Competition for Attention*

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Abstract

We present a model of market competition and product differentiation in which consumers' attention is drawn to the products' most salient attributes. Firms compete for consumer attention via their choices of quality and price. Strategic positioning of each product then affects how other products are perceived. With this attention externality, depending on the cost of producing quality some markets exhibit "commoditized" price salient equilibria, while others exhibit "de-commoditized" quality salient equilibria. When the costs of quality change, innovation can lead to radical shifts in markets. In the context of financial innovation, the model generates the phenomenon of "reaching for yield".

1 Introduction

In many markets, consumers' attention to particular attributes of a product seems critical. In fashion goods, business class airline seats, and financial products, consumers focus on quality rather than price. In these markets, firms advertise quality to draw consumers' attention. In fast food, regular air travel, or standard home goods, consumers seem much more attentive to prices. In these markets, firms typically advertise their low prices.

Scholars of strategy and marketing are keenly aware of these distinct modes of market competition, and tirelessly emphasize the importance of having differentiated attributes and drawing consumer attention to them (Levitt 1983, Rangan and Bowman 1992, Mauborgne and Kim 2005). Southwest wants to be known as "the low cost airline;" Singapore as the winner of prizes for luxury and comfort. Walmart touts its everyday low prices, Nordstrom's its service. Successful firms "frame" competition by focusing consumers' attention on their best attribute (quality or price). These mechanisms do not arise naturally in standard economic models, in which consumers attend to all product attributes equally.

This paper seeks to understand these phenomena. We take a standard model in which firms compete on quality and price, and add to it the mechanism of salience we developed elsewhere (Bordalo, Gennaioli, and Shleifer 2012, 2013). According to salience theory, the attention of decision makers is drawn to the most unusual, surprising, or salient attributes of the options they face, leading them to overweight these attributes in their decisions. As shown in BGS (2013), salience theory applied to consumer choice can shed light on a host of lab and field evidence on consumers' context dependent behavior. Such context dependence is well established in experiments, including the well known decoy effects (Huber, Payne and Puto 1982) and compromise effects (Simonson 1989). More recently, Hastings and Shapiro (2013) show using field data that after a parallel increase in the prices of all gas grades the demand for premium gas drops to an extent that cannot be accounted for by standard income effects. The salience model accounts for this evidence by recognizing that surprising price hikes focus consumer attention on gas prices, rather than quality, favoring the choice of cheaper gas grades.

The influence of prices and qualities on consumer attention has significant implications for market competition. In competitive markets, the salience of price and quality are endogenously determined as the firms' strategic choices, and create an attention externality that lies at the heart of our model. A very high quality good draws attention not only to its own quality, but also to the fact that the competitor product has lower quality, reducing the competitor's relative valuation. A good with a very low price draws attention to the competitor's higher price, reducing the competitor's relative valuation. When salience matters, part of product market competition is that for consumer attention via the choice of quality and price.

We show that, depending on the cost of producing quality, some markets exhibit price salient equilibria in which consumers are most attentive to prices and less sensitive to quality differences. In these markets firms compete on prices, and quality could be under-provided relative to the efficient level. Because consumers neglect quality, escaping such "commodity magnets" is difficult. Fast food and budget air travel can be described in this way.

In other markets, equilibria are quality salient in that consumers are attentive to quality and are to some extent insensitive to price differences. Firms compete on quality, which can be over-supplied relative to the efficient level. In these markets, it is again difficult to escape the high quality equilibrium, because consumers neglect price cuts. We think of financial services or fashion as well described by such equilibria.

We investigate how market equilibrium depends on the cost of providing quality. We explore the possibility of radical change in markets when the cost of producing quality changes dramatically. This can take the form of de-commoditization, whereby a firm acquires access to a technology of producing quality at a much lower cost than its competitor, and is able to change the market from a price-salient to a quality-salient equilibrium. In such markets, prices can rise dramatically, but quality as perceived by consumers rises more. Market transformation can also take the form of commoditization, which arises when industry costs fall dramatically, so that large price cuts become possible. As price becomes salient, and quality differences are neglected, firms reduce quality provision in order to cut prices even more.

