Persuading Consumers With Social Attitudes*

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PRELIMINARY AND INCOMPLETE

Abstract

We study advertising and pricing in a model with horizontal and vertical product differentation and consumption externalities. The key feature of this model is that a consumer's product valuation depends both on persuasive advertising and an unobservable individual (dis)utility from other consumers buying the same product. Assuming that consumer valuations follow a bivariate uniform distribution, we derive product demands and characterize equilibrium prices and advertising. We find that both quality leaders and cost leaders invest more in advertising and charge higher prices. Also, we show that a higher average degree of conformity among consumers reinforces asymmetries between firms.

Keywords: Advertising, consumption externality, product quality

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1 Introduction

Individual consumption decisions are not always well-explained by invoking rationality and individual greed alone (Sobel, 2005). Often, consumers care about, and respond to, the actions of other consumers (Clark and Oswald, 1998). It is well known that the existence of such consumption externalities has important implications for profit-maximizing *pricing* in oligopoly. For instance, Grilo et al. (2001) show that vanity concerns among consumers relax price competition while (weak) conformity concerns intensify price competition. For a market with two types of consumers—snobs and conformists—Amaldoss and Jain (2005) find a similar result. In contrast, the interplay of consumption externalities and profit-maximizing *advertising* is not very well understood. This is a relevant gap in the literature, because advertising is often an important determinant of consumer demand (cf. Bagwell (2007)).

In this paper, we attempt to fill part of this gap by introducing *persuasive advertising* (cf. von der Fehr and Stevik (1998)) into an oligopoly model with differentiated products and consumption externalities. Specifically, we study a model where products are both horizontally and vertically differentiated and sellers compete in prices and advertising. Consumers have unit demand, and their valuation of a product is additively separable in the intrinsic consumption utility and the utility derived from the consumption externality. To capture consumer heterogeneity, we allow the consumption externality to vary across individual consumers. That is, each consumer derives an individual (dis)utility from the consumption of the product by others, which depends on her "*social attitude*". A consumer's social attitude determines (i) whether the consumer has a positive or negative extra utility from the consumption of the product by others (i.e., whether she is a conformist or an exclusivist, respectively), and (ii) how large this extra (dis)utility is.[1] The distribution of social attitudes determines the average degree of conformity in the population.

The timing of the game is as follows. In the first stage, firms simultaneously choose their outlays in persuasive advertising and thus the perceived quality of their product. In the second stage, firms simultaneously set prices. In the third stage, consumers form rational expectations about the demands for the products and choose from which firm to purchase.

We derive the following main results. *First*, the demand for each product has the usual properties regarding prices and perceived qualities (i.e., it is decreasing in own price and increasing in own quality, and vice versa for the competitor's price and quality). Interestingly, social attitudes affect product de-

[1] We also include "standard" consumers who are agnostic about the consumption of others and therefore derive an extra (dis)utility of zero.

mand only through the average degree of conformity among consumers. *Second*, there is a unique subgame-perfect Nash equilibrium in which both firms engage in advertising. In this equilibrium, quality- or cost-leaders (which both feature higher quality-cost margins than their competitors) invest more in persuasive advertising and charge higher prices. *Third*, the impact of a marginal increase in the average degree of conformity on persuasive advertising and pricing is similar to the effect a marginal increase in the persuasive power of advertising: It reinforces asymmetries from intrinsic differences in quality-cost margins.

Our paper contributes to the behavioral industrial organization literature along two lines.[2] First, we incorporate persuasive advertising into the analysis of oligopoly models with consumption externalities (Grilo et al., 2001; Amaldoss and Jain, 2005). This allows us to provide the first analysis of the advertising-pricing mix of a profit-maximizing firm facing consumption externalities. In particular, our analysis shows that persuasive advertising may be more than just “promotional hype” (Johnson and Myatt, 2006): With consumption externalities, persuasive advertising may lead to a shift *and* a rotation of the demand schedule. Second, we introduce heterogeneous social attitudes into the literature on horizontal and vertical product differentiation (Vandenbosch and Weinberg, 1995; Anderson and de Palma, 2001; Baake and Boom, 2001).[3] In doing so, we provide the first oligopoly model with horizontally and vertically differentiated products and heterogenous social attitudes among consumers.

The remainder of the paper is structured as follows. Section 2 introduces the key elements of the model, including the consumers' utility deriving from intrinsic product quality and the individual consumption externality. Section 3 derives the demand functions and characterizes their key properties. Section 4 characterizes the subgame-perfect Nash equilibrium of the game and discusses some important comparative statics results. Section 5 concludes.

2 Model

In this section, we introduce a duopoly model where firms advertise and sell products which are both horizontally and vertically differentiated, and consumers have individual social attitudes regarding the consumption of others.

[2] See Ellison (2006) for a comprehensive survey of this literature.

[3] The standard Hotelling (1929) model is a another special case of our analysis in which neither advertising nor social attitudes matter. The textbook model of network competition by Pepall et al. (2011) abstracts from advertising and imposes the same externality for all consumers.

2.1 Firms

Consider a duopoly model where the products are horizontally differentiated à la Hotelling (1929) and provided by single-product firms located at $x_1 = 0$ and $x_2 = 1$, respectively. Suppose that the products are also vertically differentiated. The perceived quality of a product $i = 1, 2$,

$$\theta_i = q_i + \omega a_i, \tag{1}$$

with $\omega \in [0, 1]$, is a function of (exogenous) intrinsic quality q_i and persuasive advertising a_i. The level of advertising is endogenously determined at cost $\phi(a_i) = \beta a_i^2$, where $\beta > 0$ is an exogenous cost parameter.[4] The parameter ω denotes the 'persuasive power' of advertising (Belleflamme and Peitz, 2010). It is restricted such that the marginal effect of advertising on perceived quality is dominated by intrinsic quality. Clearly, if $\omega = 0$, product quality is solely determined by intrinsic product features. The marginal cost of producing a product at intrinsic quality q_i is given by $c_i \geq 0$.

