the lower quality product, the monopolist sets price such as to keep the type with lower willingness to pay just indifferent between buying and not buying, $s_L = \min\{s_L, \lambda \frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s)+(1-\beta)\alpha_n}\}$. Thus, he will set quality such as not to exceed the value of the associated image, $s_L = \min\{1, \lambda \frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s)+(1-\beta)\alpha_n}\}$. To summarize:

$$s_L = p_L = \begin{cases} \lambda \frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s)+(1-\beta)\alpha_n} & \text{if } \lambda < \lambda_2 \\ 1 & \text{else.} \end{cases}$$

To maximize profits, the monopolist does not want to increase the quality of the lower quality product even though marginal cost are constant. The reason is that providing $s_L > \lambda R_L$ tightens the upper bound on the high quality product's price more than necessary and thereby reduces profits.

Exclusive good (eg): To sustain a sorting where only type 11 buys, the price has to be high enough, $p_{eg} \geq \max\{\lambda, s_{eg}\}$. Furthermore for type 11 to buy, $p_{eg} \leq s_{eg} + \lambda \frac{1-\beta}{1-\beta\alpha_s}$. To maximize profits, the monopolist sets $s_{eg} = 1$, and $p_{eg} = 1 + \lambda \frac{1-\beta}{1-\beta\alpha_s}$.

Given these four product lines, I compute profits as summarized in Table B2 and identify which of those gives the highest profit for given type distribution and value of image.

Note first, that mass market never maximizes profits and I can restrict attention to the remaining three types of offers.

$$\Pi^M - \Pi^E = \begin{cases} \frac{\alpha_s\beta(\alpha_n+\beta-(\alpha_n+\alpha_s+\lambda(1-\alpha_s))\beta)}{-\alpha_n-(1-\alpha_n-\alpha_s)\beta} < 0 & \text{if } \lambda < \lambda_1 \\ \frac{-\alpha_n^2(1-\beta)^2+\alpha_n(\lambda-2(1-\alpha_s))(1-\beta)\beta-(1-\alpha_s)^2(1-\lambda)\beta^2}{-\alpha_n-(1-\alpha_n-\alpha_s)\beta} < 0 & \text{if } \lambda_1 < \lambda < \lambda_2 \\ \frac{\alpha_n\alpha_s\lambda(1-\beta)\beta}{-\alpha_n-(1-\alpha_n-\alpha_s)\beta} < 0 & \text{if } \lambda > \lambda_2 \end{cases}$$

product line	profit			
Image value	$\lambda \leq 1$	$v < \lambda \leq \lambda_1$	$1\lambda_1 < \lambda \leq \lambda_2$	$\lambda_2 < \lambda$
standard good	$\beta(1-c)$	-		
mass market	$((1-\beta)\alpha_n + \beta)(\lambda\frac{\beta}{\beta+(1-\beta)\alpha_n} - c)$		$((1-\beta)\alpha_n + \beta)(1-c)$	
image building	$((1-\beta)\alpha_n + \beta(1-\alpha_s))(\lambda\frac{\beta(1-\alpha_s)}{\beta(1-\alpha_s)+(1-\beta)\alpha_n} - c)$ $+\beta\alpha_s(1+\lambda\frac{(1-\beta)\alpha_n}{\beta(1-\alpha_s)+(1-\beta)\alpha_n} - c)$			$((1-\beta)\alpha_n + \beta(1-\alpha_s))(1-c)$ $+\beta\alpha_s(1+\lambda\frac{(1-\beta)\alpha_n}{\beta(1-\alpha_s)+(1-\beta)\alpha_n} - c)$
exclusive good	$\beta\alpha_s(1+\lambda\frac{1-\beta}{1-\beta\alpha_s} - c)$			

Table B2: Profits with constant unit cost

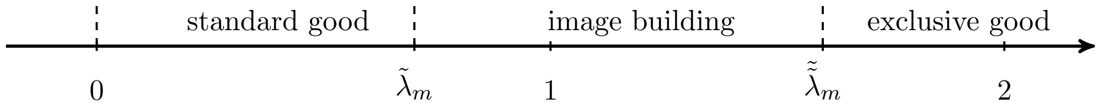

Figure B4: Equilibrium in monopoly with constant unit cost $c(s) = c < \bar{c}$.

It is straightforward to see that indeed for small λ, standard good is optimal, i.e. there exists $\tilde{\lambda} > 0$ such that for $\lambda < \tilde{\lambda}$ standard good maximizes profits. It is equally easy to see that there exists $\tilde{\tilde{\lambda}}$ large enough such that exclusive good maximizes profits.

When we look at the profit functions for the different product lines, we find

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

It is

$$\frac{\partial \Pi^E}{\partial \lambda} > \frac{\partial \Pi^S}{\partial \lambda} \text{ and } \frac{\partial \Pi^I}{\partial \lambda} > \frac{\partial \Pi^S}{\partial \lambda}$$

and

$$\frac{\partial \Pi^I}{\partial \lambda}|_{\lambda > \lambda_2} < \frac{\partial \Pi^E}{\partial \lambda} \Leftrightarrow \alpha_n < 1$$

Finally, the slope of Π^I decreases at $\lambda = \lambda_2$. I conclude that, if there is λ such that image building is optimal, then there exists an interval $[\tilde{\lambda}, \tilde{\tilde{\lambda}}]$ such that image building is optimal for all $\lambda \in [\tilde{\lambda}, \tilde{\tilde{\lambda}}]$.[46]

If I define now $\tilde{\lambda}$ and $\tilde{\tilde{\lambda}}$ as the values of image for which image building gives the same profit as does standard good ($\tilde{\lambda}$) and image building gives the same profit as does exclusive good ($\tilde{\tilde{\lambda}}$), the profit maximizing equilibrium takes the same form as in the case with quadratic costs which is illustrated in Figure B4.