Some of these effects can also arise in a traditional model, under judicious assumptions about consumer heterogeneity. Section 5 describes similarities and differences between salience and the traditional approach to competition by using two real world examples: de-commoditization of the coffee market after the entry of Starbucks, and commoditization of the U.S. air travel market after deregulation in the 1980's. One key difference between the two approaches lies in the drivers of change. In standard models, it is typically the marginal consumers who shift in response to changes in quality or price. In our model, in contrast, the attention and thus the price-sensitivity of all consumers changes in response to significant innovation. As a consequence, shifts in demand and market structure can be massive.

We conclude the analysis by considering in detail the case of financial innovation in the form of new products with higher expected return and risk, such as mortgage backed securities (MBS). We show that such innovation is particularly attractive in low interest rate environments, and when the innovation offers higher returns at a moderately higher risk. Indeed, higher returns are salient to investors when alternative yields are extremely low and the (small) extra risk of the new product is underweighted. The model generates the well documented phenomenon of "reaching for yield" in a psychologically intuitive way, based on the properties of salience.[1]

Our paper is related to recent work on "behavioral industrial organization" (Ellison 2006, Spiegler 2011). In some models, consumers restrict their attention to a subset of available options, the consideration set, which can be manipulated by firms by expending a marketing cost (Spiegler and Eliaz 2011a,b and Hefti 2012), by setting a salient low price on some products (Ellison and Ellison 2009), or by setting an inconspicuous price (de Clippel, Eliaz and Rozen 2013). In our model, the attention externality operates within a *given* consideration set.

Another strand of the literature considers the working of market competition in settings in which some product attributes are "shrouded", namely sufficiently obscured that consumers find it difficult to compare them across products (Gabaix and Laibson 2006, Ellison and Ellison 2009, Spiegler and Piccione 2012). This literature takes as given the attributes that consumers pay attention to. In our analysis, consumers may pay differential attention to quality or price, but the neglect of one attribute or the other is endogenously determined by

[1] For explorations of the role of inattention in financial markets, see Barber and Odean (2008), DellaVigna and Pollet (2009), and Bordalo, Gennaioli and Shleifer (2013b).

product design and market competition.

Azar (2008), Cunningham (2012), and Dahremöller and Fels (2012) explore models in which the relative weight that consumers put on different attributes depends on the choice context, and can thus be manipulated by firms. These papers model consumer attention by using approaches different from salience (technically, they do not combine the diminishing sensitivity and ordering properties) and explore a different set of issues, such as properties of markups or the monopolist problem. Finally, our analysis builds on recent work relating inattention to consumer demand. Some approaches – such as Gabaix (2012), Matějka and McKay (2012), and Persson (2012) – are grounded in the rational inattention framework, in which attention to different product features is efficiently allocated ex-ante. In our salience model consumer attention to different product attributes is drawn ex-post, depending on which attribute stands out. Koszegi and Szeidl (2013) follow a similar approach.

The paper is organized as follows. In section 2, we describe our basic model of competition and show how salience would influence product valuations by consumers. In section 3, we take qualities as fixed and examine the basic analytics of price competition and of price and quality salient equilibria. Section 4 focuses on the full model of quality competition, and derives our main results for markets for products where attribute salience matters. In section 5, we apply the model to discuss innovation. Section 6 concludes.

2 The Model

There are two firms, 1 and 2. Firm $k = 1, 2$ produces a good having quality q_k under a firm-specific cost function $c_k(q_k)$. From the viewpoint of consumers, the good of firm k is identified by its quality q_k and price p_k. Qualities and prices are competitively set by firms. Following Shaked and Sutton (1982), we assume that firms play a two stage game. In the first stage, each firm k makes a costless commitment to produce quality $q_k \in [0, +\infty)$. In the second stage, firms set optimal prices given the quality-cost attributes they committed to (q_k, c_k), for $k = 1, 2$, where $c_k \equiv c_k(q_k)$. In light of these quality and price offerings, consumers choose which product to buy. In what follows, we consider only pure strategy Nash equilibria of this game.

There is a measure one of identical consumers, each of whom chooses one unit of one good from the choice set $C \equiv \{(q_2, -p_2), (q_1, -p_1)\}$.[2] Absent salience distortions, each consumer values good $k = 1, 2$ at:

$$u(q_k, -p_k) = q_k - p_k. \tag{1}$$

Both qualities and prices are measured in dollars and assumed to be known to the consumer. A salient thinker departs from (1) by inflating the weight attached to the attribute that he perceives to be more salient in the choice set $C \equiv \{(q_2, -p_2), (q_1, -p_1)\}$.

