Buyer-Initiated vs. Seller-Initiated Information Revelation

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Sales presentations are the core of the selling process where salespeople provide information to prospects. One challenge is that the amount of information available to be potentially communicated may exceed salespeople’s ability to communicate or customers’ ability to process: there is limited “bandwidth” between the firm and customers. One important decision, then, is which information should customers see? What the firm chooses to tell customers may be informative in itself. When constrained to a “seller-initiated information revelation” format, where the firm chooses which feature to show, the firm never finds it optimal to offer more features than it is able to inform customers about. Consequently, customers never find credible a claim that the product has all features. The important implication is that price alone cannot serve as a signal of quality in this setting. In contrast, a “buyer-initiated information revelation” format, where customers decide which information to receive, increases the probability of a sale and also results in the production of higher quality products.

In a competitive setting, by adopting buyer-initiated information revelation, firms are able to attain positive profits. This is due to the fact that customers infer the product’s quality from the price along with the information revelation format. Customers know that at some prices, firms find it profitable to produce high-quality products and at other, lower, prices, this is not the case. Thus, customer empowerment leads to higher profits.

Key words: selling formats; information economics; product quality; marketing communication; game theory

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1. Introduction

According to Churchill et al. (2000, p. 62), the sales presentation “is the core of the selling process” in which “the salesperson transmits information about a product or service and attempts to persuade the prospect to become a customer.” The importance of this aspect of selling cannot be overstated. Indeed, it is here that the firm—via the salesperson—can “tell the product’s story to the buyer” (Kotler 2003, p. 655). The manner in which this story is told—in particular, what information is transmitted and what information is not—is thus a critical decision by the firm as part of its overall sales management strategy. In particular, should the salesperson select which aspects of the product to discuss or should he ask the prospect to first state her needs and, by implication, the nature of the information she would like to hear? This dilemma is a general one, extending across industries and firms. A cosmetics salesperson, for example, might decide whether to respond to a customer’s interest in a product with “this product has the most advanced anti-aging technology available,” or “what are you looking for in a skin cream? What can I tell you about this product?” In the former—seller-initiated information revelation—the salesperson selects which feature to reveal to the customer. In the latter—buyer-initiated information revelation—he allows the customer to decide which features will be revealed. Similarly, a car salesperson might greet customers inspecting a specific vehicle in the showroom by, on one hand, listing the two or three most salient features of the car or, on the other hand, asking what features they are looking for in a car. As a final example, a software salesperson might conduct a product demonstration by selecting two or three features himself to show or, on the other hand, by asking which of the many features the customer would prefer he focus on.
The seller-initiated approach is attractive in the sense that it decreases the probability that unfavorable information will be requested and transmitted. The software product, for example, may not offer top-of-the-line reporting capabilities and, therefore, the salesperson may prefer to focus his demonstration on the transaction processing speeds, an area in which the product excels. Of course, the rational customer knows that the salesperson would optimally choose information contained in his presentation carefully and thus might be concerned about those features not mentioned. The buyer-initiated approach, on the other hand, does not lead to this potentially costly negative inference because the firm is not allowed to "cherry pick" which features to discuss. However, this approach leaves the firm vulnerable to the discussion of unfavorable features: the customer may be more likely to ask about reporting capabilities, which may be harmful to the sales outcome.

More generally, there is a sense that different firms take very different approaches to this problem:

At first glance, the very structured memorized presentation may seem inappropriate in most situations... [However] some companies believe that controlling the flow of information and order of the presentation increases the probability of success. (Johnston and Marshall 2003, pp. 160–161)

Different firms have widely varying policies concerning how sales presentations should be organized, what selling points should be stressed and how forcefully the presentation should be made. (Churchill et al. 2000, p. 63)

Moreover, there is little rigorous guidance with respect to this problem:

A firm’s policy on sales presentations should be consistent with its other policies for managing accounts. To formulate intelligent sales presentation policies, a sales manager must know about alternative presentation methods and their relative advantages and limitations. (emphasis added, Churchill et al. 2000, p. 63)

In this paper, we seek to provide insight into a firm’s decision to retain complete control over the information divulged in a sales interaction or cede this control to the customer. This decision is particularly important in contexts in which there is finite “bandwidth” between the salesperson and prospect in which all relevant information cannot be transmitted. Indeed, it is likely that there exists some such limitation in nearly any selling context due to physical, temporal, or cognitive resource constraints. These constraints imply that some residual uncertainty may remain after the presentation and before the prospect’s decision. The firm’s presentation strategy, then, needs to account for this residual uncertainty. Our core result is that, even with a bandwidth constraint such that a firm cannot tell the customer about all of its product’s features, the firm can signal the presence of all of these features by allowing the customer to control the information presented in the sales interaction and by choosing the appropriate price. This selling format serves as a commitment device that credibly signals to the customer that the firm has “nothing to hide.” When the firm adopts a selling format in which it controls which information is revealed, it is never able to capture the surplus associated with features it cannot communicate. As a result, it produces lower quality products—products with fewer features—in equilibrium when adopting this format.

