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**Working Paper**

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ESMT Working Paper, No. 10-002 (R1)

**Provided in Cooperation with:**
ESMT European School of Management and Technology, Berlin

10-002 (R1)

June 7, 2013

ESMT Working Paper

# MARKETING SOCIAL RESPONSIBILITY

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ISSN 1866-3494

ESMT European School of Management and Technology

# Abstract

## Marketing social responsibility

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We analyze the marketing strategies of vertically differentiated firms when consumers observe their performance on corporate social responsibility (CSR) and firms simultaneously decide the price, advertising intensity and the investment in CSR. While advertising increases consumers' perception of product quality, CSR is introduced as "an observable and measurable behavior or output" which adds value for the society and "exceeds levels set by obligatory regulation or standards enforced by law" (Kitzmueller and Shimshack 2012). Results show that the firm strategies are contingent on product quality. A high quality monopolist charges a higher price, spends more on advertising but less on CSR to sell only to consumers who have a higher valuation of product quality. A low quality monopolist, in contrast, charges a lower price, spends less on advertising but more on CSR to address the entire market. However, in the presence of a high quality competitor, a low quality firm spends less on CSR than in a monopoly but may still spend more than the high quality competitor if the size of the low-end market is sufficiently large. Finally, when quality is not observable, a high quality firm spends more on CSR and charges a higher price to signal product quality. We conclude that CSR is a greater strategic consideration for firms who either rely on extensive market coverage or need to signal higher quality.

**Keywords:** Corporate social responsibility, vertical differentiation, signaling games

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# 1 Introduction

Firms are increasingly investing resources in corporate social responsibility (hereafter, CSR) and considering it as a mainstream business activity (The Economist 2008, 1) despite the initial skepticism of economists (Friedman 1970). In a recent review of the economics literature on CSR, Kitzmueller and Shimshack (2012) note that around 2 trillion USD and 300 billion EURO are certified as socially responsible assets in US and Europe respectively in 2006. During the recent economic downturn, even as companies cut other costs, many companies including Intel, GE, and Starbucks, have sustained or even expanded their commitment to CSR. Remarkably, GE's revenues from its multi-billion dollar "ecomagination" product development and advertising campaign for environmentally friendly practices and products went up 21% in 2008 despite the financial crisis (Delevigne 2009). A growing number of proponents regard CSR as "enlightened self-interest" which is self-sustaining and driven by profits (The Economist 2008, 2). Coca Cola, for example, commits through local communities to protect and replenish the main ingredient of its product − water. The company has reportedly gathered data to predict stress on water supplies until 2095 and shared this information with other companies (Rubin 2012). Our objective is to examine the rationale for CSR in the marketing context.

Increasingly, consumers are paying attention to the social responsibility and sustainability of the practices of companies whose products and services they buy (Holstein 2008). For example, a recent survey found that 82 percent of American adults claim to be well informed about companies and brands with a strong track record for sustainability.[1] There are also numerous websites such as www.goodguide.com and Newsweek's Annual Green Rankings (http://www.thedailybeast.com/newsweek/features/2012/newsweek-green-rankings.html) that provide consumers with information on CSR performance of companies. Companies, therefore, may benefit from aligning their marketing strategy with investments in CSR (Bhattacharya 2009). In competitive markets, publicized charitable outlays on social causes often invite competitor reaction. For example, competing firms such as Coke and Pepsi, JP Morgan Chase and Goldman Sachs have reportedly reacted to each other's "cause marketing" campaigns by launching their own (The Economist 2010). CSR, in other words, appears to assume a strategic role along with the marketing mix decisions of firms in competitive

[1] Source: http://business.time.com/2012/06/15/want-more-customers-become-a-green-company/ (last accessed on 30 October 2012).

markets.

Given the increasing attention paid to CSR by both firms and consumers, we examine how CSR enters the strategic decision making of firms in a differentiated product market. In other words, we examine how marketers may use CSR strategically in product markets where firm performance on CSR i.e., corporate social performance or "CSP" (Kitzmueller and Shimshack 2012) can be monitored. In particular, we examine firm decisions to spend on CSR in the context of other strategic decisions such as pricing and advertising intensity in heterogeneous markets. The following are the research questions:

1. How can a firm use CSR strategically in conjunction with pricing and advertising intensity in markets consisting of heterogenous consumers?

2. What is the effect of competition between vertically differentiated firms on CSR, pricing, and advertising intensity?

3. What is the impact of asymmetric information about product quality on the above strategies of the firm?

The key findings are as follows. First, we show that the decision to invest in CSR depends on product quality and consumer heterogeneity. For example, a monopolist with a high quality product who serves only those consumers who have a higher willingness to pay (WTP) for product quality, apart from charging a higher price, and advertising more intensely, will be less socially responsible than a monopolist with a lower-quality product, who serves the entire market and advertises less intensely. In other words, investing in CSR is relatively more beneficial when profits depend on a broad market appeal, vis-à-vis a high-end positioning.

Second, from a welfare perspective, we find that accounting for the investment in CSR, the total consumer surplus is higher in a monopoly market with a lower product quality than in a monopoly market with higher product quality.

Third, we show that market competition does not necessarily lead to higher investments in CSR. In a market with two vertically differentiated firms, the high quality firm chooses the same investment in CSR and advertising intensity as it would if it were a monopolist, but it charges a lower price. The low quality firm, on the other hand, not only charges a lower price, but also chooses lower advertising intensity and investment in CSR than when it is a monopolist. This is because competition restricts the low quality firm to serve only those

consumers who have a lower WTP, instead of the broader market that it would serve under monopoly. Still, when the proportion of low WTP consumers in the market is higher than that of high WTP customers, the low quality firm invests more in CSR than the competing high quality firm.

Fourth, we show that market competition does not necessarily lead to higher consumer surplus in the presence of CSR. Although the total consumer surplus under market competition is higher than in a market with a monopolist having a high product quality, the total consumer surplus is lower than under a monopoly with a lower product quality. Competitive pressures therefore have differential effects on the high and low quality firm's provision of consumer surplus. Competitive pressure on the high quality firm pushes it to create more consumer surplus, but competitive pressure on the low quality firm leads to not only lower profit for the firm, but also less CSR and lower consumer surplus. Our analysis, therefore, offers a nuanced view on the effects of market competition on CSR investments and total consumer surplus.

Finally, we show that under asymmetric information about product quality, a high quality firm signals its quality by distorting upward the price and either its advertising intensity or investment in CSR. While it is well known that high-type firms can choose a combination of higher price and advertising for signaling purposes, we contribute to the literature by showing that CSR acts as a substitute for advertising expenditure for signaling purposes. The low quality firm pursues the same strategies as when product quality is observable to consumers. These insights reinforce the need for managers to not only think strategically about CSR, but also adapt other elements of their marketing mix to their investment in CSR.

The rest of the paper is organized as follows. Section 2 provides a brief literature review. In Section 3 we present a model of a monopolist addressing two types of consumers (who either value product quality more or less) though a mix of marketing decisions involving price, advertising intensity and level of CSR. Section 4 considers a market with two competing firms − one having a higher product quality than the other. Finally, in Section 5 we present a model of asymmetric information where consumers cannot observe product quality by inspection.

## 2 Literature Review

One major focus of the literature on CSR has been to understand its place in relation with the objectives of the firm. There is a stream of literature which suggests that CSR is driven by

an altogether new logic of business administration that extends the goals of firms to include serving the interests of multiple "stakeholders" (including consumers, employees, society at large), replacing the conventional focus on shareholders' interests (Robin and Reidenbach 1987, Bhattacharya and Korschun 2008, Godfrey 2005, and Bruch and Walter 2005). However, a growing literature makes a more mainstream "business case" for CSR which has been found to be correlated with market success, profitability or both (Aupperle et al 1985, Orlitzky et al 2003, Berger et al 2007).[2] Increasingly, firm view social responsibility beyond conventional motives of moral obligation, sustainability, legitimacy, and reputation, as a strategic opportunity (Porter and Kramer 2006). Accordingly, our current research offers a detailed and nuanced view on the market driven rationale for firms to invest in CSR strategically to maximize profits as surmised by McWilliams and Siegel (2001).