For each good k in the choice set C, its salient attributes are those whose levels are unusual or surprising, in the sense of being furthest from the reference attribute levels in the choice set C. Following BGS (2013), we take the reference attribute levels to be the average levels in the choice set. In the choice set C, the reference good is thus $(\overline{q}, -\overline{p})$, where $\overline{p} = (p_1 + p_2)/2$ and $\overline{q} = (q_1 + q_2)/2$ are the average price and quality in the market.

Formally, we assume that there is a salience function $\sigma(x, y)$ that satisfies two properties: ordering and homogeneity of degree zero. According to ordering, if an interval $[x, y]$ is contained in a larger interval $[x', y']$, then $\sigma(x, y) < \sigma(x', y')$. According to homogeneity of degree zero, $\sigma(\alpha x, \alpha y) = \sigma(x, y)$ for any $\alpha > 0$, with $\sigma(0, 0) = 0$. Ordering and homogeneity of degree zero imply that the salience of a good's quality is an increasing function of the percentage difference between the good's quality and the average quality in the choice set, and similarly for price. In particular, consumers have diminishing sensitivity to attribute differences: increasing the prices of both goods by a uniform amount ϵ makes prices less salient, $\sigma(p_k + \epsilon, \overline{p} + \epsilon) < \sigma(p_k, \overline{p})$ for $k = 1, 2$. This property is consistent with Weber's law of sensorial perception (see BGS 2013).

In the choice set C, then, the salience of price for good k is equal to $\sigma(p_k, \overline{p})$ while the salience of quality for good k is equal to $\sigma(q_k, \overline{q})$. Good k's quality is more salient than its price – or, for short, quality is salient – if and only if $\sigma(q_k, \overline{q}) > \sigma(p_k, \overline{p})$.

[2]Though we consider the simplest setting in which there are only two firms, producing one good each, and there are no outside options, the analysis can be extended to multiple goods and outside options. The role of the outside option is not critical and Online Appendix 2 extends the model to include one. To apply the salience framework to a more general model of market competition, the relevant market should be taken as the definition of choice set. This process allows for some flexibility in defining what the alternatives of choice are, but this flexibility is similar to that involved in defining a specific competitive market context in conventional models of industrial organization.

Given a salience ranking, the salient thinker's perceived utility from good $(q_k, -p_k)$ is given by:

$$u^{ST}(q_k, -p_k) = \begin{cases} q_k - \delta p_k & \text{if} \quad \text{quality is salient} \\ \delta q_k - p_k & \text{if} \quad \text{price is salient} \\ q_k - p_k & \text{if} \quad \text{equal salience} \end{cases}, \tag{2}$$

where $\delta \in [0, 1]$ captures the extent to which valuation is distorted by salience.[3] When $\delta = 1$ valuation is rational, as it coincides with (1). When $\delta < 1$, the consumer overweights the salient attribute. The competitive equilibrium then depends on δ, allowing us to study how salience affects market competition.

The assumptions of consumer homogeneity and rank-based salience weighting allow us to characterize the basic implications of our framework. Consumer homogeneity provides a clear rational benchmark against which the effects of salient thinking are best illustrated. In Online Appendix 1 we introduce heterogeneity into the model using a specification in which the salience of different attributes has a stochastic component that varies in the population of otherwise identical consumers. In this formulation, the effect of price and quality changes is more continuous, and our key results continue to hold. Integrating salience with heterogeneity in consumer tastes is an important topic for future research, particularly with regards to testing empirically the effect of salience on consumer demand.

We solve this model in two steps. In Section 3, we take each firm's quality and cost (q_k, c_k) as given and study price competition among firms. This price setting stage is of independent interest from endogenous quality choice because in the short run firms often take quality as given, and react to cost shocks only by adjusting their prices (in some settings firms may be unable to adjust quality, due to regulatory or technological constraints). Section 4 investigates how firms choose quality in the first stage so as to influence price competition in the second stage.

[3]Relative to BGS 2013, we omit for simplicity the normalisation factor $\frac{2}{1+\delta}$.