We extend this model to a duopoly context and find that buyer-initiated learning may soften price competition. Though each firm faces the standard incentive to undercut its rival’s price by epsilon to steal the market, this incentive is counter-balanced by customers’ inferences about quality. In some cases, a firm cannot undercut its rival without the customer inferring that such an off-path price is inconsistent with a high-quality product. Thus, the firm may not do so. Importantly, by handing over the power of information revelation to the customer, the firm ensures that she will inquire about the product’s features in a way to ensure that it is of high quality. High-quality solutions are, of course, better for the customer as well. Thus, we find that the adoption of buyer-initiated revelation by both firms can lead to positive profits even though the firms are ex ante symmetric. Moreover, under certain conditions, consumer surplus may also increase, resulting in a win-win outcome.

The current work is directly related to two important streams in the literature. On one hand, our question is similar in nature to those addressed by previous researchers into the strategic implications of selling formats and sales tactics. Wernerfelt (1994a) analyzes the role of sales assistants and argues that their main function is to perform a matching between the customer and the firm’s offerings. The author begins by comparing two ways in which the assistant can perform this matching function: a “monologue” and a “dialogue.” In the former, the customer arrives and the sales assistant simply tells her what she should buy. In the latter, the customer announces her preferences and, based on this announcement, the sales assistant performs the matching task. Based on an efficiency argument, the paper assumes that dialogue is better and focuses predominantly on the question of whether or not the sales assistant’s matching is performed honestly. In particular, if the store does not have the right product to match her preferences, does the sales assistant reveal this? In a multistage game, the answer turns out to be “yes,” due primarily to reputational concerns. Our approach in
this paper differs in that we endogenize the format choice (while Wernerfelt 1994a imposes it exogenously). On the other hand, while Wernerfelt investigated honesty, we impose honesty and assume that the features in question are truthfully revealed upon inquiry.

Gerstner and Hess (1990) ask whether the adoption of a bait-and-switch policy can actually benefit customers. They show that the answer may be “yes” because, if allowed, bait and switch—accompanied by low prices on advertised brands—might result in increased price competition. A similarly surprising result is presented by Chu et al. (1995). They find that annoying “hard selling” may be optimal in a competitive setting because of the differentiated equilibrium it may facilitate. Intuitively, if some customers experience less disutility from hard selling than others, then there may exist an asymmetric equilibrium in which they buy from a hard-selling firm while those with higher disutilities buy from soft-selling firms. The resulting differentiated offerings mitigate price competition. It is important to note that in the Gerstner and Hess (1990) and Chu et al. (1995) papers, the firms engage strictly in monologues with the customers (using the language of Wernerfelt 1994a). Moreover, we investigate here a very different dimension of the selling format: information revelation.

The second major area of research to which the current study relates is that concerning a firm’s ability to signal its unobservable quality via its choice of some action. The question, in particular, of whether price and/or advertising can signal quality has been the subject of extensive research (Nelson 1974, Schmalensee 1978, Milgrom and Roberts 1986, Bagwell and Riordan 1991). While we find that price will signal quality in our model as well, the intuition behind this result is strikingly different. The extant models have generally depended on a dynamic context to endow price and advertising with signaling power. The argument in Nelson (1974), for example, is that higher quality firms will benefit more from acquiring a new customer because these new customers are more likely to remain customers over the long term. Thus, they are willing to spend more money on advertising. Of course, other researchers have shown that tools other than just price or advertising may signal quality. These have included performance warranties (Spence 1977, Lutz 1989), money-back guarantees (Moorthy and Srinivasan 1995, Soberman 2003), promotional chat (Mayzlin 2006), sale signs (Anderson and Simester 1998), message precision (Anand and Shachar 2007), and umbrella branding (Wernerfelt 1988). Our model is static. We do not rely on mechanisms in which the low-quality firm is ever identified through use and punished in some respect. The information revelation format provides this function in that it facilitates the role of price as a credible signal. Our model differs from the current stream of research in two respects. First, “quality” in our model is defined as the extent to which the firm’s products match the preferences of customers; higher quality implies that the product matches more customers’ preferences. Second, an important distinction of our model is that quality is endogenously chosen.1

In summary, the primary contribution of our analysis is that we endogenize the firm’s decision about the sales presentation’s information revelation format. We demonstrate that the adoption of buyer-initiated revelation allows the firm to signal the quality of its product to the customer. This has important implications for equilibrium product quality, firm profits, and customer surplus.

The rest of this paper is organized as follows. In §2, we develop the models for buyer-initiated and seller-initiated revelation in a monopoly setting with the quality choice being endogenous. In §3, we extend our analysis to a duopoly. The final section summarizes the results and gives future research directions.

2. Model

We model a firm as choosing which features to include in its product. The features, once chosen, are unknown to customers so the firm hires a salesperson to communicate the existence of these features to customers. The benefit to the customer is driven by the presence or absence of these features. For example, a customer considering a computer purchase may care about “speed” and “integration.” The salesperson can describe product features like floating memory and clock speed that deliver the “speed” benefit, and features like multiple USB and iLink ports (which seamlessly connect audio and video hardware to the computer) that deliver the “integration” benefit. The salesperson is, however, unable to communicate these features exhaustively. Without being able to communicate all of the features, there may be no opportunity to profitably produce a product with all of the features. Our focus is on the information revelation format adopted by the firm: Should the customer or the firm choose which features to see? We investigate the extent to which this choice of selling format can allow the firm to communicate more effectively and the impact it has on the firm’s product offering and profits.