The literature in marketing has examined the effect of CSR on consumer demand for the firm's products. CSR, for example, can provide purchase incentives to consumers similar to coupons or promotional discounts (Arora and Henderson 2007), help justify a price premium (Varadarajan and Menon 1988), or favor brand equity (Sen and Bhattacharya 2001, Luo and Bhattacharya 2006). CSR investments related to specific products seem to "spill over" the entire portfolio of products offered by the firm (Krishna and Rajan 2009, and Brown and Dacin 1997) further motivating firms to be socially responsible. Moreover, it has been argued that firms that are not socially responsible run the risk of consumer boycott, backlash or litigation in addition to governmental sanctions (Smith and Cooper-Martin 1997).

## 2.1 Competition and CSR

While managers may be driven by profit incentives to increase spending on CSR in markets where the social responsibility is valued by consumers (Baron 2008), market competition can dampen such profits and therefore may reduce CSR (Besley and Ghatak 2007). Adverse impact of competition on profits and CSR has indeed been observed in the data from vehicle emission testing facilities in the New York State (Bennett et al 2013).

Despite the risk of being detected, the intensity of competition between firms leads to greater deviation (or "vices") from behavior deemed obligatory by regulatory agencies (Branco and Villas-Boas 2012) because such deviations result in cost savings for the firms, are normally not observable to either the consumers or the regulators, and only suffer from a

[2] The perspective of this stream of literuature is, however, at odds with a conflicting and opposite view (see for example Vodel 2005 and Karnani 2010).

risk of detection by various agencies. Evidence from empirical studies, however, is inconclusive. Some have supported the prediction of Branco and Villas-Boas (e.g., Bennett et al 2013) while others (e.g., Fernández-Kranz and Santaló 2010, and Fisman et al 2008) have shown the opposite. The current research which considers CSR as a "good" instead of a "bad" and has a measurable and observable outcome also referred as corporate social or environmental performance or CSP (Kitzmueller and Shimshack 2012, p.53), shows that competition (as compared with monopoly) has a differential impact on firm investment in CSR depending on product quality. We show that competition may not affect CSR investments of firms with high quality products while, on the other hand, decrease CSR investments of low quality firms.

## 2.2 CSR and Advertising

The interaction between advertising and CSR has been identified as an interesting area of research (Kitzmueller and Shimshack 2012, p.65). In their empirical study, Servaes and Tamayo (2013), have shown that CSR has a greater positive impact on firm value when the firm's advertising intensity is high because advertising also raises the consumer awareness of and interest in CSR. In this paper, we show that firms may trade-off spending on advertising (which enhances the perceived quality of its products) and investment in CSR depending on product quality. Firms with a higher product quality spend more on advertising and less on CSR while those with lower product quality do the opposite.

Consumer awareness of firm activities has been an important consideration for firm decisions. It is possible that a firm's true performance on account of CSR may not be readily observable which may lead to the phenomenon of "greenwashing", i.e., a propensity firms not to disclose potentially adverse social consequences of business operations (Lyon and Maxwell 2011). Information asymmetry about product quality is also an important reason for a firm's advertising activities and also likely to affect firm decisions regarding CSR. Since CSR influences consumer beliefs about the firm and its offers, it may be useful as a signal of product and service attributes in industries such as durable goods and credence services (Kitzmueller and Shimshack 2012, p.74). For example, sellers of experience goods and credence services are found more likely to invest in CSR than sellers of search goods (Siegel and Vitaliano 2007). Fisman et al (2008) analyze a model where an observable charitable donation by firms is used as a signal of product quality. In their model, in contrast to the current research, the

charitable donation is only due to "warm glow", i.e., the reason the firms make this donation is purely motivated by benevolence. The donation does not add value to the consumers nor does it generate any profit. In their analytical section, they also do not consider firm decision on advertising intensity. We examine the effect of CSR of a firm in combination with pricing and advertising intensity on signaling of product quality.

The following section presents the modeling framework.

# 3 Monopoly Market

We consider a monopolist firm and a heterogeneous market.[3] The firm sells a product of quality $v$ at price $p$. Here we interpret the product quality flexibly such that it may represent objective or perceived quality and other attributes such as brand image, reputation or service. In addition, the firms can increase the quality perception of their products to the extent $a$ by spending an amount $A$ on "persuasive" advertising (Bagwell 2007, and Anderson and Renault 2012) and invest and amount $R$ in CSR. In other words, our model allows firms to spend separately to bolster both its product quality and CSR as ultimately perceived by the consumers.[4]

## 3.1 Consumer Utility

We consider the simplest form of a heterogeneous market. The market is composed of two discrete consumer segments each having consumers who are unanimous in their valuation of quality (see, for example, Tirole 1988, p.153-154, and Banerjee and Soberman 2013 for a similar modeling setup).[5] In other words, the market consists of two types of consumers with taste for quality $\theta_i \ \forall \ i \in \{L, H\}$ with segment sizes $1-\lambda$ of "Highs" (type $H$) who place a higher value on quality and $\lambda \in [0,1]$ of "Lows" (type $L$), who place a lower value on quality (i.e., $\theta_H > \theta_L$). We only look at situations where $(1-\lambda)\,\theta_H$ is so high that the firm has a trade-off between a) charging a high price and not serving Lows and b) charging a low price and leaving the Highs' premium on the table. When the Lows segment is either too large or too attractive, the firm will treat the market as being comprised entirely of Lows.

[3] We will later consider competition between two firms vertically differentiated on product quality.

[4] In some cases firms (e.g., Panera) are using CSR in their advertising campaigns (Elliott 2013). Our model captures this type of advertising to commumicate CSR as the investment ($R$) in CSR rather than advertising which we assume to contribute strictly to the quality perceptions of their product offering.

[5] Alternatively, a continuous distribution of taste for quality $\theta$ among consumers will lead to more complicated analysis for the firm decision problem with multiple decision variables. For the sake of parsimony and mathematical tractability, we stick to the simplest form of the market.

Accordingly, we assume $(1-\lambda)\theta_H > \theta_L$.[6] We further assume that "CSR responsibility manifests itself in an observable and measurable behavior or output" which adds value given by $r$ to everyone in the society and that it "exceeds levels set by obligatory regulation or standards enforced by law" (Kitzmueller and Shimshack 2012, p.53) which in our model is normalized to zero. Consumer utility of the firm's offer, therefore, increases by an amount $\delta = \beta r$ which is proportional to the firm's CSR $r$ (Krishna and Rajan 2009).[7] Here $\beta \geq 0$ is the weighting factor or the extent to which consumers value CSR $(r)$.[8] Note that here $r$ represents the observed performance of CSR i.e., corporate social performance or "CSP" (Kitzmueller and Shimshack 2012) implying that part of the investment $R$ may also be utilized for building awareness for the CSR. Consumer utility therefore can be written as $u_i = \theta_i (v + a) + \beta r - p$ where $a \geq 0$ is the increase in perceived quality due to advertising and $r \geq 0$ is the increase in utility due to CSR which is weighted by a factor $\beta \geq 0$. To represent the consumer's decision to buy the firm's product, we define an indicator function $I_{\theta i} = 1$ if a consumer of type $\theta_i$ buys, and zero otherwise. Summarizing, we have

$$I_{\theta i} = \begin{cases} 1 \text{ if } u_i(\theta_i, v, a, r, p) = \theta_i (v + a) + \beta r - p \geq 0 \\ 0 \text{ otherwise.} \end{cases}$$

To simplify the exposition, we assume $\theta_H = 1$ and $\theta_L = \theta < 1$. Figure 1 illustrates the composition of the market. Further, we consider again the simplest case where each consumer buys at most one unit of the firm's product. Note that the insights from the model can be easily extended to a market situation where consumers buy multiple (say $n$) units over time.

[6] In this simple model of only one product, we do not allow first degree price discrimination, i.e., firms are allowed to charge only one price across the two segments

[7] Research supporting such an increase in willingness to pay, for example, has been reviewed by Kitzmueller and Shimshack (2012) suggesting a higher consumer willingness to pay for products offered by socially responsible firms (p.73). The Economist (2008,3) also cite an experimental study showing an increase in willingness to pay due to the labelling of a product with CSR.

[8] Note that when $\beta = 1$, the CSR modeled here becomes exactly the same as in Krishna and Rajan (2009). Note that one may also consider CSR which is valued differentially by the two segments. For example, one may consider $\beta \in \{\beta_j\}$ where $j \in \{L, H\}$. The qualitative insights from our model remains the same when the consumer valuation of quality and CSR are negatively correlated, i.e., $\{i, j\} \in \{\{L, H\}, \{H, L\}\}$. On the other hand, when they are positively correlated, i.e., $\{i, j\} \in \{\{L, L\}, \{H, H\}\}$, CSR may be viewed as an extension of product quality. Firm strategy for such type of CSR may, therefore, follow the same insights and principles that are applicable to product innovations drawing on the new product development literature (see for example, Banerjee and Soberman 2013).