2.2 Consumers

Consumers have unit demand, and their valuation V_i of product i reflects both intrinsic utility v_i and comparison utility s_i.[5] In line with Bernheim (1994) and Clark and Oswald (1998), we assume that V_i is additively separable,

$$V_i = v_i + \mu s_i, \tag{2}$$

with the parameter $\mu \geq 0$ indicating the importance of comparison utility relative to intrinsic utility.

Intrinsic Utility

A consumer's intrinsic utility is defined as the conditional indirect utility from buying product i,

$$v_i = \theta_i - \tau |x - x_i| + m - p_i, \tag{3}$$

where θ_i is the perceived quality of product i, $x \in [0, 1]$ is the consumer's ideal point on the Hotelling line, τ measures the consumer's sensitivity to distance on the Hotelling line, and m is the consumer's income.[6]

[4] The assumption that intrinsic quality is exogenous may be justified by considering quality as being chosen in earlier stages of an extended game. Qualities may differ as they are outcomes of stochastic R&D processes.

[5] V_i reflects the consumer's complete experience of the product and therefore has the interpretation of brand value in the marketing literature (Keller and Lehmann, 2006).

[6] It is useful to think of $|x - x_i|$ as "match value" (Anderson and Renault, 2006).

Comparison Utility

A consumer's comparison utility depends (i) on the (non)use of the product by other consumers, and (ii) on her social attitude towards the (non)use by others, captured by $\sigma \in [\underline{\sigma}, \overline{\sigma}]$, with $\underline{\sigma} < 0 < \overline{\sigma}$. In line with Karni and Schmeidler (1990), we assume that a consumer's assessment of the (non)use by others is based on the firms' expected equilibrium market shares. The analysis focuses on the case where the market is covered and both firms have strictly positive sales. Letting $y \in (0,1)$ denote the expected demand (market share) of firm 1,[7] the expected utility derived from social comparisons is specified as

$$s_i = \sigma|y - x_i|.$$

Similar to the economic analysis of networks, we impose rational expectations on behalf of consumers without explicitly modeling the process of forming expectations (Katz and Shapiro, 1985). In contrast to this strand of literature, we allow consumers to have individual social attitudes (i.e., consumers may be heterogenous in their perception of the choices of others).[8] If a consumer's social attitude is characterized by $\sigma > 0$, she is better off the larger the number of consumers who buy the same product, reflecting a concern for *conformity*. Conversely, preferences reflect a concern for *exclusivity* if $\sigma < 0$, thus making the consumer worse off if a larger number of consumers buys the same product.

Consumer Characteristics

Individual consumers are characterized by the tuple (x, σ). These individual characteristics are drawn independently from uniform distributions over the intervals $[0,1]$ and $[\underline{\sigma}, \overline{\sigma}]$, respectively. Independence of the two characteristics implies that a consumer's ideal point and her social attitude are uncorrelated. The expectation of σ is given by $\mathbb{E}[\sigma] = (\underline{\sigma} + \overline{\sigma})/2$. Throughout the analysis, we impose $\mathbb{E}[\sigma] < \tau/\mu$, which places an upper bound on the average degree of conformity among consumers.[9] The distributions of x and σ are common knowledge, whereas individual types are privately known.

[7] Note that demands and market shares coincide by construction.

[8] In other words, the utility derived from social comparisons (or, the expected consumption externality) is individual specific. Pepall et al. (2011, p. 502) provide a textbook model of price competition with a common positive network effect.

[9] We will further discuss this assumption in Section 4 below.

2.3 Timing

In a first stage, firms simultaneously choose advertising outlays $\phi(a_i)$ and hence their perceived product quality θ_i. In a second stage, firms simultaneously set their prices p_i. In a third stage, consumers form rational expectations about demand and make their purchase decisions.

3 Demand

Let us now derive the demand for product $i = 1, 2$, as a function of the prices $\mathbf{p} = (p_1, p_2)$ and the perceived qualities $\boldsymbol{\theta} = (\theta_1, \theta_2)$. We proceed in two steps. First, we construct the set of consumers who buy product 1 conditional on the belief y regarding market shares. Second, imposing rational expectations (Katz and Shapiro, 1985), we solve for the demand for product 1.

Since the market is covered and both firms have strictly positive market shares by assumption, we know that there must be indifferent consumers with product valuations $V_1 = V_2$. Solving this indifference condition for x indicates that the cut-off value

$$x(\sigma|y) = \frac{\tau + (\theta_1 - p_1) - (\theta_2 - p_2) + \mu\sigma(2y - 1)}{2\tau} \tag{4}$$

is a function of the social attitude σ and conditional on the belief y. Equation (4) traces out the points of indifference in the characteristics space $T \equiv [0, 1] \times [\underline{\sigma}, \overline{\sigma}]$ when going from the most exclusivist attitude (given by $\underline{\sigma}$) to the most conformist attitude (given by $\overline{\sigma}$). Note that the slope of this "indifference curve" is determined by the belief y: It is positive (negative) if more (less) than half of the consumers are expected to buy product 1.[10] Intuitively, for $y > \frac{1}{2}$, the indifference curve is upwards-sloping because conformists (with $\sigma > 0$) are able to bear higher disutility from consuming the non-ideal product as they receive higher comparison utility. Using (4), the set of consumers that buy product 1, conditional on the belief y, can be characterized by

$$B_1(y) \equiv \left\{ (x, \sigma) \mid x - \frac{\mu\sigma(2y - 1)}{2\tau} \leq \frac{\tau + (\theta_1 - p_1) - (\theta_2 - p_2)}{2\tau} \right\}.$$

This set is illustrated in Figure 1, Panel A.