In our base model, the firm is a monopolist in a product category that is fully defined by two features

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1 Note that our core result—that high-quality products are associated with buyer-initiated selling formats—is found in a model with exogenous quality as well. This analysis is available from the authors upon request.
We define the firm’s chosen type as $A = a_1 \times a_2$ and refer to 11 as a “high-quality” product and 01 and 10 as low quality. In our main equilibrium, there will be no product 00 so this definition is not ambiguous. The firm incurs a cost $c$ for each feature included in its product sold.\(^5\)

Customers are heterogeneous with respect to preferences and information about their preferences. With respect to the former, customers are either of two types $\theta_i$, $i \in \{1, 2\}$, where the utility $U_i$ of type $\theta_i$ is

$$U_i \equiv a_i.$$ 

So, customers derive value from either $a_1$ or $a_2$ but not both. The high-quality product meets the needs of both types of customers. A proportion $\phi$ of customers are of type $\theta_1$, where $\phi > \frac{1}{2}$, without loss of generality. A proportion $\beta$ know their preferences $\theta$ perfectly while $1 - \beta$ do not.\(^4\) One can think of this $\beta$ proportion as customers who have studied and analyzed the offerings enough on their own, prior to purchase, and thus know with certainty what their preference is. For simplicity, we refer to those customers that know their preferences as $\beta$ customers and those that do not know their preferences as $1 - \beta$ customers. The firm does not observe $\theta$ for any customer. Moreover, the firm does not observe whether the customer knows $\theta$ or not. Therefore, sales presentations cannot be customized to these two “segments.” These are assumed to be uncorrelated, so the probability that a randomly chosen customer is of type $\theta_2$ and knows that she is of type $\theta_2$, for example, is $\beta(1 - \phi)$.

\(^2\) Alternatively, one could think about $a_i = 1$ as meaning that the firm offers a “high” level of feature $i$, and $a_i = 0$ as meaning that the firm offers a “low” level of feature $i$.

\(^3\) The assumption that the cost $c$ of each feature is the same is for simplification. Relaxing this assumption will change the customer’s inspection strategy $q$ but will not change our core results as stated in Proposition 1 (next section).

\(^4\) Given the model’s information structure, the expected value associated with a 11 product is unambiguously higher than that associated with either a 10 or a 01 product. This gives rise to our characterization of the former as a “better” or “high-quality” product. This is consistent with a vertical conceptualization of quality in the sense that all $1 - \beta$ customers would prefer 11 to the others at a given price. An alternative characterization would be that product 11 is a “mass-market” product and 10 and 01 are niche products. In this view, quality could be interpreted in a horizontal matching sense. We would like to thank a reviewer for suggesting this alternative conceptualization.

\(^5\) We intentionally envision the salesperson as demonstrating features to emphasize the truthfulness of the revelation. More generally, we note that Wernerfelt’s (1994a) core result suggests that reputational concerns ensure that firms do not lie. Hence, even when the firm cannot demonstrate features, it is likely that firms will not systematically claim that features exist when, in fact, they do not.
Similarly, when $F = S$, the firm may choose which feature to show with certainty, in which case $q = 0$ or 1. The firm also chooses the product’s price $P$. We make the assumption that this is done at the outset of the game and that the firm is able to commit to the posted price (i.e., the price is not changed as a function of the outcome of the sales interaction). The sequence of the game is shown in Figure 1.

The customer will buy the product if his posterior expected utility (weakly) exceeds the firm’s price:

$$E[U | F, P, a_i] = a_i \cdot Pr[q_1 = 1] + Pr[a_{-i} = 1 | F, P, a_i] \cdot Pr[q_i = 1] - P \geq 0,$$

where the subscript $-i$ represents the index of the feature the customer is not shown and, thus, the one about which he must draw inferences. So, the expected utility reflects not only the feature he saw but also whatever inferences he can draw about the other feature. Note also that the customer’s posterior belief about his type is not conditioned on the observed data $F$, $P$, and $a_i$. By assumption, the firm chooses $F$ and $P$ before observing the customer’s type and is not able to learn more before choosing $i$, so there is no information in these choices with respect to type.

The firm’s profits, conditional on the product it produces, are

$$E[\Pi | A] = Pr[E[U | F, P, a_i] \geq P] [P - nc],$$

where $n \in \{0, 1, 2\}$ is the number of features in the product. Note that $E[U | A]$ is a random variable due to the possible mixing over $i$. We assume that $c$, the cost per feature, is incurred when the product is sold.

We solve this game by implementing the Perfect Bayesian Equilibrium (PBE) concept which requires us to find a set of strategies $\Sigma \equiv \{A, F, P, q\}$ such that at each and every stage of the game, there exist no strictly profitable unilateral deviations conditional on beliefs, and such that the beliefs are consistent with the priors, the equilibrium strategies, and with Bayes’ rule, where applicable.

### 2.1. Off-Path Beliefs
It is well known that a difficulty with PBEs is that the requirement that the beliefs be “consistent with Bayes’ rule” has no implication for off-path deviations. Because there is a zero probability attached to such nonequilibrium actions, Bayes’ rule offers no guidance. As a result, technically any posterior belief may be specified without violating Bayes’ rule. Thus, these games often yield multiple equilibria, contingent on what the off-path beliefs are assumed to be.

