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Abstract

This paper studies the impact of consumer resistance, which is triggered by deviations from a psychological reference point, on optimal pricing and cost communication. Assuming that consumers evaluate purchases not only in the material domain, we show that consumer resistance reduces the pricing power and profit. We also show that consumer resistance provides an incentive to engage in cost communication when consumers underestimate cost. While cheap communication does not affect behavior, persuasive communication may increase sales and profit. Finally, we show that a firm can benefit from engaging in operational transparency by revealing information about features of the production process.

Keywords

Price Fairness, Cost Communication, Operational Transparency

JEL Classification

D9, L11, L21, M31

1 Introduction

Consumer resistance—the notion that some consumers do not purchase even though their valuation exceeds the price—is commonly observed. The literature offers several behavioral explanations for this phenomenon: unfair margins (Kahnemann, Knetsch and Thaler 1986a, b), price unfairness (Rabin 1993; Xia, Monroe and Cox 2004), inequity aversion (Fehr and Schmidt 1999; Bolton and Ockenfels 2000), anger at insufficient altruism on the part of the firm (Rotemberg 2008, 2011), and anti-profit beliefs (Bhattacharjee, Dana and Baron 2017). While these authors have focused on identifying the behavioral causes of consumer resistance, we provide a parsimonious framework for modeling behavioral consumer resistance and studying its effects on optimal pricing and cost communication by the firm.

We argue that consumer resistance limits the pricing power of the firm, but also creates an incentive for the firm to engage in cost transparency. The starting point of our analysis is the observation that consumers evaluate products (or services) not only in terms of their material value, but also in terms of their non-material value in the psychological domain, determined by deviations from a reference point that they have in mind (Köszegi and Rabin 2006).[1] Price changes by the firm thus have a dual impact: they affect the material value—the valuation net of price—as well as the deviation from the reference point and thereby the psychological loss. We develop a theoretical model in which a profit-maximizing firm chooses the price and (possibly) a cost message taking consumer resistance into account. Observing the price and the cost message, consumers decide to purchase or choose an outside option. Consumer resistance is therefore endogenously determined by the interplay of the choices made by the firm and by consumers.

We derive several key results. First, we show that consumer resistance reduces the optimal price and profit compared to standard monopoly when consumers know the unit

[1] We couch our analysis in terms of a reduced-form loss function that depends on variables that describe the outcome of the transaction (such as price, cost, and valuations). The loss function nests several commonly used reference points including reference prices, reference margins, and reference surplus shares.

cost of the firm. Intuitively, the psychological loss drives some consumers out of the market, which forces the firm to lower the price. A key driver of the price reduction is the sensitivity of the "generalized price"—the purchase price plus the loss in the psychological domain—in response to a change in the purchase price.[2] As a limiting result, we obtain that the optimal price can be forced down to cost if the generalized price is highly sensitive with respect to a change in the purchase price—a result that is reminiscent of the well-known Coase conjecture (Coase 1972).[3] Second, we show that firms have an incentive to communicate cost when consumers underestimate them. This incentive stems from the fact that consumers overestimate the loss and therefore purchase too little (which further reduces profit compared to standard monopoly). Third, we show that persuasive communication—whereby firms truthfully reveal verifiable cost information to consumers—increases profit if consumers underestimate cost in the absence of communication.[4] In the unraveling equilibrium, firms with high cost voluntarily provide cost information, whereas firms with low cost are forced to provide such information to distinguish themselves from firms that have even lower cost. Finally, we show that firms can benefit from engaging in operational transparency by revealing information about relevant features of the production process, such as labor standards or environmental standards, that often serve as a proxy for the production cost. Such operational transparency can be expected in markets where consumers have a strong concern about these features in the psychological domain.

These results contribute to the literature in several ways. First, we introduce the notion of consumer resistance into the behavioral pricing literature (Rabin 1993; Köszegi and Rabin 2006; Heidhues and Köszegi 2008). Consumer resistance captures any behavioral or psychological bias that involves a comparison to a reference point and induces consumers

[2]Our model encompasses standard pricing in the absence of psychological losses.

[3]Our result thus shows that consumer resistance may be strong enough to achieve the competitive outcome in a monopoly market. Intuitively, consumers then have all the market power and can force the firm to price at cost.

[4]Cheap communication about cost, in turn, cannot affect consumer behavior in equilibrium. The reason is that, for any price above cost, the firm always wants to send messages that induce consumers to purchase more.

not to purchase even when the valuation exceeds the price. Our analysis builds on the price fairness literature (Kahneman, Knetsch and Thaler 1986a, b; Xia, Monroe and Cox 2004; Anderson and Simester 2008) and shows how consumer resistance limits the pricing power of the firm. This is in line with recent work on anger at insufficient altruism by the firm (Rotemberg 2011), on inequity aversion in surplus division Guo (2015), and on markup aversion (Eyster, Madarasz and Michaillat 2017). We extend this line of research by allowing for consumer heterogeneity in valuations—and therefore heterogeneity in consumer resistance—and by allowing for generic reference points. Specifically, we allow for reference prices (Mazumdar, Raj and Sinha 2005, Krishna 2009), reference margins (Kahneman, Knetsch and Thaler 1986a, b), and reference surplus shares (Fehr and Schmidt 1999; Bolton and Ockenfels 2000), and generic reference production standards (e.g., "Made in America").

Second, we contribute to the recent literature on cost transparency (Jiang, Sudhir, and Zou 2016; Guo 2015) and operational transparency more broadly (Mohan, Buell, and John 2014; Buell, Kim and Tsay 2016) by clarifying the conditions under which firms communicate private cost information to consumers. We show that the possibility to engage in persuasive communication (Milgrom 2008) forces firms to reveal private cost information even if it reduces profit. Our analysis shows how pricing and communication convey relevant information to consumers.

Third, our paper adds to the literature on ultimatum games (Güth, Schmittberger and Schwarze 1982; Fehr and Schmidt 1999, Camerer 2003). This literature documents that individuals make more generous offers than standard theory predicts, and that they reject offers that they perceive as "unfair." We argue that the interaction between the firm and a consumer can be interpreted as an ultimatum game: By setting the price, the firm determines the fairness of the deal, which can be rejected by the consumer. We explicitly show how price offers translate into consumer resistance, which may induce consumers to reject offers even when their valuation exceeds the price.[5] In addition, when cost is private information, the size of the surplus is unknown to consumers. Therefore, cost communication can be used to inform consumers about the size of the surplus and influence their fairness perception.

The remainder of the paper is organized as follows. Section 2 introduces the model and defines the notion of consumer resistance. Section 3 studies optimal pricing in a monopoly setting where consumers know the production cost, and provides a reference price example to illustrate the impact of consumer resistance. Section 4 extends the pricing rule to a setting where consumers do not know cost, and shows how the firm can use persuasive communication to resolve the asymmetric information in the marketplace. Section 5 addresses operational transparency. Section 6 studies pricing with consumer resistance in a competitive market. Conclusions and directions for future research are provided in Section 7.