[10] To see this, note that

$$\frac{d\sigma(x|y)}{dx} = \frac{2\tau}{\mu(2y - 1)}$$

is positive for $y > \frac{1}{2}$ and negative for $y < \frac{1}{2}$.

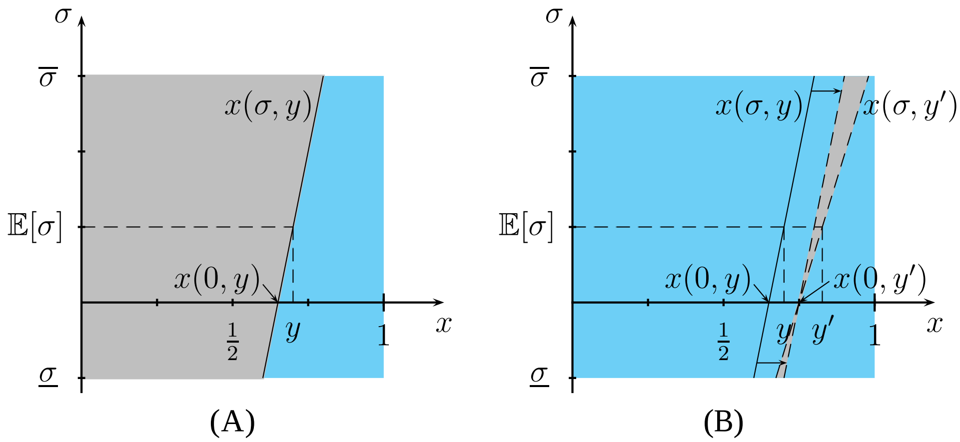

Figure 1: Demands for $y > \frac{1}{2}$ (in Panel A, shaded area indicates types that buy from firm 1) and the (type-specific) change in demand when the quality of product 1 changes (in Panel B).

Our assumptions on the distributions of x and σ, respectively, imply that consumer characteristics are distributed according to the bivariate uniform distribution

$$f_{(X,\Sigma)}(x, \sigma) = \begin{cases} (\overline{\sigma} - \underline{\sigma})^{-1} & \text{if } (x, \sigma) \in T \\ 0 & \text{otherwise} \end{cases}$$

on the rectangular space $T \equiv [0, 1] \times [\underline{\sigma}, \overline{\sigma}]$. Imposing that consumers form rational expectations, the belief y regarding firm 1's equilibrium demand must satisfy the fixed point condition

$$y = \frac{1}{(\overline{\sigma} - \underline{\sigma})} \int_{\underline{\sigma}}^{\overline{\sigma}} \int_{0}^{1} \mathbf{1}_{B_1(y)} dx d\sigma.$$

In words, this condition means that the expected demand for product 1 must be equal to the actual demand (given y). Assuming that comparison utility does not dominate intrinsic utility,[11] we can express the rational belief about firm 1's demand as follows.

Lemma 1. *For given prices* $\mathbf{p}$ *and perceived qualities* $\boldsymbol{\theta}$*, the rational belief about firm 1's demand is given by*

$$y(\mathbf{p}, \boldsymbol{\theta}) = \frac{\tau - \mu\mathbb{E}[\sigma] + (\theta_1 - p_1) - (\theta_2 - p_2)}{2(\tau - \mu\mathbb{E}[\sigma])}. \tag{5}$$

[11] This assumption leads to demand functions which are easily compared to those in standard models without comparison utility. Formally, this amounts to assuming the following: For $y > \frac{1}{2}$, we impose $x(\underline{\sigma}, y) > 0$ and $x(\overline{\sigma}, y) < 1$; for $y < \frac{1}{2}$, we require $x(\overline{\sigma}, y) > 0$ and $x(\underline{\sigma}, y) < 1$. See Buehler and Halbheer (2011) for a discussion of alternative assumptions.

Proof. See Appendix. □

Notice that expected demands depend only on differences in prices and perceived qualities. Lemma 1 implies that expected demand is uniquely determined for given prices and perceived qualities, respectively. In particular, $y > 1 - y$ if and only if $\theta_1 - p_1 > \theta_2 - p_2$. Using terminology introduced by Anderson and de Palma (2001), the latter statement implies that consumers expect firm 1 to have higher demand than firm 2 if and only if it has a higher 'quality-price margin' (to be read as 'quality minus price').

Before proceeding, it is worth noting that the cut-off value $x(\mathbb{E}[\sigma]|y)$ of a consumer with average social attitude $\mathbb{E}[\sigma]$ coincides with $y\left(\mathbf{p}, \boldsymbol{\theta}\right)$.[12] That is, what matters for expected demand is the average consumer's social attitude (see again Panel A in Figure 1).

Using Lemma 1, firms' demands functions are given by $D_1\left(\mathbf{p}, \boldsymbol{\theta}\right) = y\left(\mathbf{p}, \boldsymbol{\theta}\right)$ and $D_2\left(\mathbf{p}, \boldsymbol{\theta}\right) = 1 - y\left(\mathbf{p}, \boldsymbol{\theta}\right)$, respectively. Proposition 1 now follows immediately.