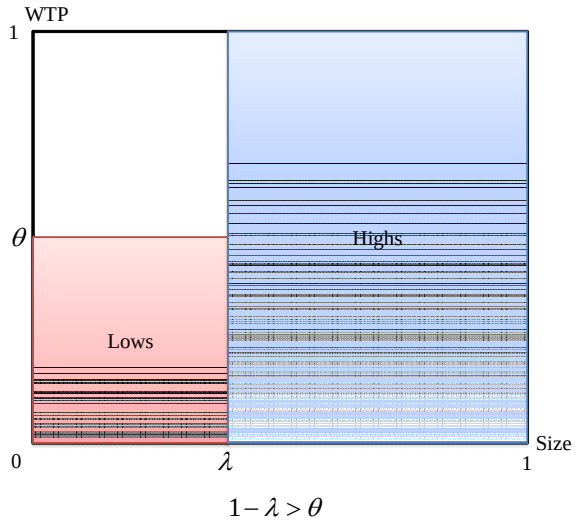


Figure 1: The demand structure

### 3.2 Market Demand and Firm Profits

The market consists of unitary aggregate demand where each consumer buys at most one unit of the product. The demand is given by:

$$D = \lambda I_\theta + (1 - \lambda) I_1. \tag{1}$$

Since consumers are homogeneous except for their type ($\theta_i$), either all the Lows ($\theta_i = \theta$) buy ($I_\theta = 1$ if $u_\theta(a, r, p) \geq 0$ resulting in demand $\lambda$) or not buy ($I_\theta = 0$ resulting in no demand). Similarly, either all the Highs ($\theta_i = 1$) buy ($I_1 = 1$ if $u_1(a, r, p) \geq 0$ resulting in demand $1 - \lambda$) or not buy ($I_1 = 0$ resulting in no demand). We assume convex costs of advertising ($A = \frac{ka^2}{2}$) and CSR ($R = \frac{mr^2}{2}$) and marginal cost of production $c \in [0, \theta v]$.

Firm profits, therefore, are given by

$$\pi = (p - c) D - A - R. \tag{2}$$

Here the parameters $k > 0$ and $m > 0$ represent, respectively, the cost of advertising and CSR and are common knowledge. The timing of the game is as follows. The firm maximizes profit by simultaneously choosing the price $p$, level of advertising $a$ and CSR $r$. The consumers observe $v$, $p$, $a$ and $r$ and then decide whether or not to purchase at most one unit of the firm's product.

Note that there are two possible market outcomes, each associated with a specific values of $D$ and the constraint, as shown below.

a) *Mass market*: Both segments buy the product ($I_\theta = 1, I_1 = 1$) under the following condition (or "pricing constraint") $p \leq \theta(v+a) + \beta r$.[9] The firm decision problem is then given by

$$\pi_M = \max_{p,a,r} \pi \text{ s.t. } \theta(v+a) + \beta r - p \geq 0. \tag{3}$$

b) *High-end market*: Only the Highs buy the product ($I_\theta = 0, I_1 = 1$) under the condition $\theta(v+a) + \beta r < p \leq v + a + \beta r$. The firm decision problem is then given by

$$\pi_H = \max_{p,a,r} \pi \text{ s.t. } v + a + \beta r - p \geq 0. \tag{4}$$

The firm's overall decision problem can be parsimoniously stated using a general "pricing constraint" as

$$\max_{p,a,r} \pi \text{ s.t. } (1 - I_\theta + \theta I_\theta)(v+a) + \beta r - p \geq 0. \tag{5}$$

Solving the firm's overall decision problem above with the Lagrange multiplier $\mu$, we get

$$\begin{aligned} p^* &= (1 - I_\theta + \theta I_\theta) v + [(1-\lambda) I_1 + \lambda I_\theta] \left( \frac{1 - (1-\theta)(2 - (1-\theta) I_\theta) I_\theta}{k} + \frac{\beta^2}{m} \right) \\ a^* &= (1 - I_\theta + \theta I_\theta) \frac{(1-\lambda) I_1 + \lambda I_\theta}{k}, \; r^* = \beta \frac{I_\theta \lambda + (1-\lambda) I_1}{m}, \text{ and } \mu^* = (1-\lambda) I_1 + \lambda I_\theta \end{aligned} \tag{6}$$

Firm decisions under the mass market strategy can be obtained by substituting $I_\theta = 1$ and $I_1 = 1$ above in equation 6:

$$p^M = \theta \left( v + \frac{\theta}{k} \right) + \frac{\beta^2}{m}, \; a^M = \frac{\theta}{k}, \; r^M = \frac{\beta}{m} \text{ (and } \mu^M = 1) \tag{7}$$

$$\Rightarrow \; \pi_M = \theta \left( v + \frac{\theta}{2k} \right) + \frac{\beta^2}{2m} - c \tag{8}$$

Similarly, firm decisions under the high-end market strategy are obtained by substituting $I_\theta = 0$ and $I_1 = 1$ in equation 6:

$$p^H = v + (1-\lambda) \left( \frac{1}{k} + \frac{\beta^2}{m} \right), \; a^H = \frac{1-\lambda}{k}, \; r^H = \beta \frac{1-\lambda}{m}, \text{ (and } \mu^H = 1 - \lambda) \tag{9}$$

$$\Rightarrow \; \pi_H = (1-\lambda) \left( v + (1-\lambda) \left( \frac{1}{2k} + \frac{\beta^2}{2m} \right) - c \right). \tag{10}$$

The following Lemma shows the necessary condition for the monopolist to serve the Lows.

[9] Notice that since $\theta < 1$, $I_\theta = 1$ also implies $I_1 = 1$ because $p \leq \theta(v+a) + \beta r < v + a + \beta r$. Therefore $p \leq \theta(v+a) + \beta r$ is a sufficient condition for both Highs and Lows to buy the product. Similarly $I_1 = 0$ also implies $I_\theta = 0$ because $\theta(v+a) + \beta r < v + a + \beta r < p$. On the other hand, $\theta(v+a) + \beta r < p \leq v + a + \beta r$ implies $I_\theta = 0$ and $I_1 = 1$ where the Highs buy the product while the Lows do not. that

**Lemma 1** *A monopolist does not serve the Lows unless consumer value for CSR exceeds a threshold (i.e., $\beta > \beta_0$ where $\beta_0 = \sqrt{\frac{m}{k}\frac{(1-\lambda)^2-\theta^2}{(2-\lambda)\lambda}}$).*

Lemma 1 shows that the necessary condition for the Lows to be served in this market is $\beta > \beta_0$. Otherwise, when $\beta \leq \beta_0$, the monopolist serves only the Highs. In other words, the higher the consumers value CSR, the more likely the entire market will be served by a monopolist. The intuition is that CSR is valued equally by both types of consumers. Therefore, the higher the value of CSR, the greater the increase in WTP of the Lows relative to the Highs which makes it attractive for the firm to serve the Lows. For the rest of the analysis, we assume $\beta > \beta_0$.

Proposition 1 describes the optimal pricing, advertising and CSR of the firm. Please refer to the appendix for all proofs.

**Proposition 1** *Under the necessary condition when the product quality is above a threshold ($v \geq v_0$ where $v_0 = \frac{1}{2}\left(\frac{\beta^2}{m}\frac{(2-\lambda)\lambda}{1-\lambda-\theta} - \frac{1-\lambda+\theta}{k}\right) - \frac{\lambda c}{1-\lambda-\theta}$), a monopolist firm pursues high-end market strategy by serving only the Highs, pricing higher ($p^H \geq p^M$), advertising more intensely ($a^H \geq a^M$) and investing less in CSR ($r^H < r^M$) than when it pursues a mass market strategy (i.e., $v < v_0$) by serving the entire market.*

Proposition 1 shows that a high quality firm chooses a higher price and advertising intensity, and a lower level of CSR to serve only the high value customers. A low quality firm on the other hand chooses lower price and advertising intensity, and a higher level of CSR to serve both segments of the market. The intuition here is that since the valuation for CSR is common to all consumers, the firm which serves all types of consumers derive relatively higher benefit from its spending on CSR. Persuasive advertising, on the other hand, is more effective on consumers who value product quality more. Therefore a firm which has a higher quality gains more by advertising, which returns higher profits from its target segment which consists of the Highs. We therefore show that advertising and CSR may serve different strategic roles in terms of targeting and influencing different customer segments. Further, when the consumer valuation of CSR is below a threshold, the Lows are not sufficiently attractive for the firm to serve. In that case, irrespective of product quality, the firm will serve only the Highs.