3 Price Competition

We begin with an analysis of price competition between firms 1 and 2, assuming that qualities q_1, q_2 and costs c_1, c_2 are fixed, and only prices are set by firms. We assume that firm 1 has a weakly higher quality and cost than firm 2, namely $q_1 \geq q_2$ and $c_1 \geq c_2$ (in Sections 3 and 4 the ranking of quality and costs is determined endogenously). Before characterizing the outcome under salience, consider the rational benchmark that obtains when $\delta = 1$.

Lemma 1 *When $\delta = 1$, the equilibrium under price competition is as follows:*
i) If $q_1 - c_1 > q_2 - c_2$, the consumer buys the high quality good 1. Prices are $p_1 = c_2 + (q_1 - q_2)$ and $p_2 = c_2$. The profit of firm 1 is equal to $\pi_1 = (q_1 - q_2) - (c_1 - c_2)$.
ii) If $q_1 - c_1 < q_2 - c_2$, the consumer buys the low quality good 2. Prices are $p_1 = c_1$ and $p_2 = c_1 - (q_1 - q_2)$. The profit of firm 2 is equal to $\pi_2 = (c_1 - c_2) - (q_1 - q_2)$.
iii) If $q_1 - c_1 = q_2 - c_2$, the consumer is indifferent between the high and the low quality good. Prices are $p_1 = c_1$ and $p_2 = c_2$. Firms make zero profits.

In the rational model, the firm creating greater surplus $q_k - c_k$ captures the entire market and makes a profit equal to the differential surplus created.[4] When, as in case *iii*), the two goods yield the same surplus, firms share the market and make zero profits, as in standard Bertrand competition. The benchmark of fully homogeneous goods and zero profits corresponds to the special case $q_1 = q_2 = q$, and $c_1 = c_2 = c$.

To see how salience affects price competition, suppose that the firm producing the low quality product 2 sets price $p_2 \leq p_1$. The next section shows that this always holds in equilibrium. Homogeneity of degree zero of the salience function then implies that the same attribute – either quality or price – is salient for both goods. In particular, quality is salient (that is, quality is more salient than price for both goods) provided:

$$\frac{q_1}{q_2} > \frac{p_1}{p_2}, \tag{3}$$

[4] In principle, the price competition game has multiple equilibria, corresponding to different price levels the losing firm may set leading to zero demand for its good. We refine the set of equilibria by assuming that the firm that loses the market sets price equal to production cost (as setting price below cost might entail negative profits). See Appendix A, footnote 17 for details.

namely if the proportional difference between qualities is higher than that between prices. Equivalently, quality is salient when the high quality good has a higher quality to price ratio than the low quality good (i.e., $q_1/p_1 > q_2/p_2$). Price is salient if and only if the reverse of Equation (2) holds, that is, if the low quality good has a better quality to price ratio than the high quality good (i.e., $q_1/p_1 < q_2/p_2$). Because by Equation (2) the good that fares better along the salient attribute is overvalued relative to the other good, salience tilts preferences in favor of the good that has the highest ratio of quality to price (BGS 2013).

According to Equation (2), the valuation of a good depends not just on the good's characteristics but also on the entire competitive context. If qualities vary more than prices across all choice options, the consumer pays more attention to (overweights) quality differences when making his choice. If prices vary more than qualities, the reverse is true. This implies that, by changing its price, a firm exerts an "attention externality" on the competing good. To see this, recall that $q_1 > q_2$ and $p_1 > p_2$, and suppose the high quality firm reduces its price p_1. This change does not simply improve the consumer's valuation of good 1: by making prices less salient, it also draws the consumer's attention to the low quality of good 2. Suppose, alternatively, that the low quality firm reduces its price p_2. This does not only improve the consumer's valuation of good 2: by making prices more salient, it also draws his attention to the high price of good 1. In other words, by cutting its price a firm draws the consumer's attention to the attribute along which it fares better. As this attention externality makes price cuts more effective in attracting consumers, it seems that it should strengthen competitive forces. As we will see, however, this is not always the case.

3.1 Salience and Competitive Pricing

When a firm sells to salient thinkers, it sets its price to render salient the advantage of its product relative to its competitor. To explore how salience affects competitive pricing, we examine price setting in two opposite situations, one in which quality is salient and firm 1 wins the market, another in which price is salient and firm 2 wins the market.