Proposition 1 (Demand). *Given prices* $\mathbf{p}$ *and perceived qualities* $\boldsymbol{\theta}$*, firm* i*'s demand is given by*

$$D_i\left(\mathbf{p}, \boldsymbol{\theta}\right) = \frac{1}{2} + \frac{(\theta_i - \theta_j) - (p_i - p_j)}{2\left(\tau - \mu\mathbb{E}[\sigma]\right)}. \tag{6}$$

Two comments are in order. First, the demand function $D_i\left(\mathbf{p}, \boldsymbol{\theta}\right)$ has the usual comparative statics properties regarding prices and qualities (i.e., demand is increasing in own quality and decreasing in own price, and vice versa for the competitor's quality and price). Second, the demand function is reminiscent of standard Hotelling-type demand functions, which depend on the consumers' (uniform) sensitivity to distance in the characteristics space τ. However, in our setting, the "perceived sensitivity" to distance is measured by $\tau - \mu\mathbb{E}[\sigma]$, which accounts for social attitudes. This implies that the higher the average degree of conformity $\mathbb{E}[\sigma]$, the lower is the "perceived transportation cost", such that the two products become closer substitutes.[13] Put differently, in contrast to standard Hotelling models, the (exogenous) degree of perceived product differentiation depends on the distribution of social attitudes (as well as on μ, which indicates the relative importance of comparison utility).[14]

The comparative statics effects mentioned above reflect overall changes in the aggregate of individual consumption decisions. To illustrate this, consider

[12] Too see this, consider a consumer with social attitude $\sigma = \mathbb{E}[\sigma]$ and let $y = x(\mathbb{E}[\sigma]|y)$ in (4). Solving the equation for y shows that the implied solution is equal to $y\left(\mathbf{p}, \boldsymbol{\theta}\right)$.

[13] Following Laffont et al. (1998), we interpret $(\tau - \mu\mathbb{E}[\sigma])^{-1}$ as an (inverse) index of substitutability between the two products. For this index to be positive, we assume $\mathbb{E}[\sigma] < \tau/\mu$.

[14] If the distribution of social attitudes is symmetric around 0 (in which case $\mathbb{E}[\sigma] = 0$), the perceived degree of product differentiation is determined solely by τ.

an increase in the perceived quality of product 1 due to higher spending on advertising by firm 1. Assuming $y > \frac{1}{2}$ prior to the change, the increase in perceived quality $\theta_i = q_i + \omega a_i$ due to a higher a_i leads to a shift of the "indifference curve" to the right (see Figure 1, Panel B). Since quality has a demand-enhancing effect, the belief y is updated accordingly (i.e., y increases to, say, y'), which leads to a clockwise rotation of the indifference curve around the point $x(0, y')$. This rotation is generated by heterogeneous social attitudes: While all consumers benefit equally from the increase in intrinsic utility, the comparison utility of conformists and exclusivists, respectively, is affected differently. The demand-enhancing effect of a quality increase is reinforced for conformists (who benefit from an increase in the demand for product 1) and weakened for exclusivists (who suffer from an increase in the demand for product 1). That is, conformists are more attracted to more heavily advertised product than standard consumers (with $\sigma = 0$), whereas exclusivists are less attracted than standard consumers.

The next proposition examines how changes in individual demand add up to changes at the aggregate (i.e., the firm) level.

Proposition 2 (Demand Composition). *Let $z_i \in \{\theta_i, -p_i\}$ and suppose that z_i increases to $z_i' > z_i$, with $y' > y$ denoting the corresponding beliefs about demand. Then, the change in the type-specific demand due to a quality increase or a price reduction is the sum of a direct effect and an indirect effect induced by social attitudes:*

$$x(\sigma, y', z_i') - x(\sigma, y, z_i) = \left(\frac{1}{2\tau} + \frac{\mu\sigma}{2\tau(\tau - \mu\mathbb{E}[\sigma])}\right) \int_{z_i}^{z_i'} dz_i.$$

The indirect effect reinforces the direct effect for conformists $(\sigma > 0)$, and it may dampen or dominate it for exclusivists $(\sigma < 0)$. When considering a marginal change in z_i, aggregating changes in type-specific demand yields the corresponding change in aggregate demand, which is given by $\partial D_i(\mathbf{p}, \boldsymbol{\theta}) / \partial z_i$.

Proof. See Appendix. □

Proposition 2 is related to Johnson and Myatt (2006). These authors argue that many forces—e.g. product design, advertising, and marketing and sales—may influence the dispersion of consumers' valuations, leading to a rotation (as opposed to a shift) of the demand curve. The key idea is that individual consumers may be affected differently by these forces: Some are discouraged from purchasing while others are encouraged. The paper distinguishes two forms of advertising: (i) *Promotional hype*, which corresponds to the traditional notions of informative and persuasive advertising; it leads to a parallel shift of the demand curve. (ii) *Real information*, which allows individual consumers to learn about their match with the product's characteristics; it leads to a rotation of the demand curve.

Proposition 2 highlights that persuasive advertising amounts to more than promotional hype if consumers have heterogeneous social attitudes: It generates both a parallel shift (the direct effect) and a rotation (the indirect effect) of the demand curve. The rotation emerges because exclusivists are discouraged from buying while conformists are encouraged.

4 Product Market Competition

In this section, we derive the subgame-perfect Nash equilibrium (SPNE) in pricing and advertising using backward induction.

4.1 Pricing

For any perceived qualities $\boldsymbol{\theta}$ from stage 1, firm i maximizes its product market profit and hence chooses its price p_i so as to maximize $\pi_i(\mathbf{p}) = (p_i - c_i)D_i(\mathbf{p}, \boldsymbol{\theta})$. Assuming an interior solution, standard analysis yields

$$p_i(\boldsymbol{\theta}) = \frac{3\hat{\tau} + (\theta_i - \theta_j) + 2c_i + c_j}{3}. \tag{7}$$

Inspection of (7) indicates that the difference in perceived qualities is an important determinant of the profit-maximizing prices: A higher-quality product commands a higher price (everything else equal). Prices are also increasing in the marginal costs of both firms, reflecting a strategic complementarity in pricing. Moreover, similar to standard Hotelling models, prices are increasing the level of perceived transportation costs $\hat{\tau} \equiv \tau - \mu\mathbb{E}[\sigma]$ because products are perceived as less substitutable. This immediately implies that, in the absence of persuasive advertising (i.e., with fixed intrinsic qualities), equilibrium prices are decreasing in the average degree of conformity $\mathbb{E}[\sigma]$, as suggested by Grilo et al. (2001) and Amaldoss and Jain (2005).