Firms (e.g., HP and Dell) which rely on covering a large market are more likely to invest heavily on CSR and advertise less intensely than firms (e.g. Apple) which rely on selling at

a premium to the high end of the market. Some anecdotal evidence of this kind of behavior can be found, for example, at: www.goodguide.com.[10]

Note that, intuitively, $v_0$ increases (i.e., high-end strategy less likely) as $\beta$ or $k$ increases while it decreases (i.e., high-end strategy more likely) as $m$ or $c$ increases. In other words, the firms are likely to be more socially responsible and serve the entire market (mass-market strategy) when the consumers value CSR more or the cost of advertising is higher. On the other hand, firms are more likely to be less socially responsible and serve only the high end of the market the higher the cost of CSR or the marginal cost of production.

**Corollary 1** *When the firms do not invest in CSR, the high quality firm earns a higher profit than the low quality firm.*

CSR allows a low quality firm to also earn higher profits than a high quality firm. As stated in Corollary 1, in markets where firms do not invest in CSR, the high quality firms earn higher profit than low quality firms. But CSR creates an opportunity also to low quality firms to earn higher profits than high quality firms as follows from Proposition 1, i.e., when $v < v_0$, a mass market strategy, which implies higher CSR, is more profitable than a high-end strategy involving lower spending on CSR and higher spending on advertising.

**Corollary 2** *The higher the product quality ($v$), marginal cost ($c$), or cost of CSR ($m$), and the lower the cost of advertising ($k$), the more likely the firm pursues a high-end strategy instead of mass marketing.*

The corollary 2 shows that as quality or marginal cost increases, the Highs become relatively more attractive to the firm than Lows making a high-end strategy preferable to mass marketing. Advertising, which is more effective for a high-end strategy as explained under proposition 1, makes a high end strategy relatively more profitable than mass marketing when the cost of advertising is lower. Similarly, when the cost of CSR ($m$) is high, the firm is spends less on CSR and therefore earns lower revenues from the Lows which makes targeting only the Highs preferable. On the other hand, when the cost of CSR is low, mass market is preferred since the relative value of CSR with respect to product quality is higher for the Lows than the Highs which makes mass market preferable.

Next we consider the welfare effects of the monopolist's strategies.

[10] See also: www.thedailybeast.com/newsweek/2012/10/22/newsweek-green-rankings-2012-technology-equipment.html last accessed on 5 May 2013.

**Proposition 2** *The total consumer surplus (net of prices) is higher in the case of a monopolist with low product quality which pursues a mass market strategy (i.e., when* $v < v_0$, $p^M < p^H$, $a^M < a^H$ *and* $r^M > r^H$*).*

Proposition 2 suggests that although the product quality of the firm which pursues a mass market strategy is lower, the total consumer surplus is higher due to the positive surplus gained by the Highs. The positive surplus is due to the higher WTP of the Highs who are nonetheless charged a lower price at which the Lows also buy. A high quality monopolist, in contrast, sells only to the Highs and extracts all the surplus. Therefore, although the total consumer surplus is higher in monopoly markets where the product quality is low, the Lows are always left without consumer surplus independently of what quality is offered.

Next we consider the pricing, advertising intensity and CSR decisions of competing firms.

# 4 Competition between Vertically Differentiated Firms

We consider a competitive market with two firms where firm $j \in \{L, H\}$ offers quality $v_j$ at price $p_j$ and incurs a marginal cost $c_j$. Since the condition when $v_H = v_L$ leads to both firms competing away their entire profits, we assume, without loss of generality that $v_H > c_H \geq c_L$ and $v_H \geq v_L > c_L \geq 0$. In other words, we assume that the two firms are identical except in terms of their product quality and marginal costs. Each consumer buys at most one unit of the product from either of the two firms. The marginal consumer who is indifferent between the two products is represented by $\theta_m = \frac{\Delta p - \beta \Delta r}{\Delta v + \Delta a}$ such that $\Delta\omega = \omega_H - \omega_L$ where $\omega_j \in \{v_j, a_j, p_j, r_j\}$. Given that $\theta < 1$, consumer choice leads to following three possible outcomes:

1. Both Highs and Lows buy the high quality product if $u_{\theta H} \geq u_{\theta L}$ and $u_{1H} > u_{1L} \Leftrightarrow \theta_m \leq \theta < 1$ where $\theta_m = \frac{\Delta p - \beta \Delta r}{\Delta v + \Delta a}$, $\Delta p = p_H - p_L$, $\Delta r = r_H - r_L$, $\Delta v = v_H - v_L$ and $\Delta a = a_H - a_L$.

2. The Highs (Lows) buy the high (low) quality product if $u_{\theta H} < u_{\theta L}$ and $u_{1H} \geq u_{1L} \Leftrightarrow \theta \leq \theta_m \leq 1$.

3. Both Highs and Lows buy the low quality product if $u_{\theta H} < u_{\theta L}$ and $u_{1H} \leq u_{1L} \Leftrightarrow \theta < 1 \leq \theta_m$.[11]

[11] Note the Highs (Lows) do not buy the low (high) quality product since $u_{\theta H} < u_{\theta L}$ and $u_{1H} \nleq u_{1L} \Leftrightarrow 1 \nless \theta < \frac{\Delta p - \beta \Delta r}{\Delta v + \Delta a}$.

Because the firms are assumed identical except for their product quality and marginal costs, an outcome in which either one of them does not earn any revenues cannot be an equilibrium. For example, if both Highs and Lows buy the low quality product, the high quality firm can deviate by charging a price slightly lower than $v_H$ to serve all the Highs and similarly, if both Highs and Lows buy only the high quality product, the low quality firm can also deviate by charging a price slightly below $v_L$.[12] We therefore focus on the case where the high (low) quality firm serves the Highs (Lows). The demand for each of the two firms is given by

$$\begin{aligned} D_H &= (1-\lambda) J_1 \text{ and } D_L = \lambda J_\theta \text{ where} \\ J_1 &= \begin{cases} 1 \text{ if } \theta_m \geq 1 \text{ and } u_H(a_H, r_H, p_H) = v_H + a_H + \beta r_H - p_H \geq 0 \\ \frac{1}{2} \text{ if } \theta_m = 0 \text{ and } u_H(a_H, r_H, p_H) = v_H + a_H + \beta r_H - p_H \geq 0 \\ 0 \text{ otherwise.} \end{cases} \text{ and} \\ J_\theta &= \begin{cases} 1 \text{ if } \theta \leq \theta_m \text{ and } u_L(a_L, r_L, p_L) = \theta(v_L + a_L) + \beta r_L - p_L \geq 0 \\ \frac{1}{2} \text{ if } \theta_m = 0 \text{ and } u_L(a_L, r_L, p_L) = \theta(v_L + a_L) + \beta r_L - p_L \geq 0 \\ 0 \text{ otherwise.} \end{cases} . \end{aligned} \tag{11}$$

Note that when $\theta_m = 0$, both firms earn zero profits and the conditions $u_H(a_H, r_H, p_H) = v_H + a_H + \beta r_H - p_H \geq 0$ and $\theta \leq \theta_m$ are non-binding for maximizing $\pi_H$ and $\pi_L$ respectively. Firm profits, therefore, following equations 11 are given by

$$\pi_H = \max_{p_H, a_H, r_H} (p_H - c_H) D_H - \frac{k a_H^2}{2} - \frac{m r_H^2}{2} \text{ s.t. } \theta_m \leq 1 \tag{12}$$

$$\pi_L = \max_{p_L, a_L, r_L} (p_L - c_L) D_L - \frac{k a_L^2}{2} - \frac{m r_L^2}{2} \text{ s.t. } p_L \leq \theta(v_L + a_L) + \beta r_L \tag{13}$$

Solving the marginal conditions simultaneously for Nash Equilibrium, we get

$$p_H^* = v_H - (1-\theta) v_L + \frac{1 - \lambda - \theta(1-\theta)\lambda}{k} + \frac{\beta^2}{m}, a_H^* = \frac{1-\lambda}{k}, r_H^* = \frac{1-\lambda}{m}\beta \tag{14}$$

$$p_L^* = \theta\left(v_L + \frac{\theta\lambda}{k}\right) + \frac{\beta^2 \lambda}{m}, a_L^* = \frac{\theta\lambda}{k}, \text{ and } r_L^* = \frac{\lambda\beta}{m} \tag{15}$$

The maximum firm profits are therefore given by

$$\begin{aligned} \pi_H^* &= (1-\lambda)\left[v_H - (1-\theta) v_L - c_H + \left(\frac{1-\lambda}{2} - \theta(1-\theta)\lambda\right)\frac{1}{k} + \frac{1+\lambda}{2}\frac{\beta^2}{m}\right], \text{ and} \\ \pi_L^* &= \lambda\left[\theta v_L - c_L + \frac{\lambda}{2}\left(\frac{\theta^2}{k} + \frac{\beta^2}{m}\right)\right] \end{aligned} \tag{16}$$

The above results leads to the following proposition.