Consider first the optimal price set by the high quality firm 1 in order to win a quality-salient market. Suppose that firm 2 has set a price p_2 for q_2. The maximal price p_1 at which firm 1 lures the consumer into buying its product while keeping quality salient solves:

$$\begin{aligned}
&\max_{p_1 \geq p_2} \quad p_1 - c_1 \\
&s.t. \quad q_1 - \delta p_1 \geq q_2 - \delta p_2, &(4)\\
&\qquad\quad q_1/p_1 \geq q_2/p_2. &(5)
\end{aligned}$$

Constraint (4) ensures that the consumer prefers good 1 when quality is salient, while constraint (5) ensures that quality is indeed salient. There are two departures from the rational case. On the one hand, firm 1 now has an additional reason to cut its price: by setting p_1 low enough, it makes quality salient in (5), inducing the consumer to buy its high quality product. On the other hand, when quality is salient the high quality good is over-valued, which may allow firm 1 to hike its price p_1 above the rational equilibrium level. This effect of salience is captured by Equation (4).

Consider next the optimal price set by the low cost firm 2 to win a price salient market. The maximal price p_2 at which firm 2 lures the consumer into buying its product while keeping prices salient solves:

$$\begin{aligned}
&\max_{p_2 \leq p_1} \quad p_2 - c_2 \\
&s.t. \quad \delta q_2 - p_2 \geq \delta q_1 - p_1, &(6)\\
&\qquad\quad q_2/p_2 \geq q_1/p_1. &(7)
\end{aligned}$$

Once again, price setting is constrained by consumer participation and salience. On the one hand, salience provides firm 2 with an additional incentive to cut its price. By lowering p_2, firm 2 does not just make its product more attractive, it also makes its lower price salient, inducing the consumer to buy its cheaper product. This effect is captured by (7). On the other hand, by causing an over-valuation of the cheap good, salience can allow firm 2 to charge a higher price than in the rational case. This effect is captured by (6).

This preliminary analysis suggests that, depending on the balance between the salience and participation constraints, salient thinking may boost or dampen prices relative to a rational world. To see which force dominates, we now characterise equilibrium prices under salience. To do so, we make the simplifying parametric restriction:

A.1: $\delta(c_1 - c_2) < q_1 - q_2 < \frac{1}{\delta}(c_1 - c_2)$.

Assumption A.1 ensures that salience fully determines the preference of consumers among goods when prices are equal to production costs. If quality is salient, consumers prefer the high quality good 1; if price is salient they prefer the cheap good 2. As evident from A.1, this is akin to assuming that the two firms produce sufficiently similar surpluses $q_k - c_k$ that changes in salience change the consumer's preference ranking. Under A.1, we can characterise which firm wins the market. Appendix A contains all the proofs.

Proposition 1 *Under A.1, pure strategy subgame perfect equilibria under price competition satisfy:*

i) if $\frac{q_1}{c_1} > \frac{q_2}{c_2}$, quality is salient, the consumer buys the high quality good, and prices are

$$p_1 = \min\{q_1 \cdot \frac{c_2}{q_2}, c_2 + \frac{1}{\delta}(q_1 - q_2)\} \quad \textit{and} \quad p_2 = c_2.$$

ii) if $\frac{q_1}{c_1} < \frac{q_2}{c_2}$, price is salient, the consumer buys the low quality good, and prices are

$$p_1 = c_1 \textit{ and } p_2 = \min\{q_2 \cdot \frac{c_1}{q_1}, c_1 - \delta(q_1 - q_2)\}.$$

iii) if $\frac{q_1}{c_1} = \frac{q_2}{c_2}$, quality and price are equally salient, the consumer buys the good delivering the highest (rational) surplus $q_k - c_k$, and prices are

$$p_1 = c_1 \textit{ and } p_2 = c_2.$$

Under salience, the market equilibrium critically depends on the quality to cost ratios q_k/c_k of different products. A firm with a higher ratio q_k/c_k monopolizes the market and makes positive profits. When the two firms have identical quality to cost ratios, they earn zero profits in the competitive equilibrium.