4.2 Advertising

Using (7), firm i's product market profit $\pi_i(\boldsymbol{\theta}) = (p_i(\boldsymbol{\theta}) - c_i)\, D_i(\boldsymbol{\theta})$ can be expressed as

$$\pi_i(\boldsymbol{\theta}) = \frac{\left(3\hat{\tau} + (\theta_i - \theta_j) - (c_i - c_j)\right)^2}{18\hat{\tau}}. \tag{8}$$

Now, substituting $\theta_i = q_i + \omega a_i$ into (8) and accounting for the cost of investment yields firm i's net profit function $\Pi_i(\mathbf{a}) = \pi_i(\mathbf{a}) - \beta a_i^2$. Firm i picks its advertising a_i so as to

$$\max_{a_i} \Pi_i(\mathbf{a}) = \frac{(3\hat{\tau} + (q_i - q_j) + \omega(a_i - a_j) - (c_i - c_j))^2}{18\hat{\tau}} - \beta a_i^2. \tag{9}$$

4.3 Equilibrium

The next proposition characterizes the unique SPNE in which both firms actively engage in advertising and product market competition.

Proposition 3 (SPNE). *Suppose that (i) $\beta > 1/6\hat{\tau}$, and (ii) both firms engage in advertising. Then, there exists a unique SPNE in which advertising levels and prices are given by*

$$a_i^* = \frac{\omega}{2}\left(\frac{1}{3\beta} + \frac{(q_i - c_i) - (q_j - c_j)}{9\beta\hat{\tau} - \omega^2}\right) \tag{10}$$

and

$$p_i^* = \hat{\tau} + c_i + \frac{3\beta\hat{\tau}\left((q_i - c_i) - (q_j - c_j)\right)}{9\beta\hat{\tau} - \omega^2}. \tag{11}$$

Proof. See Appendix. □

Condition (i) is an invertibility condition which guarantees that the system of first-order conditions can be solved for the equilibrium levels of advertising. Condition (ii) restricts the model parameters such that advertising levels are non-negative (i.e., $a_i \geq 0, i = 1, 2$).[15]

Equation (10) indicates that the aggregate level of advertising is given by $a_1^* + a_2^* = \omega/(3\beta)$. That is, the total amount of advertising depends on the persuasive power ω and the cost of advertising β, but not on the other model parameters. The result reflects the fact that the aggregate incentives to invest in advertising are driven by the fixed size of the market (normalized to one). More importantly, the fixed size of the market implies that advertising at the firm level necessarily has a *business-stealing effect*: Any demand increase for firm i is to the detriment of firm j.

It is useful to note that Proposition 3 contains two benchmark equilibria as special cases. The first benchmark concerns the case where the persuasive power of advertising is zero ($\omega = 0$). In this case, advertising has no demand-enhancing effect, so that the firms choose not to advertise ($a_i = 0, i = 1, 2$). That is, advertising is irrelevant, but the consumers' social attitudes affect the prices of both firms. This benchmark case is related to Grilo et al. (2001) and Amaldoss and Jain (2005) who focus on the role of demand externalities for equilibrium pricing but disregard advertising. In contrast to these papers, our

[15]More formally, this condition can be written as $|(q_i - c_i) - (q_j - c_j)| < (9\beta\hat{\tau} - \omega^2)/3\beta$.

analysis allows for a continuum of social attitudes across the population of consumers. The second benchmark concerns the case where firms are symmetric in the sense that their products have the same intrinsic quality and are produced at the same marginal cost (i.e., $q_i = q$ and $c_i = c, i = 1, 2$, respectively). In this case, advertising is chosen as in Belleflamme and Peitz (2010, 151),[16] but the pricing differs, as the consumers' social attitudes affect the (symmetric) prices of both firms via the perceived transportation costs.

We now discuss a number of important implications of Proposition 3 which hold beyond these special cases. The first result shows how advertising and pricing depends on the firms' respective 'quality-cost' margins $(q_i - c_i), i = 1, 2$.[17]

Corollary 1 (**Quality-Cost Margin**). *Suppose that firm i has a higher quality-cost margin than firm j. Then, firm i invests more in advertising $(a_i^* > a_j^*)$ and charges a higher price $(p_i^* > p_j^*)$ than firm j. Furthermore, firm i's advertising and price are both increasing (decreasing) in own (the rival's) quality-cost margin.*

Proof. See Appendix. □

Corollary 1 highlights that asymmetries in equilibrium advertising and pricing are driven by asymmetries in the quality-cost margins of individual firms. The result covers both *quality leadership* (with equal marginal costs) and *cost-leadership* (with equal intrinsic product qualities) as special cases. In particular, it shows that both quality leaders and cost leaders invest more in advertising and sell at higher prices than their competitors.

Intuitively, Corollary 1 follows from the existence of demand-markup complementarities (Athey and Schmutzler, 2001) in the product market, as the next result illustrates.