[12] These considerations are common in the vertical differentiation literature (see, for example, Almadoss and Shin 2011).

**Proposition 3** *In a competitive market with two firms vertically differentiated on product quality, the high quality firm charges a lower price but chooses the same advertising intensity and CSR as under monopoly. The low quality firm, on the other hand, not only charges a lower price but also chooses lower advertising intensity and CSR than under monopoly. When the size of the Lows segment is bigger (i.e.,* $\lambda > \frac{1}{2}$*), the low quality firm is more socially responsible and advertises less intensely than the high quality firm .*

Proposition 3 shows that market competition between two vertically differentiated firms has disparate effects on pricing, advertising and CSR depending on product quality. Although the price offered by a high quality firm is lower under competition, the levels of advertising and CSR remains the same as under monopoly. This is because, as under monopoly, the high quality firm continues to serve the Highs whose sensitivity to advertising and CSR remains the same. The price, on the other hand, has to be lower to prevent the low quality firm from entering this segment. The low quality firm, on the other hand, serves only the Lows as opposed to the entire market under monopoly. This decrease in demand constraints the firm to reduce its spending on advertising and CSR which in turn leads to a reduction in price since the consumers (the Lows) value its offer less than under monopoly.

Comparing the CSR of the two firms, we can see that when the size of the Lows segment is bigger (i.e., $\lambda > \frac{1}{2}$ which is perhaps more common in markets), the low quality firm is more socially responsible (although it still charges a lower price and advertises less) than the high quality firm. This is because the high quality firm reduces its spending on CSR but not on advertising (which is valued relatively higher by the Highs than the Lows) since it earns lower profits under competition. The low quality firm on the other hand also earns lower profits under competition but is unable to charge a higher price and advertise more due to the restriction on the willingness to pay for quality of and the effect of advertising on its consumers, the Lows who however still have the same valuation for CSR as the Highs. The low quality firm therefore derives higher return from spending on CSR although it is less than under monopoly.

**Corollary 3** *The marginal impact of CSR on profits for the low quality firm is greater under competition than the high quality firm when the size of the Lows segment is greater than a threshold, i.e.,* $\lambda \geq 1/\sqrt{2}$.

Corollary 3 suggests that when the size of the Lows segment is bigger and above a threshold ($\lambda \geq 1/\sqrt{2}$), the low quality firm gains more from its investment in CSR than the competing high quality firm. Only when the size of the Lows segment is below the threshold, a situation where the high quality firm has significant advantages, does the low quality firm earn lower marginal profits from its investment in CSR.

We now examine the effects of competition on consumer surplus.

**Proposition 4** *The total consumer surplus under competition is more (less) than under a high (low) quality monopolist.*

Proposition 4 shows that competition may not always increase consumer surplus in heterogeneous markets. Because each of the two firms serve one of the two segments under competition, the low quality firm is forced to serve only the Lows instead of the entire market which it serves in case of a monopoly. The total revenues it can earn is lower which forces it to reduce its spending on CSR relative to the levels under monopoly. Nonetheless, the firm is able to extract all the surplus from the Lows as it does under monopoly.

The high quality firm however serves the same market segment (the Highs) under competition as under monopoly. While the firm extracts all the surplus from the Highs under monopoly, it is unable to do so under competition because it is forced to charge a lower price thereby giving away a positive surplus to the Highs. Note that the chief beneficiaries of competition as in the case of a monopolist with a low product quality are the Highs. The Lows obtain the same surplus under both market situations.

# 5 Asymmetric Information: When Product Quality is Unobservable

When consumers are unable to observe product quality at the point of purchase, they may, however, be able to infer information about product quality from the firm's actions. We examine how the marketing mix strategy, i.e., price, advertising intensity and CSR, of the high quality firm are affected by the need to signal its quality. Many researchers have considered various means of signaling quality: advertising (Milgrom and Roberts 1986), price (Choi 1998) and warranties (Soberman 2003). While it is known that price, to signal higher quality, may be distorted either upward (e.g., Choi 1998) or downward (Milgrom and Roberts 1986,

Banerjee and Soberman 2013), we examine the joint signaling effect of price, and levels of advertising and CSR.

### 5.1 Firm Types and the Extensive Form of the Game

We consider two types of firms based on their level of product quality. A *high* quality ($v = v_H > v_0$) firm whose optimal strategy under complete information is a high-end strategy and a *low* quality ($v = v_L < v_0$) whose optimal strategy under complete information is a mass market strategy. Both types of firms have the same costs of advertising and developing CSR. The game proceeds as follows. Incorporating the asymmetric information about firm type, the two stage game under incomplete information proceeds as follows:

**Stage 1** Nature chooses the firm type, either high ($v_H$) or low ($v_L$) product quality with respective marginal costs of production $c_H \geq c_L$. The firm observes its own type and chooses simultaneously the price ($p$), levels of advertising ($a$) and the CSR ($r$).

**Stage 2** Consumers do not observe firm type but observe the price, advertising and the CSR. They decide whether or not to buy the product offered by the firm.

The rest of the assumptions remain the same as under complete information discussed in Section 3.

The objective is to identify a 'separating' equilibrium in which the firm maximizes its profit and the consumers receive the quality they believe they are buying (a situation in which a consumer believes she is purchasing a high quality product but actually receives low quality is not an equilibrium). Said differently, the actions of a firm with high quality that sells a high quality product are constrained by consumers' inferences about quality. We introduce this constraint in the high quality firm's optimization problem. This leads to a standard signaling game in which the uninformed player (the consumer) makes an inference about the type of the informed player (the firm) based on the latter's action.

A key assumption in the analysis is that consumers know that the firm can have two levels of quality and the absolute levels associated with each type are common knowledge, i.e., $v = v_H$ or $v_L$. To signal higher quality, the high quality firm changes its decisions as explained in Proposition 5.

### 5.2 Perfect Bayesian Equilibrium

As in signaling games, we look for the Perfect Bayesian Equilibrium (PBE). The PBE leads to a unique outcome when:

**(P)** The strategies of the informed player are optimal given the beliefs of the uninformed players.

**(B)** The beliefs of uninformed players are based on strategies that are consistent with Bayes' Rule.

The PBE imposes a rule of "logical consistency" on the beliefs of uninformed players (Fudenberg and Tirole 1991); that is, the beliefs of uninformed players (i.e., consumers) are derived using Bayes' Rule from the actions of the informed player (the firm) before the uninformed player makes a decision. We assume that $\mu \in [0,1]$ is consumers' prior belief that the firm has high quality, having observed the firm actions or signals $\{p, a, r\}$, and $\hat{\mu}(p, a, r)$ is their posterior belief. The triplet $\left\{\left\{p^H, a^H, r^H\right\}, \left\{p^L, a^L, r^L\right\}, \hat{\mu}\right\}$ constitutes a Perfect Bayesian Equilibrium (PBE) if and only if it satisfies the following conditions related to sequential rationality (**P**) and Bayesian consistency in beliefs (**B**).

**(P)** $p^H \in \arg\max_{p_1} \pi\left(p, a, r, \hat{\mu}(p, a, r)\right)$

**(B)** If $\left\{p^H, a^H, r^H\right\} = \left\{p^L, a^L, r^L\right\} = \left\{p^*, a^*, r^*\right\}$ then $\hat{\mu}\left(p^*, a^*, r^*\right) = \mu$. (Pooling Equilibrium)

If $\left\{p^H, a^H, r^H\right\} \neq \left\{p^L, a^L, r^L\right\}$ then $\hat{\mu}\left(p^H, a^H, r^H\right) = 1$ and $\hat{\mu}\left(p^L, a^L, r^L\right) = 0$. (Separating Equilibrium)

In this game there are two possible equilibria types. In a pooling equilibrium, consumers cannot update their prior belief by observing only the combination of price, and levels of advertising and CSR since both high and low type firms charge the same price and choose the same levels of advertising and CSR. Conversely, in a separating equilibrium consumers can identify the firm type because the two types of firms charge either different prices, choose different levels of advertising and CSR or all of these. PBE only imposes logical consistency on the beliefs of the players over actions on *the equilibrium* path; there are no restrictions on the beliefs of the players over actions off the equilibrium path. In signaling games, freedom in specifying off-equilibrium beliefs can lead to multiple equilibria when the off-equilibrium beliefs of uninformed players attribute positive probability to the informed player (the firm) choosing an equilibrium-dominated strategy. The Intuitive Criterion (IC) of Cho and Kreps (1987) eliminates these equilibria by imposing a restriction on the players' beliefs over actions off the equilibrium path.