Proposition 1 holds because the firm having the highest quality to cost ratio can always engineer a price cut turning salience in its favor. When $q_1/c_1 > q_2/c_2$, the high quality firm can set a sufficiently low price that quality becomes salient, monopolizing the market. The low quality firm is unable to reverse this outcome: in fact, doing so would require it to cut price below cost. When instead $q_1/c_1 < q_2/c_2$, the low quality firm can set price sufficiently low so that price is salient, and it monopolizes the market. The high quality firm is unable to reverse this outcome: once again, doing so would require it to cut price below cost. Finally, consider the case in which $q_1/c_1 = q_2/c_2$. In this case, salience changes as soon as a firm tries to set its price above cost. In particular, as soon as a firm tries to extract some consumer surplus, its disadvantage becomes salient and the price hike becomes self defeating. The only equilibrium outcome is zero profits for both firms.

The central role of the quality to cost ratio is economically appealing because it pins down salience distortions in terms of average costs of quality c_k/q_k. As we show when we endogenize quality, this feature allows our model to make tight predictions about how changes in cost structure affect salience and market outcomes. Before turning to that analysis, it is useful to look more closely at some implications of Proposition 1.

3.2 Price salient vs. Quality salient equilibria

Depending on the quality and cost parameters, salience leads to two types of equilibria: price salient and quality salient. In quality salient equilibria (case i of Proposition 1), consumers' attention is drawn to quality and they pay less attention to prices. This resembles de-commoditized markets described in the marketing literature. In contrast, in price salient equilibria (case ii), consumers' attention is drawn to prices and they neglect quality differences among goods. This resembles the canonical description of commoditised markets (Rangan and Bowman 1992).

According to Proposition 1, in both types of equilibria the profits of the winning firm can be either lower or higher than in the rational benchmark. To see this, note that - due to the salience constraint - the equilibrium profits of the winning firm k (the one with lowest average cost) must satisfy:

$$\pi_k^S \leq q_k \cdot \frac{c_{-k}}{q_{-k}} - c_k = q_k \left[\frac{c_{-k}}{q_{-k}} - \frac{c_k}{q_k} \right], \tag{8}$$

where equality holds when the salience constraint binds. Equation (8) shows that equilibrium profits increase in the difference between the firms' average cost of quality. Consider the following special cases:

- The two goods yield different surpluses $q_1 - c_1 \neq q_2 - c_2$ but exhibit identical (similar) average costs of quality. Under rationality, the high surplus firm would make positive profits. Under salient thinking, in contrast, industry profits are zero (negligible). Intuitively, when average costs of quality are identical (similar), a firm can always undercut its competitor and render its advantage salient. Price cuts are thus very effective and profits are lower than under rationality.

- The two goods yield the same surplus $q_1 - c_1 = q_2 - c_2$, but differ in their average costs of quality. Here, profits are zero under rationality, but positive under salient thinking. The reason is that the firm with the lower average cost of quality can set a price above cost and still be perceived as offering a better deal than its competitor. Price cuts by the losing firm are ineffective, and salience dampens competitive forces.

Salience can create abnormal profits in both quality and price salient equilibria. In quality salient equilibria, consumers overvalue the high quality good. The high quality firm is then able to hike prices and earn high profits. Financial services and fashion may be examples of this type of competition. In price salient equilibria, consumers are attentive to prices and under-appreciate quality differences among products. This grants an extra advantage to the cheap (and low quality) firm, allowing it to raise the price above cost.[5] Fast-food industry and low-cost airlines may be examples of this type of competition.

4 Optimal Quality Choice

We now examine endogenous quality choice in the two-stage game introduced in Section 1. In the first stage, each firm $k = 1, 2$ makes a costless commitment to produce quality $q_k \in [0, +\infty)$. In the second stage, firms compete in prices given the quality-cost attributes each firm committed to $(q_k, c_k(q_k))$, for $k = 1, 2$. We denote by $c_k(q)$ the increasing and

[5] This result extends to *industry* profits as a whole, namely the sum of the profits of both firms.

convex cost of firm k in producing the quality q it committed to, where $k = 1, 2$.[6] Cost functions are common knowledge.

We assume that firm 1 is the low cost firm, in the sense that it has weakly lower total and marginal costs of quality than firm 2. Formally, $c_1(q) \leq c_2(q)$ and $c_1'(q) \leq c_2'(q)$ for all qualities q. The cost function has a fixed and a variable component. Formally, $c_k(q) = F_k + v_k(q)$, where $v_k(q)$ is an increasing and convex function satisfying $v_k(0) = 0$. To obtain intuitive closed form solutions, we sometimes use the quadratic form:

$$c_k(q) = F_k + \frac{c_k}{2} \cdot q^2, \text{ for } k = 1, 2, \text{ where } c_1 \leq c_2 \text{ and } F_1 \leq F_2. \tag{9}$$

The critical question is whether the low cost of quality firm 1 will choose to produce higher or lower quality than the high cost of quality firm 2, and what this implies for the equilibrium market outcome.