Corollary 2 (**Demand-Markup Complementarity**). *Suppose that firm i has a higher quality-cost margin than firm j. Then, firm i has a higher markup $m_i^* = p_i^* - c_i$ and a higher demand D_i^* than firm j, and hence earns a higher product market profit π_i^*. Firm i also earns a higher net profit Π_i^* in equilibrium.*

Proof. See Appendix. □

Corollary 2 shows that a firm with a higher quality-cost margin has a stronger incentive to invest in demand-enhancing advertising, because the effect is more valuable thanks to a higher markup. In addition, it has a stronger incentive to

[16] Observe that β corresponds to $\alpha/2$ in their model.

[17] Note that a product with a higher quality-cost margin is more desirable from a social point of view (Anderson and de Palma, 2001).

increase the price, since a larger markup is more valuable thanks to larger demand. This is the demand-markup complementarity. Given that equilibrium demand and markup are both larger for a firm with a higher quality-cost margin, equilibrium profits are also higher. The result is related to earlier work by Anderson and de Palma (2001). The key difference to this paper is that our analysis allows for social attitudes among consumers.

The next result characterizes the relationship among the firms' equilibrium levels of advertising and pricing.

Corollary 3 (**Price-Advertising Relation**). *There exists a positive relationship between the optimal price p_i^* and the optimal level of advertising a_i^*.*

Proof. See Appendix. $\square$

The relationship between pricing and advertising is at the core of the advertising literature (Bagwell, 2007). The persuasive view of advertising, for instance, suggests that heavily advertised products are more expensive than less advertised products due to the consumers' higher willingness to pay. The complementary view, in turn, suggests that more heavily advertised products have higher prices because they have higher quality. Clearly, both of these effects are relevant in our model for $\omega > 0$ (see equation (7)). Corollary 3 highlights that the positive relationship between the equilibrium levels of advertising and pricing is robust to the introduction of social attitudes.

4.4 Comparative Statics

In this section, we provide some comparative statics results of our analysis. We focus on marginal changes in the persuasive power of advertising ω and the average degree of conformity $\mathbb{E}[\sigma]$.[18] We will show that the impact of these variables on equilibrium quantities is fairly similar. To ease notation, we let $k \equiv 1/(9\beta\hat{\tau} - \omega^2)^2 > 0$.

Persuasive Power of Advertising

We first consider the impact of a marginal change in ω on equilibrium advertising a_i^* and pricing p_i^*.

Differentiating (10) yields

$$\frac{\partial a_i^*}{\partial \omega} = \frac{1}{6\beta} + \frac{k}{2}(\omega^2 + 9\hat{\tau}\beta)[(q_i - c_i) - (q_j - c_j)]. \tag{12}$$

[18] Additional comparative statics results are available on request from the authors.

Equation (12) indicates that the equilibrium advertising of asymmetric firms is affected differently. More specifically, the larger firm with the higher quality-cost margin (and higher initial advertising) increases advertising, whereas the smaller firm with the lower quality-cost margin may increase or decrease[19] advertising. In any case, the larger firm increases advertising more than the smaller firm, such that equilibrium advertising becomes more asymmetric.

Differentiating (11) yields

$$\frac{\partial p_i^*}{\partial \omega} = 6k\hat{\tau}\beta\omega[(q_i - c_i) - (q_j - c_j)]. \tag{13}$$

Again, we find that an increase in the persuasive power of advertising reinforces the asymmetry in equilibrium behavior: The larger firm with the higher quality-cost margin (and the higher price) increases the price, whereas the smaller firm (with the lower price) reduces the price.

The next observation summarizes the results:

Observation 1. *A marginal increase in the* ***persuasive power of advertising*** ω *reinforces asymmetries in equilibrium advertising and pricing from differences in quality-cost margins.*

Average Degree of Conformity

Next, consider a marginal increase in $\mathbb{E}[\sigma]$, which increases the perceived substitutability of the products. Differentiating (10) yields

$$\frac{\partial a_i^*}{\partial \mathbb{E}[\sigma]} = \frac{k}{2}9\beta\omega[(q_i - c_i) - (q_j - c_j)]. \tag{14}$$

The result implies that a marginal increase in $\mathbb{E}[\sigma]$ increases advertising by the larger firm with the higher quality-cost margin (and higher initial advertising) and decreases advertising by the smaller firm. Consequently, equilibrium advertising becomes more asymmetric.

Differentiating (11) yields

$$\frac{\partial p_i^*}{\partial \mathbb{E}[\sigma]} = -1 + 3k\tilde{\tau}\beta\omega^2[(q_i - c_i) - (q_j - c_j)]. \tag{15}$$

The result indicates that the larger firm reduces the price by less then the smaller firm, such that equilibrium pricing becomes more asymmetric.

The next observation summarizes these results.

[19] Note that a decrease in advertising by the smaller firm requires a very strong asymmetry in quality-cost margins, in which case the small firm can be viewed as being 'marginalized'.

Observation 2. *A marginal increase in the* ***average degree of conformity*** $\mathbb{E}[\sigma]$ *reinforces asymmetries in equilibrium advertising and pricing from differences in quality-cost margins.*

Observation 2 implies that the structure of a market may depend on the non-observable average degree of conformity among consumers. Specifically, the structure of a market with a conformist population ($\mathbb{E}[\sigma] > 0$) should typically be expected to be more asymmetric than that of a market with a non-conformist or exlusivist population ($\mathbb{E}[\sigma] \leq 0$).

5 Conclusion

This paper has studied advertising and pricing in an oligopoly model with horizontal and vertical product differentiation. The key feature of this model is that a consumer's product valuation depends both on persuasive advertising and an (unobservable) individual (dis)utility from other consumers buying the same product.