**Proposition 5** *When product quality is not observable by inspection, a high quality firm signals its quality by charging a higher price and distorting its level of either advertising or CSR upwards while pursuing a high-end marketing strategy. The strategies of the low quality firm remains the same as when quality is observable.*

Proposition 5 suggests that the need to signal their type to consumers pushes a high quality firm to increase either the level of CSR or advertising which in turn allows it to charge a higher price to signal its quality. It also shows that advertising and CSR can be viewed as "strategic substitutes" as tools to signal product quality. Recall that the high quality firm under complete information charges a higher price, advertises more but is less socially responsible than the low quality firm (Proposition 1). Due to the effect of asymmetric information, however, when the cost of advertising is above a threshold, it chooses a higher level of CSR. Although firms are increasingly spending on CSR these days (see, for example, The Economist 2008-2010), we show that even under asymmetric information, high quality firms increase either their CSR or advertising but not both.

**Proposition 6** *The total consumer surplus under signaling remains the same as in a monopoly market under complete information.*

Although signaling often benefits consumers at the expense of the high quality firms (e.g., Banerjee and Soberman 2013), in this model signaling does not benefit the Highs who derive the same surplus as in case of a market where there is a high quality monopolist (Proposition 1). This is because the signaling firm spends more on either advertising or CSR but extracts the spending from the price obtained from sales to the Highs but still earns lower profit than under complete information. The Lows, as in the case of complete information, are not served and therefore derive no surplus.

# 6 Conclusion

Our analysis shows how CSR adds to a managers' arsenal of marketing mix strategies to increase firm performance in heterogeneous markets. Firms can choose CSR optimally like other marketing mix strategies such as price and advertising intensity to address the specific demands of the market. The analysis also enhances our understanding of the interaction between CSR and marketing mix strategies. In particular, it demonstrates how firms' pricing,

advertising intensity and CSR depend on factors such as product quality, competition and information asymmetry in markets where consumers are heterogeneous in their willingness to pay for product quality. Empirically testable hypotheses can be drawn from the relationship proposed between product quality, prices, advertising intensity, CSR and competitive rivalry (Propositions 1 to 3).

In our model, advertising plays only a persuasive role by enhancing the quality perception of the product but does not raise awareness of other firm attributes such as CSR as evidenced by Servaes and Tamayo (2013). Future research, therefore, can examine the trade-offs firms face between CSR and advertising that has a different purpose, e.g., to raise awareness for products or informative advertising (as in Butters 1977). Further, in our model, since consumers with high WTP for quality value persuasive advertising more, spending on advertising is more profitable than CSR for the high quality firm because it serves only the high WTP consumers. Spending on social responsibility, on the other hand, is valued equally by all consumers and therefore is more profitable for the low quality firm because it serves the entire market. An interesting area of future research is to analyze the effects of different types of CSR on firm strategies and performance. For example, whether CSR is directly linked to the core business (product-market related) or is entirely unrelated. Further, it may be also interesting to examine the effects of CSR in reputation and brand building. However, our choice of assumptions in the present paper was dictated by a desire to draw the sharpest contrast between primary interpretations of advertising (as a booster of perceived quality) and CSR (as a common good).

We also show, contrary to current trends (as reported in The Economist 2010), that market competition may not always lead to higher CSR. As noted also by Branco and Villas-Boas (2012) and observed empirically by Bennett et al (2013), we show that competitive pressures on firm profits may reduce the incentives to spend on CSR. Market competition, in fact, forces firms to deviate from their optimal strategies under monopoly markets. While a high quality firm spends the same amount on CSR and advertising but charges a lower price under competition than it would under monopoly, the low quality is forced to spend less on CSR and advertising, and also charge a lower price than under monopoly. This finding opens up new possibilities for empirical investigation.

We also illustrate the welfare implications of CSR (reflected in our model through inclusion in consumer utility). The increasing public awareness and emphasis on CSR may lead one to

believe that CSR increases total consumer surplus. In this simple model of a market consisting of only two distinct consumer segments, we show that in many situations either firms are able to extract the additional surplus due to CSR, or only those consumers who are willing to pay more for product quality derive a positive surplus. For example, we show that the total surplus is the greatest under a monopolist with a low product quality. This surplus, however, accrues only to the high end of the market. While, generally, market competition is expected to increase consumer surplus by forcing firms to charge lower prices, our analysis of markets where firms spend additionally on CSR, suggests that this may not always be the case. Note that the mass market strategy under which the high end of the market derived a positive surplus in a monopoly market with a low quality supplier is not an equilibrium strategy for the firm when it faces competition from a high quality firm. In addition, competition pressures the firms to charge a lower prices and extract more surplus from the consumers resulting in a lower surplus. Nevertheless, a high quality firm facing competition from a low quality firm is also forced to charge a lower price which increases the surplus of the high end of the market it sells to. In summary, we show that the chief beneficiaries of the higher levels of investment in CSR (associated either with increased competition at the high end or the presence of a low quality monopolist) are the high-end consumers. The surplus accruing to the low end of the market remains unchanged across all the cases we have examined.

Finally, the asymmetric information model suggests that CSR and advertising may act as alternative means to signal product quality. While we have assumed that CSR is measurable and observable to consumers, an interesting question for future research is to analyze situations where consumers cannot observe the true CSR of firms while making their purchase decisions based on advertised claims.

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# Appendix

**Proof of lemma 1**

Define $\Delta\pi_{HM} := \pi_H - \pi_M$. We can see that $\Delta\pi_{HM} = (1-\lambda-\theta)\,v + \lambda c + \frac{1}{2}\left(\frac{(1-\lambda)^2-\theta^2}{k} - \frac{(2-\lambda)\beta^2\lambda}{m}\right) \geq 0$ is trivially satisfied if $\beta \leq \sqrt{\frac{m}{k}\frac{(1-\lambda)^2-\theta^2}{(2-\lambda)\lambda}}$due to the assumption $1-\lambda > \theta$. **Q.E.D**.

**Proof of Proposition 1**

From the Proof of the Lemma 1, we can see that Note that $a^H > a^M$ , $r^H < r^M$. Also $p^H > p^M$ since $p^H \geq p^M \Leftrightarrow (1-\theta)\,v + \left(\frac{1-\lambda-\theta}{k} + \frac{1-\lambda-\theta^2}{m}\beta^2\right) \geq 0$ since $1-\lambda > \theta$. The necessary and sufficient condition for $\Delta\pi_{HM} \geq 0$ is $v \geq v_0$ where $v_0 = \frac{1}{2}\left(\frac{\beta^2}{m}\frac{(2-\lambda)\lambda}{1-\lambda-\theta} - \frac{1-\lambda+\theta}{k}\right) - \frac{\lambda c}{1-\lambda-\theta}$. We can see that $\Delta\pi_{HM}$ increases as $v$, $c$ or $m$ increases, or $k$ decreases. **Q.E.D**.

**Proof of Corollary 1**

From the Proof of Proposition 1, we can see that when $\beta = 0$, $\Delta\pi_{HM} = (1-\lambda-\theta)\,v + \lambda c + \frac{1}{2}\frac{(1-\lambda)^2-\theta^2}{k} \geq 0$. **Q.E.D**.

**Proof of Corollary 2**

We can see that $\Delta\pi_{HM}$ (ref. Proof of Proposition 1) increases as $v$, $c$ or $m$ increases, or $k$ decreases.[1] **Q.E.D**.

**Proof of Proposition 2**

Under a High-end market strategy, the utility of the Lows from purchase $u_\theta = -(1-\theta)\left(v + a^H\right) < 0$ which is the reason why they do not buy the product. The utility of the Highs is given by $u_1 = 0$ which leads to the total welfare also being 0.