The model we analyze here, while parsimoniously capturing the phenomenon of interest, is somewhat more complex in this regard than the standard PBE models. This complexity arises from the fact that the firm chooses its own type. The typical signaling model (Wernerfelt 1994b, Moorthy and Srinivasan 1995, Simester 1995, Anderson and Simester 1998) is characterized by a firm that is exogenously endowed with a type, be it skill, quality, or insanity. An important implication of this aspect of our game structure is that a commonly used approach for narrowing the set of “reasonable” off-path beliefs—namely, the Intuitive Criterion (Cho and Kreps 1987)—is not available to us directly. The Intuitive Criterion disallows equilibria with off-path beliefs that assign positive probability to a player for which the off-path action is dominated by the equilibrium action. However, the direct implementation of this condition is not possible in our game because, unlike a standard signaling setup, our game is not characterized by the specification of equilibrium actions for every possible type. This is because our firm chooses its type endogenously and, as a result, there is only a single on-path type. The analysis of such a structure, in fact, may represent a more realistic context than the exogenous-type models because firms typically choose their types over some horizon.

Our approach in dealing with this complication is to employ the basic spirit of the Intuitive Criterion, which is to consider the relative incentives behind each type’s choice of an off-path action. If type $t_1$ has no incentive to choose off-path action $a_{t_1}$, yet type $t_2$ does, then we should infer upon seeing the action
exposition:
in that her beliefs are not updated other than when
over, it reflects our specification of a rational customer
ity optimally conditional on the observables. More-
cost function is linear in the number of features, this
she still believes that feature 2 is there. Because the
rium that the firm has chosen type
example, if the customer expects based on the equilib-
come of the inspection of the other attribute. So, for
noninspected features will not be affected by the out-

For example, the customer does not see a feature she
spection" off-path beliefs which come into play when,
the firm’s chosen type before actually viewing any of
observables.

Formally, we define the customer’s inferred proba-
ability that the firm has produced a product of type \( A' \)
conditional on observing \( P' \) and \( F' \) to be:

\[
\mu_{A'} = \begin{cases} 
1 & \text{if } A' = \arg \max_A E[\Pi | P', F'], \\
0 & \text{otherwise}, 
\end{cases}
\]

where off-path actions are indicated by the super-
script prime \((A', P', F')\). Note that the customer’s
inference is also conditional on her own equilibrium
actions to be taken upon observing the firm’s off-path
actions. Note also that our discussion to this point has
been with respect to what we term ‘preinspection’
beliefs. That is, these are the customer’s beliefs about
the firm’s chosen type before actually viewing any of
the features. Our equilibria must also specify “postin-
spection” off-path beliefs which come into play when
for example, the customer does not see a feature she
expects to see. As noted formally below, each of our
equilibria will specify that the customer’s postinspec-
tion off-path beliefs with respect to the existence of
noninspected features will not be affected by the out-
come of the inspection of the other attribute. So, for
example, if the customer expects based on the equilib-
rarium that the firm has chosen type \( A = 11 \), but upon
inspection of feature 1 she finds that it is not there,
she still believes that feature 2 is there. Because the
cost function is linear in the number of features, this
is consistent with our assumption above that off-path
beliefs reflect the view that the firm will choose qual-
ity optimally conditional on the observables. More-
ever, it reflects our specification of a rational customer
in that her beliefs are not updated other than when
relevant information is revealed.

We introduce the following notation to assist with
exposition:

\[
\chi(\beta, \phi, c, P) \equiv \{ q \in [0, 1]: E[\Pi | A = 11] \\
\geq \text{Max}[E[\Pi | A=10], E[\Pi | A=01]] \}, \quad (1)
\]

\[
\Delta(\beta, \phi, c) \equiv \{ P \in (0, 1]: \chi(\beta, \phi, c) \neq \emptyset \}, \quad (2)
\]
such that \( \chi(\cdot) \) represents the set of randomization
probabilities that the customer could implement that
would “discipline” the firm to offer the high-quality
product, and \( \Delta(\cdot) \) represents the set of prices for
which there exists a nonempty set of such random-
ization probabilities.

3. Results

In order to appreciate the impact of a firm’s selection
of selling format, it is useful to begin with a brief
analysis of two benchmark models for comparison.

3.1. Benchmark Models

The first model useful for comparison is one in which
communication of the product’s features is not pos-
sible at all. The following lemma shows that, as one
would expect, no features are added to products in
such a context.

**LEMMA 1.** When communication is not possible, there
exists no equilibrium with \( \Pi^* > 0 \).

**PROOF.** Assume there exists such an equilibrium in
which the firm chooses \( A^* \neq 00 \) and \( P^* > 0 \) and that
\( \Pi^* > 0 \). The firm is always strictly better off deviating
to \( A' = 00 \) and saving \( nc \). If \( A^* = 00 \), then \( P^* > 0 \) yields
\( \Pi^* = 0 \) because there are no sales given the on-path
belief that the type is \( A = 00 \). □

Clearly, in any purported equilibrium in which
\( a_i = 1 \) for some \( i \), the firm would find a strictly prof-
itable deviation by surreptitiously dropping the fea-
ture, thereby saving production cost \( c \). This result
simply demonstrates the importance of communica-
tion to economic efficiency. As long as \( c < 1 \), there
exists some opportunity for gains from trade. When
this trade does not occur, there is a resulting dead-
weight loss in the economy.