We have derived the following key results. First, product demand has the usual properties regarding prices and perceived qualities, and consumers' social attitudes affect demand only through the average degree of conformity in the population. Second, there is a unique SPNE in which both firms engage in advertising. In this equilibrium, quality- or cost-leaders (which feature higher quality-cost margins than their competitors), invest more in advertising and charge higher prices. Third, an increase in the average degree of conformity in the population reinforces asymmetries from intrinsic quality-cost differences between firms.

Our analysis contributes to a fairly thin behavioral industrial organization literature and suggests a number of avenues for future research. First, it would be interesting to examine settings where the sellers may influence the social attitudes of consumers (which are exogenous in our setting). Second, it would be natural to extend the analysis to other distributions of consumer characteristics (and higher-dimensional tastes). Third, it would be desirable to endogenize the persuasive effect of advertising on individual consumers. We hope to address these issues in future research.

Appendix

PROOF OF LEMMA 1: To establish the first claim, fix y and define $\underline{x} = x(\underline{\sigma}, y)$ and $\overline{x} = x(\overline{\sigma}, y)$, respectively, and recall that each point in $B_1 \subset T$ has density $(\overline{\sigma} - \underline{\sigma})^{-1}$. Actual demand can be expressed as $(\underline{x} + \overline{x})/2$. Using (4) and letting $\xi \equiv \tau + (\theta_1 - \theta_2) - (p_1 - p_2)$, we obtain, respectively,

$$\underline{x} = \frac{\xi + \mu\underline{\sigma}(2y-1)}{2\tau} \quad \text{and} \quad \overline{x} = \frac{\xi + \mu\overline{\sigma}(2y-1)}{2\tau}.$$

Recalling that $\mathbb{E}[\sigma] = (\underline{\sigma} + \overline{\sigma})/2$, we thus can express actual demand as

$$\frac{\xi + \mu\mathbb{E}[\sigma](2y-1)}{2\tau},$$

which has to be equal to expected demand y under our rational expectations assumption. Solving the fixed-point condition yields

$$y(\mathbf{p}, \boldsymbol{\theta}) = \frac{\tau - \mu\mathbb{E}[\sigma] + (\theta_1 - p_1) - (\theta_2 - p_2)}{2(\tau - \mu\mathbb{E}[\sigma])},$$

which establishes the result.

PROOF OF PROPOSITION 2: Write the type-specific change in demand as

$$\Delta x(\sigma) \equiv x(\sigma, y, z_i') - x(\sigma, y, z_i) + x(\sigma, y', z_i') - x(\sigma, y, z_i').$$

Applying the fundamental theorem of calculus, the preceding expression reads

$$\Delta x(\sigma) = \int_{z_i}^{z_i'} \frac{\partial x(\sigma, y, \tilde{z}_i)}{\partial \tilde{z}_i} d\tilde{z}_i + \int_{y}^{y'} \frac{\partial x(\sigma, \tilde{y}, z_i')}{\partial \tilde{y}} d\tilde{y}.$$

Equation (5) defines y as a continuously differentiable function of z_i, denoted by $y \equiv \phi(z_i)$. Moreover, observe that Equation (4) defines $x(y)$. Using integration by substitution, the second integral on the RHS can be written as:[20]

$$\int_{y}^{y'} \frac{\partial x(\sigma, \tilde{y}, z_i')}{\partial \tilde{y}} d\tilde{y} = \frac{\mu\sigma}{2\tau(\tau - \mu\mathbb{E}[\sigma])} \int_{z_i}^{z_i'} dz_i.$$

We thus have

$$\Delta x(\sigma) = \left(\frac{1}{2\tau} + \frac{\mu\sigma}{2\tau(\tau - \mu\mathbb{E}[\sigma])}\right) \int_{z_i}^{z_i'} dz_i,$$

[20]Observe that

$$\int_{y}^{y'} \frac{\partial x(\tilde{y})}{\partial \tilde{y}} d\tilde{y} = \int_{\phi^{-1}(y)}^{\phi^{-1}(y')} \frac{\partial x}{\partial y} (\phi(z_i)) \phi'(z_i) dz_i.$$

which establishes the first part of the proposition. The second part follows from aggregating the type-specific demand changes across types σ:

$$\frac{1}{\overline{\sigma}-\underline{\sigma}}\int_{\underline{\sigma}}^{\overline{\sigma}}\Delta x(\sigma)d\sigma=\frac{1}{2\left(\tau-\mu\mathbb{E}[\sigma]\right)}\int_{z_i}^{z_i'}dz_i.$$

Dividing the preceding equation by $z_i'-z_i$ and taking limits yields

$$\lim_{z_i'\to z_i}\frac{1}{\overline{\sigma}-\underline{\sigma}}\int_{\underline{\sigma}}^{\overline{\sigma}}\frac{\Delta x(\sigma)}{z_i'-z_i}d\sigma=\frac{\partial D_i\left(\mathbf{p},\boldsymbol{\theta}\right)}{\partial z_i},$$

which completes the proof.

PROOF OF PROPOSITION 3: The first-order conditions of the problem given in (9) read in matrix form as

$$\begin{pmatrix} -\omega^2+18\hat{\tau}\beta & \omega^2 \\ -\omega^2 & \omega^2-18\hat{\tau}\beta \end{pmatrix}\begin{pmatrix} a_1 \\ a_2 \end{pmatrix}=\omega\begin{pmatrix} \gamma+3\hat{\tau} \\ \gamma-3\hat{\tau} \end{pmatrix}, \tag{A.1}$$

where $\gamma\equiv q_1-q_2-c_1+c_2$. The matrix on the LHS of (A.1), call it M, is invertible if and only if $\det M\neq 0$; that is, if and only if $324\hat{\tau}^2\beta^2-36\hat{\tau}\beta\omega^2\neq 0$. This condition holds whenever $\beta>\omega^2/9\hat{\tau}$. As $\omega\in[0,1)$, this condition is met if $\beta>1/6\hat{\tau}$ (which holds by hypothesis). The reduced-form profit function is strictly concave in own advertising if $\beta>\omega^2/18\hat{\tau}$. If this condition holds, the first-order conditions uniquely determine the advertising levels. Clearly, the invertibility condition is more stringent as the second-order condition, and hence the unique solution of (A.1) is given by

$$a_i^*=\frac{\omega}{2}\left(\frac{1}{3\beta}+\frac{(q_i-c_i)-(q_j-c_j)}{9\beta\hat{\tau}-\omega^2}\right).$$