Under a Mass market strategy, on the other hand the utility of the Lows is $u_\theta \geq 0$. The utility of the Highs is given by $u_1 = (1-\theta)\left(v + \frac{\theta}{k}\right)$ which leads to the total welfare $(1-\lambda)(1-\theta)\left(v + \frac{\theta}{k}\right) > 0$. **Q.E.D**.

**Proof of Proposition 3**

Follows directly from the comparison of the optimal decisions of the firms as given in equations 14 and 15. **Q.E.D**.

**Proof of Corollary 3**

From equations 16 that the effect of CSR on profit for the low and high quality firms are respectively given by $\frac{\lambda^2\beta^2}{2m}$ and $\frac{(1-\lambda^2)\beta^2}{2m}$. The former is greater if $\lambda \geq 1/\sqrt{2}$. **Q.E.D**.

**Proof of Proposition 4**

[1] Note also that intuitively, $\frac{d\Delta\pi_{HM}}{d\theta} = -v - \frac{\theta}{k} \leq 0$ and $\frac{d\Delta\pi_{HM}}{d\lambda} = c - v - (1-\lambda)\left(\frac{1}{k} + \frac{\beta^2}{m}\right) \leq 0$.

Using equations 14 and 15, we can see that the total consumer surplus net of prices is given by $(1-\lambda)\ u_H\left(a_H^*, r_H^*, p_H^*\right) + \lambda u_L\left(a_L^*, r_L^*, p_L^*\right) = (1-\lambda)\left[(1-\theta)\, v_L + \frac{1-\theta}{k}\theta\lambda - \frac{\beta^2\lambda}{m}\right] + \lambda.0 < (1-\lambda)(1-\theta)\left(v_L + \frac{\theta}{k}\right)$, the latter being the total welfare under a low quality monopolist (see Proof of Corollary 2). **Q.E.D**.

**Proof of Proposition 5**

**Intuitive Perfect Bayesian Equilibrium**

A PBE violates the intuitive criterion if there exists an action that yields strictly greater payoffs for a player given that the uninformed players ascribe zero probability to a player's action that is "equilibrium-dominated". An action is "equilibrium-dominated" for a player if that action leads to lower profits than another putative equilibrium. In other words, a firm type choosing an "equilibrium-dominated" action cannot increase its profit over what it earns under equilibrium.

In the context of this model, the beliefs of consumers subject to the IC restrict the high quality firm to a set of strategies $\left(p^H, a^H, r^H\right)$ which is equilibrium dominated for a firm with low quality: were it to implement a strategy from this set, the low quality firm would earn less than its "guaranteed" level of profit. The only equilibrium that survives the intuitive criterion is a separating equilibrium with minimal inefficient signaling. In addition, a high quality firm has a profit-increasing deviation from all possible pooling equilibria when signaling is possible.[2] The guaranteed profit for the low quality firm, $\pi_L^c$, is the profit it earns when consumers can observe quality. The low quality firm has an incentive to mimic a high quality firm if it increases profit by offering $\left(p^H, a^H, r^H\right)$: the offer that would be made by a firm with high quality, i.e., $\pi_L\left(\left(p^H, a^H, r^H\right), \hat{\mu} = 1\right) > \pi_L^c$. In equilibrium, the intuitive criterion rules out these strategies for the high quality firm. As noted earlier, the intuitive criterion is the basis for the following constraint in the high quality firm's optimization:

$$\pi_L\left(\left(p^H, a^H, r^H\right), \hat{\mu} = 1\right) < \pi_L^c. \tag{17}$$

Note that a high quality firm should not be able increase profits by pretending to be a firm with low quality, i.e.,

$$\pi_H\left(\left(p^L, a^L, r^L\right), \hat{\mu} = 0\right) < \pi_H^c. \tag{18}$$

Because $v_L < v_H$, this restriction is satisfied.

The "guaranteed" profit of the low quality firm is the profit it earns when it offers the combination $\left(p^L, a^L, r^L\right)$ which is the optimal price and levels of advertising and CSR of the low quality firm when quality is observable. The guaranteed profit, $\pi_L^c$, is obtained by substituting $v = v_L$ into the firm's profit function and optimizing.

**All Putative Pooling Equilibria are unstable based on the Intuitive Criterion.**

When quality is unobservable, if the high quality firm charges the same price and chooses the same levels of advertising and CSR as under complete information, it would violate the "no-mimic condition" (Equation 17). This implies that a low quality firm will have an incentive to offer the same price and choose the same levels of advertising and CSR as the high quality firm. That would result in a pooling equilibrium. We show below using the Intuitive Criterion that a pooling equilibrium does not exist using a standard approach in signaling games (see, for example, Choi 1998).

Suppose there is a putative pooling equilibrium $(p^*, a^*, r^*)$ in which the customers accept the price-advertsing-CSR combination given the expected quality $E(v) = \mu v_H + (1-\mu)\, v_L$. The profit of a firm is given by Equations 8 and 10.

[2] When a signal is either costless or inexpensive, signaling may be impossible.

First we can find a deviation combination $\left(p^D, a^D, r^D\right)$ such that

$$\pi_L^D\left(p^D, a^D, r^D, \hat{\mu}=1\right) = \pi_L\left(p^*, a^*, r^*, \mu\right), \tag{19}$$

where $\pi_L^D = \left(p^D - c_L\right) D_L\left(p^D, a^D, r^D\right) - \frac{k a^{D2}}{2} - \frac{m r^{D2}}{2}$ and

$\pi_L^* = \left(p^* - c_L\right) D_L\left(p^*, a^*, r^*\right) - \frac{k a^{*2}}{2} - \frac{m r^{*2}}{2}$.

Note that Equation 19 implies that if $p^D > p^*$, then $D_L\left(p^D, a^D, r^D\right) < D_L\left(p^*, a^*, r^*\right)$. Further, note that

$$D_H\left(p^*, a^*, r^*, \hat{\mu}=\mu\right) = D_L\left(p^D, a^D, r^D, \hat{\mu}=1\right) = 1-\lambda \text{ and } D_L\left(p^*, a^*, r^*\right) = 1.$$

Using Equation 19, we can write

$$\begin{aligned}
& \pi_H^D\left(p^D, a^D, r^D, \hat{\mu}=1\right) - \pi_H^*\left(p^*, a^*, r^*, \hat{\mu}=\mu\right) \\
= \; & \left[\pi_H^D\left(p^D, a^D, r^D, \hat{\mu}=1\right) - \pi_L^D\left(p^D, a^D, r^D, \hat{\mu}=1\right)\right] - \left[\pi_H^*\left(p^*, a^*, r^*, \hat{\mu}=\mu\right) - \pi_L^*\left(p^*, a^*, r^*, \hat{\mu}=\mu\right)\right] \\
= \; & \left[\left(p^D - c_H\right) D_H\left(p^D, a^D, r^D\right) - \left(p^D - c_L\right) D_L\left(p^D, a^D, r^D\right)\right] \\
& - \left[\left(p^* - c_H\right) D_H\left(p^*, a^*, r^*\right) - \left(p^D - c_L\right) D_L\left(p^*, a^*, r^*\right)\right] \\
= \; & \lambda\left(p^* - c_L\right) \geq 0
\end{aligned} \tag{20}$$

Therefore considering a deviation combination $\left(p^{D-}, a^{D-}, r^{D-}\right)$ which is infinitesimally less profitable than $\left(p^D, a^D, r^D\right)$, we can see that $\left(p^{D-}, a^{D-}, r^{D-}\right)$ is equilibrium-dominated for the low quality firm but not for the high quality firm since $\pi_L^{D-}\left(p^{D-}, a^{D-}, r^{D-}, \hat{\mu}=1\right) < \pi_L^*\left(p^*, a^*, r^*, \hat{\mu}=\mu\right)$ (from Equation 19) and $\pi_H^{D-}\left(p^{D-}, a^{D-}, r^{D-}, \hat{\mu}=1\right) - \pi_H^*\left(p^*, a^*, r^*, \hat{\mu}=\mu\right) = \lambda\left(p^* - c_L\right) \geq 0$.

Thus the combination $\left(p^{D-}, a^{D-}, r^{D-}\right)$ is equilibrium-dominated (i.e., results in lower profit than under a putative pooling equilibrium $(p^*, r^*)$) for the low quality firm. According to the Intuitive Criterion the customers cannot ascribe positive probability to a firm type choosing a strategy that is equilibrium-dominated. Therefore the posterior probability of the customers $\hat{\mu}\left(p^{D-}, a^{D-}, r^{D-}\right) = 0$. However, the combination $\left(p^D, a^D, r^D\right)$ is not equilibrium-dominated for the high quality firm. The high quality firm can increase its profits by offering a deviation combination $\left(p^{D-}, a^{D-}, r^{D-}\right)$ and convince the customers that it is a high-quality type and also earn a higher profit. Thus there can be no intuitive pooling equilibrium.