Another useful benchmark is a model in which the
firm is constrained to seller-initiated information rev-
olution. This is a traditional view of “selling as telling”
in which the salesperson engages in a monologue
about the product’s features. The following lemma
shows that in such a context, products of high quality
are never produced.

**LEMMA 2.** When the firm is restricted to seller-initiated
information revelation, there exists no equilibrium in which
\( A = 11 \).

**PROOF.** Assume there does exist such an equilib-
rium in which \( A' = 11 \) and that the equilibrium price
is \( P^* \leq 1 \) and equilibrium revelation distribution is
\( q^* \in [0, 1] \). In such an equilibrium, everyone buys
because they obtain nonnegative utility from purchas-
ing. Firm profits are \( \pi^* = P^* - 2c \). A deviation to
\( A' = 10 \) and \( q' = 1 \) yields profit of \( \pi' = P^* - c > \pi^* \).
Note that this holds for all off-path beliefs because the customer never views off-path behavior. □

Again, this result is intuitive. When constrained to seller-initiated revelation, firms never find it profitable to produce more features than they are able to inform the customer about. As a result, customers never find credible a claim that the product has two features. The important implication of this is that price alone cannot serve as a signal of quality in this model.\textsuperscript{9} As we show in the next section, not only does selling strategy based on a buyer-initiated approach increase the probability of a sale but it also has the additional economic benefit of leading to the production of higher quality products.

### 3.2. Main Results—Choice of Revelation Format

We begin by demonstrating the existence of a high-quality equilibrium which requires the adoption of buyer-initiated information revelation. The following proposition summarizes the high-quality equilibrium. All proofs for this and the propositions to follow are found in the online appendix, which is provided in the e-companion.\textsuperscript{9}

**Proposition 1.** There exists a nonempty range $C$ such that for all $c \in C$, there is an equilibrium in which $P^* = 1$, $A^* = 11$, and $F^* = B$. In this equilibrium, the $1 - \beta$ customers randomize between inspecting features 1 and 2 and the $\beta$ customers inspect their preferred feature.

Firms can produce high-quality products in this model when they implement a buyer-initiated revelation strategy. The intuition for this result comes from the fact that the buyer-initiated revelation format enables a customer shopping policy that imposes costs on low-quality firms but not high-quality firms. This cost comes in the form of lower expected utility—and hence lower purchase probabilities—associated with lower quality products. Simply put, by allowing the customer to select which feature to inspect, the firm establishes a single-crossing property that penalizes low-quality products. Thus, it represents a commitment to the customer that—even though the customer cannot fully inspect all attributes—the firm has nonetheless produced a high-quality product. As shown above, without buyer-initiated revelation, the firm can never produce a high-quality product.

As noted in the proof, the condition stated in the proposition ensures the existence of a $q^* \in [0, 1]$ that satisfies the following:

$$
(1 - \beta)(1 - c) - (1 - 2c) + \beta(1 - \phi)(1 - c) \leq q^* \leq \frac{1 - 2c - \beta\phi(1 - c)}{(1 - \beta)(1 - c)}.
$$

This customer inspection strategy disciplines the seller to ensure that it always finds it more profitable to produce a high-quality product. Note that this distribution may or may not contain degenerate values, which would represent a pure strategy for the customers. To see why we may expect the customer to mix when $\beta$ is low, consider what would happen if all of the $1 - \beta$ customers always looked at, for example, $a_1$. The firm would always have a profitable deviation to $A^* = 10$ and the equilibrium would not exist.

Nonetheless, it is important to note that the distribution in Equation (3) can in some cases be a degenerate one (corresponding to a pure strategy implemented by the customer) in which the $1 - \beta$ customers always choose to view either $a_1$ or $a_2$ in equilibrium. These cases correspond to regions of the parameter space in which

$$
(1 - \beta)(1 - c) - (1 - 2c) + \beta(1 - \phi)(1 - c) \leq 0
$$

and

$$
\frac{1 - 2c - \beta\phi(1 - c)}{(1 - \beta)(1 - c)} \geq 1,
$$

respectively. Each of these cases requires a relatively small value of $c$, the cost of including the feature in the product. As $\beta \rightarrow 0$, both conditions fail and the $1 - \beta$ customers will always randomize in order to sustain the high-quality equilibrium.

Of course, we do not always observe high-quality products. There may also be cases in which a firm produces low-quality products, as shown in the next proposition.

**Proposition 2.** There exist four types of equilibria in which $A^* = 10$. When $c$ is at moderate levels, we can have (i) $\Sigma^* = \{10, S, \phi, 1\}$ and (ii) $\Sigma^* = \{10, B, \phi, 1\}$. When $c$ is high, we can have (iii) $\Sigma^* = \{10, S, 1, 1\}$ and (iv) $\Sigma^* = \{10, B, 1, 1\}$. In each of these equilibria, all customers inspect feature 1.

As shown in the above proposition, it is possible to have buyer-initiated information revelation adopted by low-quality firms. Having buyer-initiated information revelation does not imply high quality, but having a high-quality product makes it necessary for a firm to adopt buyer-initiated information revelation. Thus, we characterize the buyer-initiated revelation format as enabling the firm to signal its quality.
as opposed to actually signaling its quality directly. Finally, we note that the equilibrium in Proposition 1 is unique when the cost of production \( c \) is low enough. This can be seen by simple inspection of the equilibrium conditions for Propositions 1 and 2 presented in the online appendix.