Investments are positive as long as $|(q_i-c_i)-(q_j-c_j)|<(9\beta\hat{\tau}-\omega^2)/3\beta$. The prices follow from substituting the a_i^*'s into (1) and plugging the θ_i's into (7):

$$p_i^*=\hat{\tau}+\frac{3\beta\hat{\tau}\left((q_i-c_i)-(q_j-c_j)\right)+\left(9\beta\hat{\tau}-\omega^2\right)c_i}{9\beta\hat{\tau}-\omega^2}.$$

This completes the proof.

PROOF OF COROLLARY 1: First, consider advertising. By the hypothesis of Proposition 3, $\omega/\left(9\beta\hat{\tau}-\omega^2\right)>0$. From (10),

$$a_i^*-a_j^*=\frac{\omega\left((q_i-c_i)-(q_j-c_j)\right)}{9\beta\hat{\tau}-\omega^2},$$

which is positive as firm i has higher quality-cost. Hence, $\partial a_i^*/\partial(q_i - c_i) > 0$ and $\partial a_i^*/\partial(q_j - c_j) < 0$. Next, consider pricing. From (11),

$$p_i^* - p_j^* = \frac{6\beta\hat{\tau}(q_i - q_j) - (\omega^2 - 3\beta\hat{\tau})\, c_i + (\omega^2 - 3\beta\hat{\tau})\, c_j}{9\beta\hat{\tau} - \omega^2}. \tag{A.2}$$

Write the nominator of (A.2) as $(6\beta\hat{\tau}q_i - (\omega^2 - 3\beta\hat{\tau})\, c_i) - (6\beta\hat{\tau}q_j - (\omega^2 - 3\beta\hat{\tau})\, c_j)$. By the hypothesis, $(q_i - c_i) - (q_j - c_j) > 0$. So if $6\beta\hat{\tau} > (\omega^2 - 3\beta\hat{\tau})$, this implies that $6\beta\hat{\tau}q_i - (\omega^2 - 3\beta\hat{\tau})\, c_i > 6\beta\hat{\tau}q_j - (\omega^2 - 3\beta\hat{\tau})\, c_j$. As $\beta > 1/6\hat{\tau}$, the result $p_i^* - p_j^* > 0$ follows by noting that $6\beta\hat{\tau} > \omega^2 - 3\beta\hat{\tau}$. Clearly, $\partial p_i^*/\partial(q_i - c_i) > 0$ and $\partial p_i^*/\partial(q_j - c_j) < 0$. This completes the proof.

PROOF OF COROLLARY 2: From (11), the markup $m_i^* = p_i^* - c_i$ is given by

$$m_i^* = \hat{\tau}\left(1 + \frac{3\beta\left((q_i - c_i) - (q_j - c_j)\right)}{9\beta\hat{\tau} - \omega^2}\right).$$

Hence, $m_i^* > m_j^*$ by the hypothesis. Plugging (7) into (1) yields

$$D_i(\boldsymbol{\theta}) = \frac{3\hat{\tau} + (\theta_i - \theta_j) - (c_i - c_j)}{6\hat{\tau}}.$$

Next, from (7),

$$m_i(\boldsymbol{\theta}) = \frac{3\hat{\tau} + (\theta_i - \theta_j) - (c_i - c_j)}{3},$$

implying that $m_i(\boldsymbol{\theta}) = 2\hat{\tau}D_i(\boldsymbol{\theta})$, which in turn implies that $D_i^* > D_j^*$. Further, $\pi_i(\boldsymbol{\theta}) = m_i(\boldsymbol{\theta})D_i(\boldsymbol{\theta})$, we have that $\pi_i^* > \pi_j^*$. Finally, as $\Pi_i(\mathbf{a}) = \pi_i(\mathbf{a}) - \beta a_i^2$, straightforward substitution from (10) yields

$$\Pi_i^* = \frac{1}{2}\left(k - \frac{\omega^2}{18\beta}\right)\left(1 + \frac{3\beta\left((q_i - c_i) - (q_j - c_j)\right)}{9k\beta - \omega^2}\right)^2.$$

From this we find

$$\Pi_i^* - \Pi_j^* = \frac{18k\beta - \omega^2}{3\left(9k\beta - \omega^2\right)}\left((q_i - c_i) - (q_j - c_j)\right)$$

and hence $\Pi_i^* > \Pi_j^*$ (recalling from Proposition 3 that $\beta > 1/6\hat{\tau}$). This completes the proof.

PROOF OF COROLLARY 3: Rewrite p_i^* as given in (10) as

$$p_i^* = \hat{\tau} + \frac{6\beta\hat{\tau}\omega}{\omega}\left(\frac{1}{6\beta} + \frac{(q_i - c_i) - (q_j - c_j)}{2\left(9\beta\hat{\tau} - \omega^2\right)}\right) - \hat{\tau} + c_i.$$

Substituting a_i^* from (11) into the preceding equation, we find that

$$p_i^* = \frac{6\beta\hat{\tau}a_i^*}{\omega} + c_i,$$

which implies a positive relationship between advertising and pricing. This completes the proof.

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