2 The model

We first introduce the decision-makers in our model: the firm and consumers. In particular, we explain how consumers evaluate products not only in terms of their material value, but also in terms of their non-material value in the psychological domain, determined by deviations from a reference point. Next, we characterize demand and show how such psychological losses lead to consumer resistance. Finally, we provide examples of common reference points that are nested into our framework.

2.1 The firm

We consider a monopoly firm that offers a product (or service) to consumers. The firm chooses the price p at which it sells the product. The constant unit cost to provide the

[5] We focus on selfish consumers who suffer from a loss when the outcome is worse than the reference outcome and ignore social preferences, whereby consumers suffer from guilt if the outcome is better than the reference outcome (Levine 1998, Fehr and Schmidt 1999; Sobel 2005).

product is denoted by $c \geq 0$. The fixed costs of operation are normalized to zero as they do not affect the choice of the price.

2.2 Consumers

There is a unit measure of consumers who have raw valuation v for the product that is private knowledge and independently distributed across consumers over the interval $[0, \infty)$ according to the cumulative distribution function $F(v)$ with density $f(v)$. Consumers know the unit cost c and care not only about the material value $v - p$ from purchasing the product, but also the non-material dimension of the transaction. Specifically, we assume that consumers compare the outcome of the transaction $x \in \mathbb{R}_+$ to an exogenous reference point $\bar{x} \in \mathbb{R}_+$ in the psychological domain.[6] We introduce the following definition:

Definition 1. *Let $\Delta x \equiv x - \bar{x}$ denote the deviation of the outcome of the transaction x from the reference point $\bar{x}$ in the psychological domain.*

For ease of exposition, Definition 1 suppresses the dependence on the variables that determine the outcome of the transaction. In general, x is a summary statistic that depends on the firm's price and cost, and on the consumer's raw valuation, so that $x(p; c, v)$ and $\Delta x(p; c, v, \bar{x})$ (we will consider specific functional forms below). Note that there is consumer heterogeneity in deviations from the reference point if Δx is a function of the raw valuation v, which is distributed according to $F(v)$.

We assume that consumers may suffer from a psychological loss if the outcome of the transaction deviates from the reference point. The loss function is given by

$$L(\Delta x, \lambda) \tag{1}$$

where $\lambda \geq 0$ is a dissatisfaction parameter that translates deviations from the reference point Δx in the psychological domain into the associated (monetary) losses L. We impose the following assumption.

[6]For instance, consumers may evaluate the purchase of a product based both on the price and the difference to some reference price.

Assumption 1. *The loss function satisfies*

(i) $L(\Delta x, \lambda) > 0$ *for* $\Delta x > 0$ *and* $\lambda > 0$*,*

(ii) $L(\Delta x, \lambda) = 0$ *for* $\Delta x \leq 0$ *and all* λ*, and* $L(\Delta x, 0) = 0$ *for all* Δx*,*

(iii) $L_{\Delta x}(\Delta x, \lambda) \geq 0$ *and* $L_{\lambda}(\Delta x, \lambda) \geq 0$ *for all* Δx *and* λ*, and*

(iv) $\frac{\partial}{\partial v}(v - L(\Delta x, \lambda)) = 1 - L_{\Delta x}(\Delta x, \lambda)\frac{\partial \Delta x}{\partial v} > 0$ *for all* Δx *and* λ*.*

Assumption 1 assures that (i) consumers suffer from a loss if there is a costly deviation of the outcome from the reference point, (ii) that there is no loss if either $\Delta x \leq 0$ or $\lambda = 0$, (iii) that the loss increases in Δx and λ, respectively, and (iv) that the net valuation $v - L$ is increasing in v. Intuitively, for $\lambda > 0$ there is a costly deviation from the reference point if $x > \bar{x}$, which means that consumers prefer the reference outcome $\bar{x}$ over the actual outcome x (i.e., $\bar{x} \succ x$). Assumption 1 mirrors loss aversion in that unfavourable deviations from the reference point weigh more heavily than comparable favourable deviations (Tversky and Kahneman 1991; Rabin and Köszegi 2006). Note that we focus—in line with the marketing and economics literature—on consumer heterogeneity in net valuations (allowing for negative and positive correlation between raw valuation and losses), but abstract from heterogeneity in reference points. To simplify exposition, we introduce the following definition:

Definition 2. *For* $y \in \{p, c, v, \bar{x}\}$*, let* $L_y \equiv L_{\Delta x}\frac{\partial \Delta x}{\partial y}$ *denote the derivative of the loss function with respect to* y*.*

Finally, a consumer's indirect utility function is given by

$$V(p) = \max\{v - p - L(\Delta x, \lambda), 0\},$$

where $v - p - L$ is the utility when purchasing the product at price p, while the utility of the outside option is normalized to zero. Intuitively, a consumer purchases when the raw valuation v exceeds the "generalized price" $p + L(\Delta x, \lambda)$, the sum of the purchase price and the monetary loss associated with the purchase.

2.3 Timeline

The firm and the consumers play the following game: In the first stage, the firm sets the price p knowing the distribution of consumer types $F(v)$ and the loss function $L(\Delta x, \lambda)$ (from market research). In the second stage, consumers make their purchase decision based on the price p. Note that the timing is the same as in standard "ultimatum games," where proposers offer a deal that can be rejected by the respondents (Camerer 2003).

2.4 Demand

Consumers with a raw valuation v that exceeds the generalized price $p + L(\Delta x, \lambda)$ purchase the product. Assumption 1 implies that the raw valuation of the consumer who is indifferent between purchasing and choosing the outside option $\bar{v}(p)$ is uniquely defined by the indifference condition

$$\bar{v}(p) = p + L(\Delta x, \lambda). \tag{2}$$

The cutoff $\bar{v}(p)$ depends on p (and all other variables that determine the outcome of the transaction) and satisfies $\bar{v}(p) > p$ if some consumers suffer from a loss at the given purchase price p. We introduce the following definition.

Definition 3. *Consumer resistance occurs if and only if the cutoff $\bar{v}$ strictly exceeds the price p, that is, $\bar{v}(p) > p$.*

Definition 3 implies that consumers with raw valuations $v \in [p, \bar{v}(p)]$ do not purchase at the given price p—even when they should do so from a purely material perspective. Consumer resistance therefore means that some consumers drop out of the market due to psychological losses that raise the generalized price above the purchase price. Note that consumer resistance cannot occur when consumers care only about the material value of the transaction, in which case the cutoff satisfies $\bar{v}(p) = p$ due to the absence of psychological losses associated with the purchase.[7]

[7] There is an interesting parallel to the mechanics of Coasian dynamics (Hart and Tirole 1988), where the cutoff exceeds the price when strategic consumers do not buy because they anticipate lower prices in

The demand for the product follows from summing up purchases across consumers at the given price p:

$$D(p) = \int_{\bar{v}(p)}^{\infty} dF(v) = 1 - F(\bar{v}(p)). \tag{3}$$

To put additional structure on demand, we impose the following assumption:

Assumption 2. *The demand function $D(p) = 1 - F(\bar{v}(p))$ is log-concave.*

Assumption 2 is standard and implies that the revenue function is "well-behaved" (the assumption includes a concave revenue function as a special case). We derive the following result (the proof of this and all other results is relegated to the Appendix).