To fix ideas, consider the rational benchmark. In stage 2, the market is monopolized by firm k producing the highest surplus $q_k - c_k(q_k)$. Anticipating this, at $t = 1$ the two firms set their qualities as follows.

Lemma 2 *Under rationality, it is (weakly) optimal for firm $k = 1, 2$ to set q_k^* such that:*

$$c_k'(q_k^*) = 1. \tag{10}$$

a) If firms have the same marginal cost of quality $v_1'(q) = v_2'(q) = v'(q)$, they set identical quality levels $q_1^* = q_2^* = q^*$. Firm 1 sets price $p_1^* = c_2(q^*)$ and monopolizes the market (making positive profits) if and only if $F_1 < F_2$. If $F_1 = F_2$, equilibrium profits are zero.
b) If firm 1 has a lower marginal cost of quality than 2, namely $v_1'(q) < v_2'(q)$, then it commits to higher quality $q_1^* > q_2^*$ and monopolizes the market (making positive profits) by setting $p_1^* = c_2(q_2^*) + (q_1^* - q_2^*)$.

By choosing the surplus-maximizing quality in (10), each firm maximizes its chance to

[6] This implies, plausibly, that a firm's marginal cost of quality increases with the quality it produces. Results would change under the alternative assumption that the marginal cost of producing the good does not depend on q but firms must incur a variable cost $H(q)$ at $t = 0$ to produce quality q at $t = 1$. Abstracting from the issue of firm entry or exit (thus taking as given the presence of the two firms in the market), in that case quality will always be salient at $t = 1$ and only quality-salient equilibria would exist.

win the market.[7] If firms have identical costs $c_1(q) = c_2(q)$, they produce homogeneous goods, split the market, and make no profits. If instead firm 1 has strictly lower costs than firm 2, it captures the entire market and makes positive profits. Firm 1 then provides higher quality if and only its marginal cost of quality is lower than that of firm 2.

Under the quadratic cost function of Equation (9), firm k sets its quality at the level:

$$q_k^* = \frac{1}{c_k},$$

which intuitively increases as the marginal cost falls (as c_k becomes smaller), but is independent of F. In the rational model, a drop in the marginal cost of quality for all firms increases equilibrium quality, while a drop in the fixed cost of quality F leaves quality unaffected.

4.1 Salience and Quality Choice

Consider now how salience affects quality choice. To build intuition , suppose that the two firms have identical costs of quality $c_1(q) = c_2(q) = c(q)$. Suppose that firms are at the "rational" quality level q^*, which is pinned down by the optimality condition $c'(q^*) = 1$. If consumers are salient thinkers, would firm 1 have an incentive to deviate from the first best quality q^*?

Consider the incentive of firm 1 to choose a lower quality, cheaper, product. The new product has quality $q' = q^* - \Delta q$ and cost $c(q') = c(q^*) - \Delta c$. Whether this new product is successful or not against q^* critically relies on salience. If the lower quality q' is salient, the new product fails. If instead the lower price is salient, the new product may be successful. By Proposition 1, price is salient if and only if the quality to cost ratio of q' is higher than that of product q^*:

$$\frac{q^* - \Delta q}{c(q^*) - \Delta c} > \frac{q^*}{c(q^*)} \iff \frac{\Delta c}{\Delta q} > \frac{c(q^*)}{q^*}. \tag{11}$$

A cost cutting deviation works if the marginal cost of quality $\Delta c/\Delta q$ is higher than the

[7] If firm 1 has strictly lower costs than firm 2, then in equilibrium firm 2 loses the market. Firm 2 is then indifferent to deviating to a different quality than the one entailed by (10). In principle, there may be multiple equilibria, each corresponding to a different quality level chosen by firm 2. We refine the set of Nash equilibria by assuming that firm 2 chooses the surplus maximizing quality, which is a weakly dominant strategy.

average cost $c(q^*)/q^*$ at the rational equilibrium. This is intuitive: when the marginal cost is high, a small quality reduction greatly reduces the cost of firm 1. This allows firm 1 to set a salient low price, and to win the market.