4. Competitive Model
The results in §3 suggest that better products are associated with buyer-initiated selling formats in which the customer is empowered by the firm to drive the sales interaction. In that model, even with limited bandwidth, the firm finds it profitable to produce high-quality products and is able to extract the surplus associated with these products. However, this may or may not be true in a competitive model in which the firm’s ability to extract surplus is limited. Thus, we analyze whether the usefulness of the buyer-initiated revelation format extends to such a setting in which these benefits may be bargain away.

To investigate whether the intuition we have developed carries over to a competitive setting, we use the same basic model specified in §2 while adding a second firm. Customers are, again, knowledgeable about their preferences with probability \( \beta \) and are of type \( \theta_i \) with probability \( \phi \). Referring to the stages of the game presented in Figure 1, we make the following assumptions to accommodate the competitive context: First, with respect to Stage 1, strategy selection, the two firms make their decisions (price, product, and format) simultaneously. In Stage 2, observation, the customer sees both firms’ choices and forms her pre-inspection beliefs. In Stage 3, inspection, customers are assumed to inspect the products at both firms. Finally, in Stage 4, purchase, the customers choose the offering with the highest nonnegative expected utility net of price. If neither product yields nonnegative utility, neither is bought. If they yield equal expected utility, they are each purchased with equal probability. Off-path beliefs work according to the same principle as described in §2.1 in which customers infer that, conditional on the observed actions, the firm chooses its type optimally. The only difference in the competitive model in this regard is that inferences about optimality are conditioned on the other firm’s actions as well:

\[
\chi(\beta, \phi, c, P_i, P_j) \equiv \{q_i \in [0, 1]: E[\Pi_i | A_i = 11, A_j = 11] \geq \max \{E[\Pi_i | A = 10, A_j = 11], E[\Pi_i | A = 01, A_j = 11]\}\],
\]

(4)

\[
\Delta(\beta, \phi, c, P_i) \equiv \{P_i \in (0, 1]: \chi(\beta, \phi, c, P_i, P_j) \neq \emptyset\}.
\]

(5)

So, in the competitive model, we are checking to see whether, when faced with an equilibrium in which both firms are believed to be of high quality \((A_i^* = A_j^* = 11)\), the customer is able to implement a randomized shopping policy \( q \in (0, 1) \) to verify that neither firm has unilaterally deviated on quality. It is important to condition on the other firm’s actions in this case, because they will drive the potential profitability of the firm’s off-path actions. Because the model is symmetric, we omit the \( i, j \) subscripts when they are superfluous.

We again begin by analyzing a benchmark model in which the firms are not able to offer buyer-initiated information revelation; they must resort to a “canned” approach in which all customers observe the same predetermined message.

PROPOSITION 3. When \( \beta > 0 \) and when the firms are restricted to seller-initiated information revelation, there exists no equilibrium with pure strategies in prices.

Previous research (Varian 1980, Narasimhan 1988) has addressed the lack of pure-strategy equilibria in models with “loyal” and “switcher” segments, which are somewhat analogous to our \( \beta \) and \( 1 - \beta \) customers in that the firms have the incentive to produce (and thus reveal) different features in equilibrium. As a result, the \( \beta \phi \) customers become “loyal” for one firm while the \( \beta(1 - \phi) \) customers become “loyal” for the other. As Proposition 4 shows, however, if the firms adopt (in equilibrium) buyer-initiated revelation, we find equilibria with pure strategies in prices. Moreover, when adopting this format, the firms are also able to offer symmetric high-quality products.

PROPOSITION 4. If \( c \) and \( \beta \phi \) are low enough, then there exists a high-quality pure-strategy equilibrium characterized by both firms choosing \( A_i^* = 11 \), \( F^* = B \), and setting prices \( P^* = 3c \) and earning profits \( \Pi^* = c^2/2 > 0 \). In equilibrium, the \( 1 - \beta \) customers randomize between inspecting features 1 and 2 and the \( \beta \) customers inspect their preferred feature.

This proposition yields the insight that—by implementing buyer-initiated information revelation—the firms are able to reach a pure-strategy equilibrium and one in which they earn positive profits. The intuition for the latter result is best understood by comparing the model to the standard model of Bertrand competition. In that model, symmetric firms continue to undercut each other because epsilon price cuts yield first-order sales increases with second-order price cuts. Eventually, the customer—who knows the firms’ qualities with certainty—is able to purchase at marginal cost. Here, this does not happen because customers infer the product’s quality from the observables: price, inspected features, and revelation format. Because we assume that firms choose product quality optimally conditional on price—both on- and off-path—customers know that at some prices the firm will choose to produce high-quality products and at
others—in particular, at lower prices—it will produce lower quality products. As a result, if one envisions the standard tâtonnement process—in which firms alternate in epsilon price cuts in order to steal the entire marker from each other, ultimately reaching marginal cost—at some point, in our model, they reach a \( P \) such that all prices below \( P \) are consistent with low-quality products and prices above \( P \) are consistent with high-quality products. Thus, in order to steal the market from firm B which may be pricing at \( P \), firm A must cut below \( P \). However, cutting to \( P - \varepsilon \) (with \( \varepsilon \) small) will not work because the customer then infers rationally that the firm has produced a lower quality product which is not worth \( P - \varepsilon \). Thus, in order to steal the market, a first-order price cut is required which is consistent with the lower quality product. The proof of the proposition characterizes the conditions in which such a price cut is not profitable. Under these conditions, an equilibrium is maintained where the firms price above marginal cost and can thus earn positive profits.