Lemma 1. *Suppose Assumptions 1 and 2 hold, and in addition that $L_p \geq 0$. Then, demand is downward sloping and, at any given price p, consumer resistance increases the price elasticity of demand $\varepsilon(p) \equiv -\frac{pD'(p)}{D(p)}$.*

To understand the intuition for Lemma 1, observe that an increase in price has two effects. First, consumer resistance increases the generalized price and must therefore increase the price elasticity of demand because of log-concavity (this is the standard effect of increasing the cutoff). Second, a higher price may also increase the loss (because $L_p \geq 0$), which provides a new channel for the price to affect demand.[8]

2.5 Common examples of reference points

So far, we have been agnostic about the consumers' choice of the relevant reference point. We now want to illustrate that the reduced-form loss function $L(\Delta x, \lambda)$ nests several commonly used reference points into our analysis. The common feature of these examples is that consumers suffer from a loss if the firm's profit is perceived as "too high."[9]

the future. Here, the cutoff exceeds the price because consumers suffer from losses in the non-material dimension of the transaction.

[8] Anderson and Simester (2008) empirically identify such a channel and show that fairness concerns make demand more elastic.

[9] Of course, there may be other reasons for consumer resistance. For instance, consumers may suffer from a psychological loss if the production process violates ethical norms. We address this issue in Section 5.

Reference price. If consumers compare the price p to some reference price $\bar{p}$ (e.g., a suggested retail price), the deviation from the reference point is given by $\Delta x \equiv p - \bar{p}$, and they suffer from a loss if the price exceeds $\bar{p}$. Various models of reference prices have been studied in the marketing literature (see Mazumdar, Raj and Sinha 2005 for a survey) and the industrial organization literature (Spiegler 2011; Puppe and Rosenkranz 2011; Buehler and Gaertner 2013; Fabrizi et al. 2016, Lubensky 2017).

Reference margin. If consumers compare the firm's (profit) margin m to some reference margin $\bar{m}$, the deviation from the reference point is given by $\Delta x \equiv m - \bar{m}$, and they suffer from a loss if the margin exceeds $\bar{m}$. This notion builds on the seminal work of Kahnemann, Knetsch, and Thaler (1986a), who show that consumers dislike paying prices above a fair markup over marginal cost, a robust psychological phenomenon (Eyster, Madarasz and Michaillat 2017). Alternatively, $\bar{m}$ could be interpreted as an "anger threshold" (Rotemberg 2005, 2008) that triggers consumer resistance. We consider two common measures for the profit margin in the context of cost-plus pricing:

(i) *Absolute margin*. In this case, consumers compare the absolute markup $m \equiv p - c$ to the reference point $\bar{m}$.

(ii) *Percentage margin*: In this case, consumers compare the percentage markup over cost $m \equiv \frac{p-c}{c}$ to the reference point $\bar{m}$.[10]

Reference surplus share. If consumers compare the firm's surplus share $s \equiv \frac{p-c}{v-c}$ to some reference share $\bar{s} \in [0,1]$, the deviation from the reference point is given by $\Delta x \equiv s - \bar{s}$, and they suffer from a loss if the share exceeds $\bar{s}$. Clearly, this is equivalent to a setting in which consumers feel entitled to a surplus share of at least $1 - \bar{s}$ (cf. Kahnemann, Knetsch, and Thaler 1986a, b). Note that our framework allows for arbitrary reference shares $\bar{s}$ and $1 - \bar{s}$ and thus nests settings with inequality aversion (Fehr and Schmidt 1999; Bolton and Ockenfels 2000; Guo 2015) that focus on an egalitarian reference point.

[10] Alternatively, one could assume that consumers compare the percentage markup over price $m \equiv \frac{p-c}{p}$, the so-called "Lerner index," to some reference point. Consumers then judge whether the margin as a fraction of price is "appropriate."

These common examples illustrate that there are several reasons why consumers resist purchases that they should accept based on material considerations alone: consumer resistance may be triggered by "excessively high prices," by "excessively high margins," or by "excessively high surplus shares" appropriated by the firm. The following result holds:

Lemma 2. *For a given raw valuation v, the consumers' reference points regarding the price $\bar{p}$, the margin $\bar{m}$, and the surplus share $\bar{s}$ may represent the same consumer entitlement to profit.*

Lemma 2 shows that the different reference points reflect the same entitlement by the consumers to value created by the transaction—and thus to firm profit (Kahnemann, Knetsch, and Thaler 1986a, b). However, the three examples differ in an important way: in contrast to the reference price, reference markups and reference surplus shares require consumers to have cost information. This suggests a natural role for cost communication when costs are private information of the firm, an issue that we address in Section 4 below.

3 Pricing under full information

This section studies optimal pricing when consumers know the unit cost—our benchmark case. We first study optimal pricing and point out incentives to shape consumer resistance. Next, the optimal pricing rule is illustrated using a reference price example.

3.1 Optimal pricing

The firm chooses the price by maximizing profit subject to the participation constraint and therefore solves

$$\max_{p} \quad \pi(p) = \int_{\bar{v}(p)}^{\infty} (p-c)dF(v) = (p-c)\left[1-F(\bar{v}(p))\right].$$

Assumption 2 implies that $\pi(p)$ is strictly quasi-concave, which ensures the existence of a unique global maximizer of $\pi(p)$ (Caplin and Nalebuff 1990). The necessary and sufficient first-order condition for profit maximization is

$$1 - F(\bar{v}(p^*)) - (p^* - c) f(\bar{v}(p^*)) \bar{v}_p(p^*) = 0. \tag{4}$$

This first-order condition has an intuitive interpretation. A marginal increase in the price p directly increases profit by $1 - F(\bar{v}(p))$. The resulting revenue reduction from the inframarginal units is distorted by the factor $\bar{v}_p(p)$, which captures the change in the cutoff in response to a marginal increase in p: Raising the price affects the loss $L(\Delta x(p), \lambda)$ and thus $\bar{v}(p)$, which also distorts the direct effect of a price change on consumer demand. We derive the following result.

Proposition 1. *Suppose Assumptions 1 and 2 hold, and in addition that $\bar{v}_p(p^*) \geq 1$. Then, the optimal monopoly price p^* satisfies*

$$p^* = c + \frac{1 - F(\bar{v}(p^*))}{f(\bar{v}(p^*)) \bar{v}_p(p^*)},$$

and consumer resistance forces the optimal price and profit down compared to standard monopoly.

Proposition 1 shows how consumer resistance affects the optimal price. The key difference to the standard monopoly price is the factor $\bar{v}_p(p) = \frac{1+L_p}{1-L_v} \geq 1$, which implies that the generalized price must increase at least as much as the price itself (due to the loss). Intuitively, this means that an increase in price cannot reduce consumer resistance.[11] Proposition 1 also shows that consumer resistance reduces both price and profit. The lower price results as the firm is limited in its ability to extract surplus from consumers who suffer from a psychological loss when they purchase at p^*. While the price goes down relative to standard monopoly, the generalized price increases, which in turn reduces demand and profit. The next result is an implication of Proposition 1:

[11] Note that the case $\bar{v}_p = 1$ represents either the standard monopoly with $L_p = L_v = 0$ or the case where the loss function satisfies $L_p = -L_v$.