**Separating Intuitive Perfect Bayesian Equilibrium**

We first derive the no-mimic condition for the low quality firm: it mimics the high quality firm's complete information strategy $(p_H, a_H, r_H)$ which results in profits:

$$\pi_L\left(\left(p^H, a^H, r^H\right), \hat{\mu}=1\right) = \left(p_H - c_L\right)(1-\lambda) - \frac{k a_H^2}{2} - \frac{m r_H^2}{2}.$$

The complete information profit of the low quality firm (see equation 8) is given by $\pi_L^c = \theta\left(v_L + \frac{\theta}{2k}\right) + \frac{\beta^2}{2m} - c_L$. The no-mimic condition following Equation 17 therefore simplifies as

$$\pi_L\left(\left(p_H, a_H, r_H\right), \hat{\mu}=1\right) \leq \pi_L^c \Leftrightarrow p_H(1-\lambda) + \lambda c_L - \frac{k a_H^2}{2} - \frac{m r_H^2}{2} \leq \theta\left(v_L + \frac{\theta}{2k}\right) + \frac{\beta^2}{2m}.$$

Further, $p_H \leq v_H + a_H + \beta r_H$ must be true for the Highs to buy the product. This reduces the no-mimic condition to $\Phi + (a_H + \beta r_H)(1-\lambda) - \frac{ka_H^2 + mr_H^2}{2} \leq 0$ where $\Phi = v_H(1-\lambda) - \theta v_L + \lambda c_L - \frac{1}{2}\left(\frac{\theta^2}{k} + \frac{\beta^2}{m}\right)$. This no-mimic condition enters the high quality firm's optimization problem as a constraint. Note that the low quality firm has incentives to mimic only if $\pi_L((p_H, a_H, r_H), \hat{\mu} = 1) > \pi_L^c$, i.e., $\Phi + (a_H + \beta r_H)(1-\lambda) > \frac{ka_H^2 + mr_H^2}{2}$. The Lagrangian for the high quality firm's decision problem: $\max_{p_H, a_H, r_H} (p_H - c_H) D_H - \frac{ka_H^2}{2} - \frac{mr_H^2}{2}$ s.t. $\Phi + (a_H + \beta r_H)(1-\lambda) - \frac{ka_H^2 + mr_H^2}{2} \leq 0$. Using the multiplier $\gamma$, the Lagrangian therefore is given by

$$\begin{aligned}\mathcal{L} &= (v_H + a_H + \beta r_H - c_H)(1-\lambda) - \frac{ka_H^2}{2} - \frac{mr_H^2}{2} \\ &\quad -\gamma\left[\Phi + (a_H + \beta r_H)(1-\lambda) - \frac{ka_H^2 + mr_H^2}{2}\right]\end{aligned}$$

Solving the constrained problem, we have the Kuhn-Tucker conditions for each of the above:

| Marginal Conditions | Complementary Slackness |
|---|---|
| $\frac{\partial \mathcal{L}}{\partial a_H} = (1-\gamma)(1-\lambda - ka_H) \leq 0$ | $a_H \frac{\partial \mathcal{L}}{\partial a_H} = 0$ |
| $\frac{\partial \mathcal{L}}{\partial r_H} = (1-\gamma)(\beta(1-\lambda) - mr_H) \leq 0$ | $r_H \frac{\partial \mathcal{L}}{\partial r_H} = 0$ |
| $\frac{\partial \mathcal{L}}{\partial \gamma} = \Phi + (a_H + \beta r_H)(1-\lambda) - \frac{ka_H^2 + mr_H^2}{2} \leq 0$ | $\gamma \frac{\partial \mathcal{L}}{\partial \gamma} = 0$ |

The above has the following solutions: $\{\gamma = 1, a^H = \frac{1-\lambda}{k}, r^H = \frac{\beta(1-\lambda)}{m} + \sqrt{\frac{\Psi}{m}}\}$ and $\{\gamma = 1, a^H = \frac{1-\lambda}{k} + \sqrt{\frac{\Psi}{k}}, r^H = \frac{\beta(1-\lambda)}{m}\}$ where $\Psi = 2\Phi + (1-\lambda)^2\left(\frac{1}{k} + \frac{\beta^2}{m}\right)$. Note that the the negative roots are ruled out since $a^H \geq 0$ and $r^H \geq 0$ (both $\frac{\beta^2(1-\lambda)^2}{m^2} < \frac{\Psi}{m}$ and $\frac{(1-\lambda)^2}{k^2} < \frac{\Psi}{k}$).[3] In other words, the firm distorts upward either only the level of CSR (and consequently price $p^H = v_H + a^H + \beta r^H$) while keeping the advertising intensity the same as under complete information or the advertising intensity and price keeping the level of CSR the same as under complete information.

Comparing between the profits when the firm distorts CSR versus that when it distorts advertising we have $\pi^H\left(a^H = \frac{1-\lambda}{k}, r^H = \frac{\beta(1-\lambda)}{m} + \sqrt{\frac{\Psi}{m}}\right) = \pi^H\left(a^H = \frac{1-\lambda}{k} + \sqrt{\frac{\Psi}{k}}, r^H = \frac{\beta(1-\lambda)}{m}\right)$. **Q.E.D**.

[3] Note that the high quality firm can also choose a mass market strategy. The no-mimic constraint in that case would become $\theta(v_H + a_H) + \beta r_H - c_L \leq \frac{ka_H^2 + mr_H^2}{2}$ and the firm decision problem involves the Lagrangian: $\mathcal{L} = \theta(v_H + a_H) + \beta r_H - c_H - \frac{ka_H^2}{2} - \frac{mr_H^2}{2} - \gamma\left[\theta(v_H + a_H) + \beta r_H - c_L - \frac{ka_H^2 + mr_H^2}{2}\right]$. Solving the Kuhn-Tucker marginal conditions ($\frac{\partial \mathcal{L}}{\partial a_H} = (1-\gamma)(\theta - ka_H) \leq 0$, $\frac{\partial \mathcal{L}}{\partial r_H} = (1-\gamma)(\beta - mr_H) \leq 0$, and $\frac{\partial \mathcal{L}}{\partial \gamma} = \theta(v_H + a_H) + \beta r_H - c_L - \frac{ka_H^2 + mr_H^2}{2} \leq 0$) for the constrained problem as before, we have again two solutions $\{\gamma = 1, a^H = \frac{\theta}{k}, r^H = \frac{\beta}{m} + \sqrt{\frac{2(\theta v_H - c_L) + \frac{\theta^2}{k} + \frac{\beta^2}{m}}{m}}\}$ and $\{\gamma = 1, a^H = \frac{\theta}{k} + \sqrt{\frac{2(\theta v_H - c_L) + \frac{\beta^2}{m} + \frac{\theta^2}{k}}{k}}, r^H = \frac{\beta}{m}\}$. Note again that negative roots are not valid since $a^H \geq 0$ and $r^H \geq 0$. The high quality firm profits are given by $\pi^H\left(a^H = \frac{\theta}{k}, r^H = \frac{\beta}{m} + \sqrt{\frac{2(\theta v_H - c_L) + \frac{\theta^2}{k} + \frac{\beta^2}{m}}{m}}\right) = \pi^H\left(a^H = \frac{\theta}{k} + \sqrt{\frac{2(\theta v_H - c_L) + \frac{\theta^2}{k} + \frac{\beta^2}{m}}{k}}, r^H = \frac{\beta}{m}\right)$.This strategy is however dominated by the high end strategy since $\pi_{HE}^H - \pi_{MM}^H = \lambda(c_H - c_L) + \theta v_L - c_L + \frac{1}{2}\left(\frac{\theta^2}{k} + \frac{\beta^2}{m}\right) \geq 0$ under the sufficient condition $c_H \geq c_L$.

**Proof of Proposition 6**

Note that the total consumer surplus in case of a low quality firm is the same as under Corollary 2. In case of a high quality firm which signals its type, the total welfare is given by $(1-\lambda)\, u_H\left(a^H, r^H, p^H\right) = 0$. In other words, the total consumer surplus under signaling is the same as under complete information in case of a high quality monopolist. **Q.E.D**.

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