For $\lambda < \tilde{\lambda}$, the monopolist offers a standard good, for $\tilde{\lambda} < \lambda < \tilde{\tilde{\lambda}}$ he offers an image building product line and for $\lambda > \tilde{\tilde{\lambda}}$, he offers the exclusive good.

So far, I have ignored the possibility of randomization. From the main text and B.8 we know that with quadratic cost, there is only one type of randomization which is profitable for certain parameter constellations. Type 10 could mix between buying the lower quality product in a

[46] $c < \bar{c}$. Having cost $c < \bar{c} = \frac{(1-\alpha_s)^2\beta(\alpha_n(1-\beta)+\beta(1-\alpha_s\beta)^2)}{\alpha_n^2\alpha_s(1-\beta)^3+(1-\alpha_s)^3\beta^2(1-\alpha_s\beta)+\alpha_n(1-\alpha_s)(1-\beta)\beta(1+\alpha_s(1-2\beta))}$ ensures that image building is profitable for lower values than is the exclusive good, i.e. $\tilde{\lambda} < \tilde{\tilde{\lambda}}$.

two-product line and not buying at all. In analogy to the analysis with quadratic unit costs, one can derive precise conditions for the optimality of randomization. However, this would go beyond the scope of this robustness check. Proposition B7 shows that there are parameters such that randomization by type 10 is not profitable with constant marginal cost of quality. Note that the proposition derives sufficient conditions and their not being fulfilled does not imply that randomization is optimal.

Proposition B6. *Suppose marginal cost of quality is constant. For each set of parameters, $\alpha_s, \alpha_n, \beta, \lambda$, such that $\beta\alpha_s < \alpha_n(1-\beta) + \beta(1-\alpha_s)$, there exists $\hat{c} > 0$ such that for $c \leq \hat{c}$ a two-product mechanism where type 10 randomizes between buying the lower quality from the monopolist and not buying at all gives lower profit than a deterministic mechanism where type 10 buys the low quality product with certainty.*

Proof. Suppose an image building product line is offered and denote the high quality product by (s_H, p_H), the low quality product by (s_L, p_L). Suppose a fraction q of type 10 consumers buys (s_L, p_L) and the remaining fraction of $(1-q)$ of type 10 consumers does not buy but obtains $(0,0)$. I compare the gain in profit from selling this product line with partial participation over the one where all type 10 consumers participate.

$$\begin{aligned}
\Delta\Pi &= \Pi_I^{\text{rand}} - \Pi_I^{\text{det}} \\
&= \alpha_s\beta\lambda\left(\tfrac{(1-\beta)\alpha_n}{(1-\beta)\alpha_n+\beta(1-\alpha_s)} - \tfrac{(1-\beta)\alpha_n}{(1-\beta)\alpha_n+q\beta(1-\alpha_s)}\right) \\
&\quad - (1-q)\beta(1-\alpha_s)\left(\lambda\tfrac{(1-\beta)\alpha_n}{(1-\beta)\alpha_n+\beta(1-\alpha_s)} - c\right) \\
&\quad - ((1-\beta)\alpha_n + \beta(1-\alpha_s))\lambda\left(\tfrac{\beta(1-\alpha_s)}{(1-\beta)\alpha_n+\beta(1-\alpha_s)} - \tfrac{q\beta(1-\alpha_s)}{(1-\beta)\alpha_n+q\beta(1-\alpha_s)}\right) \\
&= (1-q)\left(c - \lambda\tfrac{(1-\beta)\alpha_n((1-\beta)\alpha_n+\beta(1-\alpha_s)-\beta\alpha_s)}{((1-\beta)\alpha_n+\beta(1-\alpha_s))((1-\beta)\alpha_n+q\beta(1-\alpha_s))}\right)
\end{aligned}$$

Then,

$$\begin{aligned}
& & \Delta\Pi < 0 \\
\text{(B16)} \qquad & \Leftrightarrow & c < \lambda\frac{(1-\beta)\alpha_n((1-\beta)\alpha_n+\beta(1-\alpha_s)-\beta\alpha_s)}{((1-\beta)\alpha_n+\beta(1-\alpha_s))((1-\beta)\alpha_n+q\beta(1-\alpha_s))} =: \hat{c}
\end{aligned}$$

For $c \leq \hat{c}$, profit with randomization is lower than with deterministic participation. Furthermore, the term is decreasing in q, such that no randomization is profitable starting from $q = 1$. The intuition behind this finding is that for costs low enough, the cost saving from selling to fewer consumers does outweigh the loss from selling to them. We also learn from this special case with constant cost, that if randomization is profitable with quadratic cost, this is related to the fact that underproducing quality for the low quality product (i.e. $s_L < 1$) is not efficient and thereby dropping some of this consumers in exchange for higher prices from those served at efficient levels, may pay off.

The threshold $\hat{c}$ from (B16) is positive as long as the fraction of image and quality concerned consumers is small enough, i.e. $\beta\alpha_s < \alpha_n(1-\beta) + \beta(1-\alpha_s) \Rightarrow \hat{c} > 0$

□

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