Corollary 1. *Consumer resistance may force the firm to set price at cost and leave the entire surplus to consumers.*

Thus result is unexpected in a monopoly market: Corollary 1 shows that, even though the monopolist can make take-it-or-leave-it offers to consumers, it does not have any market power (i.e., it cannot raise the price above cost): consumers can appropriate the total surplus when deviations from the reference point c are extremely costly ($\lambda \to \infty$). Such preferences make demand perfectly elastic ($\bar{v}_p(p^*) \to \infty$) and thus force the firm to sell at cost—a result similar to the Coase conjecture (Coase 1972). Corollary 1 provides a behavioral explanation for pricing patterns in digital markets, where it is often a good approximation to assume that $c = 0$: Consumer resistance may then drive the price down to zero—the "culture of free."

3.2 Shaping consumer resistance

The reference point $\bar{x}$ and the dissatisfaction parameter λ are key determinants of the loss and therefore consumer resistance. Specifically, we assume that the loss is decreasing in $\bar{x}$ ($L_{\bar{x}} \leq 0$)—which means that an increase in the reference point makes a consumer happier (à la Köszegi and Rabin 2006)—and increasing in λ ($L_\lambda \geq 0$), which means that a given deviation from the reference point translates into a higher monetary loss. This suggests that the firm has an incentive to influence consumer resistance by increasing $\bar{x}$ and decreasing λ to boost sales and profit, which is consistent with the observation that companies often downplay the negative impact of their activities—both in production and consumption—on the environment.[12] In turn, consumer protection agencies are motivated to strengthen consumer resistance to limit the pricing power of the firm. This fundamental tension between firm and consumer interests gives rise to competition for the minds of consumers.[13]

[12]For instance, Exxon Mobil has been accused of misleading consumers about the risks of climate change (Schwartz 2017).

[13]This tension is best perhaps best illustrated in the reference price example: the firm would like the reference price in the minds of consumers to be high, whereas the consumer protection agency has the opposite interest.

The exogenous reference point $\bar{x}$ and the dissatisfaction parameter λ can be viewed as characterizing the outcome of such a battle for the minds of consumers. To endogenize these parameters of the loss function, one could assume that a firm and a consumer protection agency engage in a contest in which the probability of winning the minds of consumers is a function of efforts exerted. The winning party determines $\bar{x}$ and λ, and therefore consumer resistance in the subsequent pricing game.

3.3 Reference price example

Consider a market in which consumers suffer from a psychological loss if the price p exceeds the reference price $\bar{p}$. The loss function is given by

$$L(\Delta x, \lambda) = \max\{0, \lambda(p - \bar{p})\},$$

which satisfies Assumption 1.[14] We assume that the raw valuation v is uniformly distributed over the interval $[0,1]$, so that demand is given by

$$D(p) = 1 - (p + \max\{0, \lambda(p - \bar{p})\}).$$

The next result illustrates the impact of the reference price on optimal pricing.

Corollary 2. *Suppose that the reference price satisfies $\bar{p} < \frac{1+c}{2}$. Then, there is consumer resistance, and the optimal price p^* is given by*

$$p^* = \frac{1 + c + \lambda(c + \bar{p})}{2(1+\lambda)}.$$

When the reference price is $\bar{p} \equiv c$ and consumers suffer from a large disutility if $p > c$ ($\lambda \to \infty$), then the firm is forced to price at cost, that is, set $p^* = c$. Instead, if $\bar{p} \geq \frac{1+c}{2}$, it is optimal to set the standard monopoly price $p^m = \frac{1+c}{2}$.

To intuitively understand this result, note that the reference price $\bar{p}$ has no impact on pricing if it exceeds the standard monopoly price p^m as consumers do not suffer from a

[14] This specification has been extensively used in the behavioral industrial organization literature. See Spiegler (2011) for a comprehensive survey.

loss. Corollary 2 provides three insights: First, consumer resistance distorts p^* downward relative to the standard monopoly price:

$$p^* - p^m = \frac{\lambda(\bar{p}-1)}{2(1+\lambda)} \leq 0.$$

Clearly, there is no distortion if deviations from the reference point do not matter, that is, if $\lambda = 0$. Note that a low reference price limits the pricing power of the firm: the price reduction is higher when the reference price is lower.[15] Second, ignoring consumer resistance leads to market failure if $p^m \geq 1 - L^*$, where $1 - L^*$ is the highest net valuation in the market given p^*. Put differently, if managers do not take consumer resistance into account, sales may be zero when the product is sold at p^m instead of p^*. Third, reference price comparisons act as a competitive constraint and force the price down to cost when deviations from the reference point are extremely costly ($\lambda \to \infty$).[16]

4 Dealing with unknown cost

This section considers the setting in which the firm has private information about cost c. Consumers are risk-neutral and must form a belief about cost. We study three scenarios: no communication, cheap communication (that may or may not be truthful), and persuasive communication (that is truthful and verifiable).

4.1 No communication

In the absence of communication about cost, the firm's only move is to set the price, which is observed by consumers who then make their purchase decisions. A perfect Bayesian equilibrium of the game between the firm and consumers consists of the following:

1. Firm strategy: Profit-maximizing choice of the price p conditional on the true cost level c.

[15]Low (internal or external) reference prices are thus to the detriment of the firm.

[16]This analysis shows that fairness considerations indeed put a constraint on profit seeking (Kahneman, Knetsch and Tversky 1986a): If $m = p - c$ and $L(\Delta x, \lambda) = \max\{0, \lambda(m - \bar{m})\}$, the optimal price is forced down to cost if $\bar{m} = 0$, that is, if consumers feel entitled to the total surplus created by the transaction. Note that the implicit "reference price" is in this case given by $\bar{p} = c + \bar{m}$.

2. Consumers' strategy: Utility-maximizing purchase decision conditional on the price p.
3. Consumers' belief: The posterior belief $\mu(c|p) = \int_0^p cz(c|p)dc$ is derived from the prior $\mu(c) = \int_0^\infty cz(c)dc$ and the price p using Bayes' rule (when applicable).

Note that the posterior belief $\mu(c|p)$ is a conditional expectation of c that sums up (density-weighted) cost levels after having observed the price p.[17] Importantly, $\mu(c|p)$ rules out cost levels that exceed the observed price, because such beliefs would be inconsistent with profit maximization by the firm. Given the posterior belief $\mu(c|p)$, the cutoff satisfies $\hat{v}(p) = p + L(\Delta x(p;\mu(c|p),\lambda)$. For later reference, we let $L_\mu \equiv L_{\Delta x}\frac{\partial \Delta x}{\partial \mu}$ denote the derivative of the loss function with respect to the belief μ. In equilibrium, only consumers with types $v \geq \hat{v}(p)$ purchase.