As noted, this proposition also established the fact that we are able to maintain a pure-strategy price equilibrium in this model. This differs from previous research (Varian 1980, Narasimhan 1988) in that the models employed in these analyses typically had the quality that firms would continually undercut each other down to marginal cost. However, because the firms in these models endogenously choose to differentiate, they each have a captive, or loyal, segment. Because of this, zero-profit equilibria are not possible in their models because firms would always deviate from such an equilibria and simply serve their captive segments. In our model, on the other hand, when the firms choose their type, they choose to be symmetric (they both choose \( A = 11 \)) which ensures that equilibria exist at levels at which further price cuts are not possible.

This equilibrium is noteworthy because it demonstrates that customer empowerment may lead to higher profits and a pure-strategy equilibrium in a Bertrand game. As well, it makes possible the existence of higher quality products. Note also that customers may benefit. To see this, note that customer surplus in the high-quality equilibrium is \( 1 - 3c \), where 1 is the total utility that customers get and 3c is the price. In a potential low-quality equilibrium, the maximum total customer surplus is \( (1 - \beta)(\phi - c) \), which might occur if firms offer different features.\(^{10}\)

So, when \( 1 - 3c > (1 - \beta)(\phi - c) \) or \( c < ((1 - (1 - \beta)\phi)/(2 + \beta)) \), the high-quality equilibrium that is possible as a result of buyer-directed information revelation yields higher customer surplus. Specifically, by combining the conditions for the existence of the high-quality competitive equilibrium (as found in the online appendix) with the condition for customer surplus to be higher, we find that this would occur when

\[
c < \min \left\{ \frac{1 - (1 - \beta)\phi}{2 + \beta}, \frac{2 (1 - \beta)(\beta\phi + 1 - \beta)}{4(\beta\phi + 1 - \beta) - 1} \right\}
\]

and

\[
\beta\phi \leq \frac{1}{4}.
\]

5. Discussion and Conclusion

In this research, we investigate the firm’s decision about how to structure the sales presentation given the finite bandwidth between the salesperson and the customer. With the product quality endogenously determined, the high-quality firm optimally adopts buyer-initiated information revelation, engaging in a dialogue with the customer. By allowing the buyers to determine which feature to inquire about, the firm is able to send a credible signal that its product is of high quality. Without buyer-initiated revelation, the firm never produces a high-quality product.

In a competitive model, the firms are able to reach a pure-strategy equilibrium in which the firms adopt buyer-initiated revelation and produce high-quality products. The profits to the two firms are positive, unlike the standard Bertrand model where the firms continue to compete on price, thereby driving their profits to zero. Profits are not bargained away in our model because the customers are trying to infer the quality of the product from the price and the revelation format. This equilibrium yields the interesting insight that empowering customers can increase both firms’ profits. This profit impact comes as a result of the dual impact of (a) higher quality products and (b) the customers’ inference about the quality as a function of observed prices and information revelation format. Consumer surplus may also increase in this equilibrium demonstrating that the use of buyer-initiated information revelation may represent a win-win situation.

While we have conceptualized the revelation-format decision as one that relates to personal sales, it is also interesting to note that the intuition we have developed might apply to a broader range of information-transmission decisions facing a firm. In particular, one interesting question facing retailers is the extent to which they provide extensive information online. Conceptually, this problem is quite similar to that we specify above in that offering every possible piece of information on a website is very similar to buyer-directed revelation because all information

\(^{10}\)This is found by recognizing that the lowest firm profits that could exist in such an equilibrium would occur when each firm offered different attributes and charged 1, thereby earning no profit from the \( 1 - \beta \) customers. In this case, the firms earn a combined \( \beta(1 - c) \). On the other hand, the maximum total social welfare available in a low-quality equilibrium is \( \beta + (1 - \beta)\phi - c \). The difference, the maximum customer surplus, is thus found by subtracting the minimal profit from the maximum welfare.
cannot be processed and the consumer, instead, simply looks at what she is interested in. On the other hand, offering a limited set of information on the website is akin to a seller-directed strategy in that the firm has chosen what to put on the website and what not to put on the website. Applying this reasoning, we would predict that, all else equal, higher quality products should provide more information on their websites than products of low quality. In fact, casual observation suggests this may be true. As an example, compare the websites of two makers of digital cameras, Sony and Oregon Scientific. It is fairly obvious that the former is of higher quality than the latter. Consistent with the theory, their websites provide vastly different amounts of product information.\(^\text{11}\) For their four-megapixel digital camera, Oregon Scientific provides eight pieces of information (resolution, zoom, display size, flash, auto focus, movie capabilities, memory format, and additional features included). On the other hand, Sony’s four-megapixel camera is described on its website in great detail. Not only does Sony list 24 features as compared with 8, each feature is also discussed with a great deal more precision (for example, Oregon Scientific states that its camera has “autofocus” while Sony states that it has “5 Area Multipoint Auto Focus: By evaluating 5 separate focus areas of the frame, Sony’s Multipoint AF system can intelligently focus on the subject and avoid mistakenly focusing on the background”). While there are certainly other forces at work simultaneously in the firms’ optimization of the information content on their websites, it is reasonable to note that this is consistent with the model and results presented above. Our model would suggest that there may be a positive signal associated with the decision to allow customers to determine which of the many pieces of information they would like to evaluate.