The firm chooses the price to maximize profit subject to the participation constraint and therefore solves

$$\max_p \quad \pi(p) = \int_{\hat{v}(p)}^{\infty} (p-c)dF(v) = (p-c)[1-F(\hat{v}(p)].$$

We derive the following result.

Proposition 2. *Suppose Assumptions 1 and 2 hold, and in addition that $L_\mu \leq 0$. Then, in perfect Bayesian equilibrium, (i) the optimal price p° satisfies*

$$p^\circ = c + \frac{1-F(\hat{v}(p^\circ))}{f(\hat{v}(p^\circ))\hat{v}_p(p^\circ)}$$

and coincides with the optimal price p^* under full information if consumers have correct point beliefs about cost; and (ii) if consumers underestimate (overestimate) cost, profit is lower (higher) than in the benchmark case with full information.

Proposition 2 shows that the structure of the pricing rule carries over the case where consumers do not know the cost. The difference is that the posterior belief $\mu(c|p)$ depends on p and generally differs from the true cost level, which affects $\hat{v}(p^\circ)$ and $\hat{v}_p(p^\circ)$.

[17] Throughout, we focus on interesting cases where Bayes' rule allows us to pin down posterior beliefs.

Therefore, if consumers have correct point beliefs about c, the optimal price p° must coincide with p^* in the benchmark case.[18]

Proposition 2 also shows that profit is lower than in the benchmark case if consumers underestimate cost. Intuitively, consumers overestimate the loss and therefore purchase too little, which reduces profit. This result has an important implication: When consumers underestimate cost, the firm has an incentive to communicate this to consumers. In contrast, if consumers overestimate cost, the firm can benefit from the distorted beliefs.

4.2 Cheap communication

With cheap communication, the firm not only sets the price p, but also sends a message $\tilde{c}$ about the unit cost c to consumers. Communication is cheap because the cost message is costless, non-verifiable, and possibly non-truthful. A perfect Bayesian equilibrium consists of the following:

1. Firm strategy: Profit-maximizing choice of the price p and the message $\tilde{c}$ conditional on the true cost level c.
2. Consumers' strategy: Utility-maximizing purchase decision conditional on the price p and the message $\tilde{c}$.
3. Consumers' belief: The posterior belief $\mu(c|p,\tilde{c}) = \int_0^p c\,z(c|\,p,\tilde{c})dc$ is derived from the prior $\mu(c) = \int_0^\infty cz(c)dc$, the price p, and the message $\tilde{c}$ using Bayes rule (when applicable).

We derive the following result.

Proposition 3. *Suppose Assumptions 1 and 2 hold, and in addition that $L_\mu \leq 0$. Then, there exists a babbling equilibrium in which the cost message $\tilde{c}$ is ignored by consumers and the optimal price is set at p°, as in the case absent communication.*

[18] This is perhaps best illustrated if consumers know the true distribution $F(v)$, in which case they can infer c from observing p by solving the firm's optimization problem. In this case, the conditional probability density function $z(c|p)$ is degenerate and has point measure at c. Instead, if consumers do not know the true distribution $F(v)$, they must attach a probability weight to each possible $F(v)$, infer the corresponding cost, and form the conditional expectation $\mu(c|p)$ from the inferred cost levels.

Proposition 3 is intuitive: If a change in the message $\tilde{c}$ were able to change the belief and thereby demand, the firm would always want to overstate cost, as profit is increasing in demand (conditional on p and c). Consequently, in equilibrium consumers must ignore cheap cost messages and make purchase decisions based solely on the posterior belief $\mu(c|p)$, as in the case absent communication.[19]

4.3 Persuasive communication

With persuasive communication, the firm not only sets the price p, but may also send a truthful and verifiable message $\hat{c}$ about the unit cost c to consumers (Milgrom 2008). Whenever the firm sends a message, it therefore discloses the true cost level.[20] The assumption that cost messages are truthful seems plausible: costs are verifiable and therefore the firm cannot make manifestly false public statements about its cost.[21] A perfect Bayesian equilibrium consists of the following:

1. Firm strategy: Profit-maximizing choice of the price p and the message $\hat{c} \in \{c, \emptyset\}$ conditional on the true cost level c.
2. Consumers' strategy: Utility-maximizing purchase decision conditional on the price p and the message $\hat{c}$.
3. Consumers' belief: The posterior belief $\mu(c|p,\hat{c}) = \int_0^p c z(c|p,\hat{c}) dc$ is derived from the prior $\mu(c) = \int_0^\infty cz(c)dc$, the price p, and the message $\hat{c}$ using Bayes rule (when applicable).

We derive the following result.

Proposition 4. *Suppose Assumptions 1 and 2 hold, and in addition that $L_\mu \leq 0$. Then, there is an unraveling equilibrium in which the firm benefits (suffers) from cost disclosure when consumers underestimate (overestimate) its cost.*

[19] The firm can of course choose to remain silent about its cost level, which does not affect the result.

[20] The firm can also choose not to disclose cost. In contrast to the setting with cheap communication, the firm's decision not to disclose cost contains information and triggers consumer skepticism.

[21] Obviously, if there are no legal or other institutions that sanction the firm for false statements, communication is necessarily cheap.

Proposition 4 shows that the firm always discloses its cost in equilibrium. While a firm that benefits from disclosure voluntarily engages in communication, a firm that suffers from disclosure is forced to reveal its cost because of consumer resistance. Intuitively, when consumers overestimate cost, the firm is forced to disclose its cost even though it reduces profit: if it were silent, skepticism would induce consumers to revise their belief downward until it becomes profitable for the firm to disclose its cost and distinguish itself from firms with even lower cost.

5 Operational transparency

So far, we have focused on settings in which the firm sends a message about the cost of production. However, in many markets firms have recently started to send messages that disclose features of their production process (Mohan, Buell, and John 2014; Buell, Kim and Tsay 2016). Often times, these messages serve as a proxy for cost: labor standards (child labor, workplace safety), environmental standards (carbon footprint, waste management), or more generally, production standards ("Made in America," protected origin labels). To capture this phenomenon, we introduce the index $\xi > 0$ that reflects the quality of the production process. If quality encompasses multiple dimensions, ξ should be interpreted as a real-valued index summarizing the various aspects of quality.[22] Specifically, we assume that the unit cost is $c(\xi)$, where $c'(\xi) > 0$ reflects that a higher quality of the production process increases unit cost.

If a firm can send a truthful and verifiable message $\tilde{\xi}$ about the quality of the production process, the consumers' posterior belief about cost is given by $\mu(c|p, \tilde{\xi})$. The following result holds.

Proposition 5. *Suppose Assumptions 1 and 2 hold, and in addition that $L_\mu \leq 0$. Then, there is an unraveling equilibrium in which the firm engages in operational transparency about the quality of the production process.*

[22] We allow that ξ affects the net valuation $v - L$, but abstract from influences of the quality of the production process on the consumers' raw valuation of the product.

This result shows that firms communicate about the features of the production process in markets where consumers have a strong concern about them in the psychological domain.[23]

6 Competitive markets

Up to now, we have assumed that there is a single firm in the market. In this section, we relax this assumption to study how consumer resistance affect the optimal prices and profits when consumers can choose among competitive offerings.

To capture a competitive environment, we consider two firms $i = 1,2$ that produce vertically differentiated products. The unit cost of firm i is $c_i \geq 0$ and product quality is $s_i \geq 0$. We assume that product 2 is the high-quality product ($s_2 > s_1$) and that it is sold at a higher generalized price ($p_2 + L_2 > p_1 + L_1$). The latter assumption is natural, as otherwise the low-quality product would be perceived as the more expensive one and therefore never purchased. There is a unit measure of consumers who have valuation of quality θ that is private knowledge and distributed according to $G(\theta)$ with density $g(\theta)$. We derive the following result.

Proposition 6. *Suppose Assumption 1 holds, and in addition that $g'(\theta) \geq 0$. Then, consumer resistance forces the optimal prices and profits down compared to standard duopoly.*

Proposition 6 shows that consumer resistance puts downward pressure on price under competition if $g'(\theta) \geq 0$. Intuitively, this requires that the number of consumers with high raw valuation is increasing in θ.[24]

[23] A prominent quality feature in digital markets is how firms handle and use consumer data, and more generally, the terms of service. Violations of privacy can lead to "consumer backlash" (Acquisti, Taylor and Wagman 2016).

[24] Assuming $g'(\theta) \geq 0$ is more stringent than imposing log-concavity of demand, which is not strong enough to assess the impact of consumer entitlement on the price of the low-quality firm.

7 Conclusion

We have analyzed how consumer resistance affects optimal pricing and communication. Assuming that consumers resistance is generated by deviations from a psychological reference point, we have derived the following key results.

First, consumer resistance reduces the optimal price and profit compared to standard monopoly when consumers know the firm's unit cost. Second, the firm has an incentive to engage in cost communication when consumers underestimate its cost, because they then overestimate their psychological losses and therefore purchase too little. Third, while cheap communication cannot influence consumer behavior, persuasive cost communication may increase a firm's sales and profit. Finally, a firm can benefit from engaging in operational transparency regarding features of the production process that consumers have a strong concern for.

Our analysis suggests several avenues for future research. First, one could generalize our analysis to a fully dynamic setting and explore how consumer resistance interacts with the incentive of sophisticated consumers to wait for lower prices in the future. Second, one could extend the analysis to allow for communication by competing firms and explore the relations to the analysis of information exchange. Third, it would be interesting to further examine the extent to which the logic of consumer resistance applies to instances of consumer backlash in digital markets. We hope to address these issues in future research.

Appendix

Proof of Lemma 1. First we show that demand is downward-sloping. Differentiating demand with respect to p yields

$$D'(p) = -f(\bar{v}(p))\bar{v}_p(p),$$

with

$$\bar{v}_p(p) = \frac{1+L_p}{1-L_v}$$

where $\bar{v}(p)$ follows from applying the implicit function theorem to the indifference condition in (2). Since $L_p \geq 0$ (as $L_{\Delta x} \geq 0$) and $1 - L_v > 0$ (by Assumption 1), we have that $\bar{v}_p(p) > 0$ and thus that $D'(p) < 0$.

Next, the price elasticity of demand can be written as

$$\varepsilon(p) = -\frac{pD'(p)}{D(p)} = \frac{pf(\bar{v}(p))}{1 - F(\bar{v}(p))} + \frac{pf(\bar{v}(p))L_p}{1 - F(\bar{v}(p))}.$$

The first term on the r.h.s. is positive and non-decreasing due to the log-concavity of demand (Assumption 2). The second term is positive as $L_p \geq 0$. Consequently, consumer resistance opens up a new channel that increases the price elasticity of demand. □

Proof of Lemma 2. Fix the valuation v and suppose that a consumer feels entitled to a share $1 - \bar{s}$ of the surplus created by the transaction. Equivalently, this means that the consumer views the share $\bar{s}$ as an upper limit of the surplus share that accrues to the firm. Thus, the consumer suffers from a loss if

$$\frac{p - c}{v - c} \geq \bar{s}.$$

Expressed in terms of the absolute margin, the consumer suffers from a loss if

$$p - c \geq \bar{s}(v - c) \equiv \bar{m}_a,$$

or, equivalently, if the percentage margin satisfies

$$\frac{p - c}{c} \geq \frac{\bar{s}(v - c)}{c} \equiv \bar{m}_p.$$

In terms of price, the consumer suffers from a loss if

$$p \geq c + \bar{s}(v - c) \equiv \bar{p}.$$

Consequently, the reference points regarding the price $\bar{p}$, the margin $\bar{m}$, and the surplus share $\bar{s}$ express the same underlying entitlement to firm profit. □

Proof of Proposition 1. The optimal price p^* follows from rearranging the first-order condition (4). Now suppose, contrary to the assumption, that $L > 0$ and $p^* \geq p^m$, where p^m is the standard monopoly price satisfying

$$p^m = c + \frac{1 - F(p^m)}{f(p^m)}$$

(note that this corresponds to the case where $\bar{v}_p = 1$). Since $L > 0$ by assumption, it follows that $\bar{v}(p^*) > p^*$, and therefore that $\bar{v}(p^*) > p^m$ (as $p^* \geq p^m$). Next, log-concavity of $1-F$ implies that the Mills ratio $\frac{1-F(v)}{f(v)}$ is non-increasing in v. Taken together, this implies

$$p^* = c + \frac{1-F(\bar{v}(p^*))}{f(\bar{v}(p^*))\bar{v}_p(p^*)} < c + \frac{1-F(p^m)}{f(p^m)} = p^m,$$

a contradiction. Profit decreases as both price and demand decreases. □

Proof of Corollary 1. The result immediately follows from Proposition 1 if $\bar{v}_p(p^*) \to \infty$, which makes demand perfectly elastic and thus forces the firm to sell at cost. □

Proof of Corollary 2. Note that the uniform assumption implies that $F(\bar{v}(p)) = \bar{v}(p)$. The generalized price follows from the indifference condition in (2) and is given by $\bar{v}(p) = p + \max\{0, \lambda(p-\bar{p}\}$. Hence the profit function is

$$\max_p \quad \pi(p) = (p-c)\left[1-(p+\max\{0,\lambda(p-\bar{p})\})\right].$$

There are two cases. First, note that the reference price does not bind when it exceeds the standard monopoly price p^m, which solves $\max_p \pi(p) = (p-c)(1-p)$ and is given by $p^m = \frac{1+c}{2}$. Second, there is consumer resistance if $\bar{p} < p^m$. In this case, the optimal price is characterized by the first-order condition (4):

$$1-\bar{v}(p^*)-(p^*-c)\bar{v}_p(p^*) = 0.$$

Substituting for $\bar{v}(p^*)$ and $\bar{v}_p(p^*) = 1+\lambda$, and solving immediately yields

$$p^* = \frac{1+c+\lambda(c+\bar{p})}{2(1+\lambda)}.$$

The comparative statics properties are straightforward and therefore omitted. Note that the loss evaluated at the optimal price p^* is given by

$$L^* = \lambda(p^*-\bar{p}) = \frac{\lambda^2(\bar{p}-1)}{2(1+\lambda)}.$$

The highest net valuation in the market is therefore $1-L^*$. Clearly, there are zero sales for prices above this level. □