These insights offer several important implications for managers. First and foremost, we provide a clear justification for the adoption of a selling format in which the customer—not the firm’s salesperson—determines which information about the product will be revealed. That is, this approach represents an effective way to communicate to customers that the product is a high-quality one. Second, we provide interpretable and implementable conditions for the adoption of such a format. In particular, high-quality firms—those with products matching the preferences of a broader set of customers—should always do so. Lower quality firms may also do so in some equilibria though it brings no strict profit gains as compared with analogous equilibria in which these firms adopt the seller-initiated format. With respect to the latter, the risk of revealing unflattering information may outweigh the potential “signaling” gains. Finally, we show that an important benefit of the adoption of such a format in an industry is that it might decrease the intensity of price competition. Recall that the adoption of buyer-initiated revelation represents a commitment to the customer that the product is of high quality. Epsilon price cuts bring with them an inference that the product has also dropped in quality, and, thus, may not allow the firm to automatically capture the whole market.

There are several directions in which this research could be extended. The current model is a static one and thus precludes repeat purchases. However, many customer categories are characterized by such dynamic behavior. Incorporating this into the model would allow one to investigate the impact of customers’ “punishment” of the firm for cheating on quality. Another useful extension would be the incorporation of two-way communication between the customer and the firm’s salesperson. In the approach we have taken here, the customer asks a question and the salesperson answers it. However, the “conversation” can be far richer and more complex. For example, a customer might ask about a feature and the seller can decide to tell about another feature that it thinks is more important for the product category. One might also investigate more deeply the knowledge structure surrounding the customer’s preferences. For example, the firm’s expertise in the product category is likely to allow salespeople to infer the customer’s optimal product based on several questions or a profile. Thus, the information it chooses to send may be informative about the underlying preferences to the extent that this information is chosen as a function of the inferred customer type. In a multichannel situation, the level of information provided by a direct marketer has strategic implications (Balasubramanian 1998). It would be interesting to model the effect of buyer-initiated and seller-initiated learning in a similar, multichannel setting.

There are some limitations to our analysis. One restriction we make in the model is that there is a bandwidth restriction preventing the communication and processing of all of the relevant information. Clearly, without this assumption, our results do not hold. However, given the complexity associated with the purchase of many durable goods—digital camera, flat-screen televisions, laptop computers—it is difficult to imagine that every piece of information is processed and understood by the customer. Most analogous models typically assume that information is complete yet biased, allowing the bias to come from

the misalignment between the firm’s (or the firm’s representative’s) incentives and those of the customer. Our approach here has been to investigate the bias emanating from a different source: a firm’s ability to choose what information to truthfully reveal. An interesting follow-up study might investigate contexts with both sources of bias to evaluate their interactions and relative impact.

We also model the interaction between the firm and the customer in a fairly parsimonious way. In particular, for reasons of tractability, we effectively assume that all information is revealed in either a buyer-initiated fashion or a seller-initiated fashion while, in reality, one would imagine that it is more typically a mix of the two. On one hand, we would argue that our model highlights the firm’s choice of the format through which it would prefer most of its information to be delivered. We might also make the intuitive argument that in many industries, there is a small set of factors that all customers will consider and that these might be delivered early in a sales interaction by seller-initiated revelation. Then, the question becomes how the firm is able to differentiate itself using the remaining resources it has (time, for example) to present some subset of the remaining features.

6. Electronic Companion
An electronic companion to this paper is available as part of the online version that can be found at http://mansci.journal.informs.org/.

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Appendix. List of Symbols
\[ a_i, i = 1, 2: \text{ product features} \]
\[ A \equiv a_1 \times a_2: \text{ firm type} \]
\[ \theta_i, i = 1, 2: \text{ customer type} \]
\[ U_i, i = 1, 2: \text{ utility of customer type } \theta_i \]
\[ \phi: \text{ proportion of customers of type } \theta_i \]
\[ \beta: \text{ proportion of customers that know their preferences } \theta \]
\[ B: \text{ buyer-initiated information revelation format} \]
\[ S: \text{ seller-initiated information revelation format} \]
\[ P: \text{ price of the product} \]
\[ c: \text{ cost per feature} \]
\[ \sum_(\cdot): \text{ set of strategies} \]
\[ A', P', F': \text{ off-path actions} \]

\[ \mu_{\cdot A}^{\cdot}: \text{ customer’s inferred probability about off-path action } A' \]
\[ \chi(\cdot): \text{ set of randomization probabilities} \]
\[ \Delta(\cdot): \text{ set of prices for which } \chi(\cdot) \text{ is nonempty} \]
\[ \hat{i} \in [1, 2]: \text{ index of feature that the customer sees} \]
\[ q: \text{ probability that the customer inspect feature } \]
\[ \hat{n} \in [0, 1, 2]: \text{ number of features in the product} \]

References