Proof of Proposition 2. (i) The optimal price p° satisfies the first-order condition

$$1 - F(\hat{v}(p^\circ) - (p^\circ - c)f(\hat{v}(p^\circ))\hat{v}_p(p^\circ) = 0, \tag{A.1}$$

Applying the implicit function theorem to the indifference condition, it follows that

$$\hat{v}_p(p) = \frac{1 + L_p + \mu_p L_\mu}{1 - L_v}.$$

With correct point beliefs, we have that $\mu(c|p) = c$ and thus $\mu_p = 0$ by assumption, which implies that the first-order condition (A.1) is equivalent to (4). (ii) In equilibrium, consumers underestimate cost if $\mu(c|p^\circ) < c$. Since $L_\mu \leq 0$ by assumption, this implies that $L(\Delta x(p^\circ;\mu)) \geq L(\Delta x(p^\circ;c))$, and therefore that $p^\circ + L(\Delta x(p^\circ;\mu)) \geq p^\circ + L(\Delta x(p^\circ;c))$. Consequently, we have that $\hat{v}(p^\circ) \geq \bar{v}(p^\circ)$, which means that incorrect beliefs reduce sales at p°. Thus,

$$\begin{aligned}
\pi(p^\circ) &\equiv (p^\circ - c)[1 - F(\hat{v}(p^\circ))] \\
&\leq (p^\circ - c)[1 - F(\bar{v}(p^\circ))] \\
&\leq (p^* - c)[1 - F(\bar{v}(p^*))] \\
&\equiv \pi(p^*)
\end{aligned}$$

by optimality of p^*. Instead, consumers overestimate cost if $\mu(c|p^\circ) > c$. Using that $L_\mu \leq 0$, we know that $p + L(\Delta x(p;\mu)) \leq p + L(\Delta x(p;c))$ for any p, and in particular for $p = p^*$. Consequently, we have that $\hat{v}(p^*) \leq \bar{v}(p^*)$, which means that incorrect beliefs increase sales and profits at p^*. A fortiori, since the firm can choose the price in equilibrium, $\pi(p^\circ) \geq \pi(p^*)$. □

Proof of Proposition 3. If consumers do not know cost and receive the cost message $\tilde{c}$, the loss function is given by $L(\Delta x(p;\mu)$. Applying the implicit function theorem to the indifference condition yields

$$\hat{v}_{\tilde{c}}(p) = \frac{\mu_{\tilde{c}} L_\mu}{1 - L_v}.$$

Equilibrium requires that changes in $\tilde{c}$ do not affect sales, and hence that $\hat{v}_{\tilde{c}}(p) = 0$. Consequently, we must have $\mu_{\tilde{c}} = 0$, which means that in equilibrium the consumer belief is not allowed do depend on the message sent by the firm. The optimal price is therefore characterized by Proposition 2. □

Proof of Proposition 4. The firm has two options: to disclose cost or to remain silent. First, consider the case where the firm discloses c. Hence, consumers form correct point beliefs

$\mu(c|p,c) = c$. It is then immediate that only consumers with $v \geq \bar{v}(p)$ purchase, where the cutoff $\bar{v}(p)$ satisfies equation (2), the threshold under full information. The optimal price (and profit) is therefore characterized by Proposition 1.

Second, consider the case where the firm remains silent and does not disclose its cost. Then, if $c \geq \mu(c|p,\emptyset)$, consumers overestimate the loss and therefore purchase too little. As a result, firms with a type $c \geq \mu(c|p,\emptyset)$ reveal their type. Instead, if $c < \mu(c|p,\emptyset)$, consumers infer that they underestimate the loss and therefore would consume too much. This leads consumers to adjust their belief downward to some strictly lower level $\mu^*(p,\emptyset) < \mu(p,\emptyset)$. As a result, firms with a type $c \geq \mu^*(c|p,\emptyset)$ also reveal their type. This process continues until $\mu^*(p,\emptyset)$ approaches zero. In this limiting case, the firm's profit is $\pi(p^*(0))$, where $p^*(0)$ denotes the optimal price for a firm with known type $c = 0$.

Finally, we need to compare among the two options. Since $\pi(p^*(c)) \geq \pi(p^*(0))$ for $c \geq 0$, it is always optimal for the firm to disclose its cost. □

Proof of Proposition 5. The result immediately follows from Proposition 4 because cost is monotone in ξ. □

Proof of Proposition 6. Consumers purchase the high-quality product if their valuation exceeds $\bar{\theta}$ defined by the indifference condition

$$\bar{\theta}s_1 - p_1 - L_1 = \bar{\theta}s_2 - p_2 - L_2, \tag{A.2}$$

and they purchase the low-quality product if their valuation θ is less than $\bar{\theta}$ and exceeds $\underline{\theta}$ defined by

$$\underline{\theta}s_1 - p_1 - L_1 = 0. \tag{A.3}$$

The indifference condition (A.2) implies that

$$\bar{\theta} = \frac{p_2 + L_2 - p_1 - L_1}{s_2 - s_1} > 0,$$

while the indifference condition (A.3) implies that

$$\underline{\theta} = \frac{p_1 + L_1}{s_1}.$$

Demand for the low-quality product is positive if $\underline{\theta} < \bar{\theta}$, that is,

$$\frac{s_2}{p_2 + L_2} < \frac{s_1}{p_1 + L_1}.$$

To determine the optimal price, each firm solves its respective profit-maximization problem:

$$\begin{aligned}
\max_{p_1} \quad \pi_1(p_1, p_2) &= (p_1 - c_1)\left[G(\bar{\theta}) - G(\underline{\theta})\right] \\
\max_{p_2} \quad \pi_2(p_1, p_2) &= (p_2 - c_2)\left[1 - G(\bar{\theta})\right]
\end{aligned}$$

The first-order condition for p_1 is given by

$$\frac{\partial \pi_1}{\partial p_1} = \left[G(\bar{\theta}) - G(\underline{\theta})\right] + (p_1 - c_1)\left[-g(\bar{\theta})\frac{1 + \partial L_1/\partial p_1}{s_2 - s_1} - g(\underline{\theta})\frac{1 + \partial L_1/\partial p_1}{s_1}\right] = 0,$$

which can be rearranged as

$$p_1^* = c_1 + \frac{G(\bar{\theta}) - G(\underline{\theta})}{g(\bar{\theta})\frac{1+\partial L_1/\partial p_1}{s_2 - s_1} + g(\underline{\theta})\frac{1+\partial L_1/\partial p_1}{s_1}}.$$

Similarly, the first-order condition for p_2 is given by

$$\frac{\partial \pi_2}{\partial p_2} = \left[1 - G(\bar{\theta})\right] + (p_2 - c_2)\left[-g(\bar{\theta})\frac{1 + \partial L_2/\partial p_2}{s_2 - s_1}\right] = 0,$$

which yields

$$p_2^* = c_2 + \frac{1 - G(\bar{\theta})}{g(\bar{\theta})\frac{1+\partial L_2/\partial p_2}{s_2 - s_1}}.$$

Solving simultaneously yields the optimal prices

$$p_1^* = c_1 + \frac{G(\bar{\theta}) - G(\underline{\theta})}{g(\bar{\theta})\frac{1+\partial L_1/\partial p_1}{s_2 - s_1} + g(\underline{\theta})\frac{1+\partial L_1/\partial p_1}{s_1}}$$

and

$$p_2^* = c_2 + \frac{1 - G(\bar{\theta})}{g(\bar{\theta})\frac{1+\partial L_2/\partial p_2}{s_2 - s_1}}.$$

To see that p_2^* is lower than the price absent consumer resistance, note that $g'(\theta) \geq 0$ is sufficient for $(1-G)/g$ to be non-increasing. In addition, recall that $\partial L_2/\partial p_2 \geq 0$ by Assumption 1. Taken together, this yields that consumer resistance forces the price of the high-quality firm down. The argument for the price of the low-quality firm p_1^* is more involved: Defining

$$Z(L_1) = \frac{G(\bar{\theta}) - G(\underline{\theta})}{g(\bar{\theta})\frac{1+\partial L_1/\partial p_1}{s_2 - s_1} + g(\underline{\theta})\frac{1+\partial L_1/\partial p_1}{s_1}}$$

and differentiating it with respect to L_1 shows that $Z'(L_1) < 0$ if $g'(\theta) \geq 0$ (the analysis is tedious but straightforward).

□

References

Anderson, E.T, & Simester, D.I. (2008). Does demand fall when customers perceive that prices are unfair? The case of premium pricing for large sizes. *Marketing Science*, 27(3), 492–500.

Acquisti, A., Taylor, C.R., & Wagman, L. (2016). The economics of privacy. *Journal of Economic Literature*, 54(2), 442-492.

Bhattacharjee, A., Dana, J., & Baron, J. (2017). Anti-profit beliefs: How people neglect the societal benefits of profit. *Journal of Personality and Social Psychology*, 113(5), 671–696.

Bolton, L.E., & Alba, J.W. (2006). Price fairness: Good and service differences and the role of vendor costs. *Journal of Consumer Research*, 33(2), 258–265.

Bolton, G.E., & Ockenfels, A. (2000). ERC: A theory of equity, reciprocity, and competition. *American Economic Review*, 90(1), 166–193.

Buehler, S., & Gaertner, D. (2013). Making sense of nonbinding retail-price recommendations. *American Economic Review*, 103(1), 335–359.

Buell, R.W., Kim, T., & Tsay, C.J. (2016). Creating reciprocal value through operational transparency. *Management Science*, 63(6), 1673–1695.

Camerer, C.F. (2003). *Behavioral game theory: Experiments in strategic interaction*. Princeton University Press.

Caplin, A., & Nalebuff, B. (1990). Aggregation and imperfect competition: On the existence of equilibrium. Mimeo.

Coase, R.H. (1972). Durability and monopoly. *Journal of Law and Economics*, 15(1), 143–149.

Fabrizi, S., Lippert, S., Puppe, C., & Rosenkranz, R. (2016). Manufacturer suggested retail prices, loss aversion and competition. *Journal of Economic Psychology* 53, 141–153.

Fehr, E., & Schmidt, K.M. (1999). A theory of fairness, competition, and cooperation. *Quarterly Journal of Economics*, 114(3), 817–868.

Guo, L. (2015). Inequity aversion and fair selling. *Journal of Marketing Research*, 52(1), 77–89.

Güth, W., Schmittberger, R., & Schwarze, B. (1982). An experimental analysis of ultimatum bargaining. *Journal of Economic Behavior and Organization*, 3(4), 367–388.

Hart, O.D., & Tirole, J. (1988). Contract renegotiation and Coasian dynamics. Review of Economic Studies, 55(4), 509–540.

Heidhues, P., & Kszegi, B. (2008). Competition and price variation when consumers are loss averse. *American Economic Review*, 98(4), 1245-.68.

Jiang, B., Sudhir, K., & Zou, T. (2016). Effects of cost-information transparency on intertemporal pricing and innovation (February 1, 2017). Available at SSRN: https://ssrn.com/abstract=2732812.

Kahneman, D., Knetsch, J.L., & Thaler, R.H. (1986a). Fairness as a constraint on profit seeking: Entitlements in the market. *American Economic Review*, 76(4), 728–741.

Kahneman, D., Knetsch, J.L., & Thaler, R.H. (1986b). Fairness and the assumptions of economics. *Journal of Business*, 59(4), S285–S300.

Köszegi, B., & Rabin, M. (2006). A model of reference-dependent preferences. *Quarterly Journal of Economics*, 121(4), 1133–1165.

Krishna, A. (2009). Behavioral pricing. *Handbook of pricing research in marketing*, 76–90.

Levine, D.K. (1998). Modeling altruism and spitefulness in experiments. *Review of Economic Dynamics*, 1(3), 593–622.

Lubensky, D. (2017). A model of recommended retail prices. *Rand Journal of Economics*, 48(2), 358–386.

Mazumdar, T., Raj, S.P., & Sinha, I. (2005). Reference price research: Review. *Journal of Marketing*, 69, 84–102. and Propositions

Milgrom, P. (2008). What the seller won't tell you: Persuasion and disclosure in markets. *Journal of Economic Perspectives*, 22(2), 115–131.

Mohan, B., Buell, R.W., & John, L.K. (2014). Lifting the veil: The benefits of cost transparency (September 11, 2016).
Available at SSRN: https://ssrn.com/abstract=2498174.

Puppe, C., Rosenkranz, S. (2011), Why Suggest Non-Binding Retail Prices? *Economica*, 78(310), 317-329.

Rabin, M. (1993). Incorporating fairness into game theory and economics. *American Economic Review*, 83(5), 1281–1302.

Rotemberg, J.J. (2011). Fair pricing. *Journal of the European Economic Association*, 9(5), 952–981.

Rotemberg, J.J. (2008). Minimally acceptable altruism and the ultimatum game. *Journal of Economic Behavior & Organization*, 66(3), 457–476.

Rotemberg, J.J. (2005). Customer anger at price increases, changes in the frequency of price adjustment and monetary policy. *Journal of Monetary Economics*, 52(4), 829–852.

Schwartz, J. (2007, August 23). Exxon misled the public on climate change, study says. *New York Times*, accessible at: `https://www.nytimes.com/2017/08/23/climate/exxon-global-warming-science-study.html`.

Sobel, J. (2005). Interdependent preferences and reciprocity. *Journal of Economic Literature*, 43(2), 392–436.

Spiegler, R. (2011). *Bounded Rationality and Industrial Organization*. Oxford University Press.

Tversky, A., & Kahneman, D. (1991). Loss aversion in riskless choice: A reference-dependent model. *Quarterly Journal of Economics*, 106(4), 1039–1061.

Xia, L., Monroe, K.B., & Cox, J.L. (2004). The price is unfair! A conceptual framework of price fairness perceptions. *Journal of Marketing*, 68(4), 1–15.