The attention externality plays a key role here. As prices become salient, consumers pay less attention to quality, which reduces consumer valuation of the quality q' offered by the deviating firm. This effect may undermine the profitability of the new product. However, because price becomes salient for *both* firms, the valuation by consumers of the competing product q^* drops even more! It is precisely this externality that allows the quality reduction to be profitable for firm 1.

Consider the alternative move whereby firm 1 deviates to a higher quality product $q' = q^* + \Delta q$, which entails a higher cost $c(q') = c(q^*) + \Delta c$. If the higher price of q' is salient, the deviation fails. If however its higher quality is salient, the new product may be successful. This scenario occurs provided:

$$\frac{q^* + \Delta q}{c(q^*) + \Delta c} > \frac{q^*}{c(q^*)} \;\Leftrightarrow\; \frac{\Delta c}{\Delta q} < \frac{c(q^*)}{q^*}. \tag{12}$$

A quality improving deviation can work provided the marginal cost of quality is below the average cost at the rational equilibrium. Intuitively, if the marginal cost is low, a large quality improvement entails only a small price hike, making quality salient. Once again, the attention externality is at work. The salience of quality boosts consumer valuation of the new product, but it also draws the consumer's attention to the low quality q^* of the competing product. These effects cause a relative over-valuation of the high quality product q', allowing the deviating firm to make profits.

This discussion delivers two messages. First, salience creates incentives to deviate away from the rational equilibrium. Second, the deviation can be toward higher or lower quality depending on the relationship between marginal and average costs of quality. In equilibrium, quality is generally provided at inefficient levels.

To further explore these forces, let us consider the general case in which firms have different cost of quality functions, $c_k(q) \neq c_j(q)$. Suppose that firm j has set the quality level q_j. The best response of firm k is then as follows.

Lemma 3 *The best response q_k^{br} of firm k to its opponent's quality q_j satisfies:*

i) weakly higher quality $q_k^{br} \geq q_j$ provided $c_k'(q_j) < c_j(q_j)/q_j$,

ii) weakly lower quality $q_k^{br} \leq q_j$ provided $c_k'(q_j) > c_j(q_j)/q_j$.

Both inequalities above are strict provided $c_j(q_j)/q_j \in (\delta, 1/\delta)$.

According to the salience constraint in (5) and (7), the maximum price per unit of quality that firm k can extract while still having its advantage salient is equal to the average cost $c_j(q_j)/q_j$ of the competing firm j. As a consequence, firm k optimally raises quality when the marginal cost $c_k'(q_j)$ of quality is lower than the marginal benefit $c_j(q_j)/q_j$. The firm optimally lowers quality when the reverse is true.

This mechanism implies that when the average cost of quality is high, the consumer is willing to pay a high price and still perceive quality as salient. In particular, when $c_j(q_j)/q_j > 1$, consumers overpay for quality and firm k has an incentive to over-provide it (relative to the rational benchmark $c_k'(q_k^*) = 1$). In contrast, when the average cost of quality is low, even a slight price increase is very salient. In this case, firm k benefits from cutting both quality and price. In particular, when $c_j(q_j)/q_j < 1$ firm k under-provides quality relative to the rational benchmark.

To describe the market equilibrium, we focus on the symmetric case in which the two firms have the same cost function $c_1(q) = c_2(q) = c(q)$. This case captures the long run outcome arising when all firms, through imitation or entry, end up adopting the best available technology.

Proposition 2 *When $\delta < 1$ and firms have identical cost functions, the unique pure strategy equilibrium is symmetric. Denote by $\overline{q}$ and $\underline{q}$ the quality levels such that $c'(\overline{q}) = 1/\delta$ and $c'(\underline{q}) = \delta$, and by $\widehat{q}(F)$ the quality level minimizing average cost, namely $\widehat{q}(F) \equiv$ $\arg\min c(q)/q$. Then, in equilibrium price and quality are equally salient, firms make no profits, and quality provision is given by:*

$$q_2^S = q_1^S = q^S \equiv \begin{cases} \overline{q} & if \quad F > \overline{F} \equiv \overline{q}/\delta - v(\overline{q}) \\ \widehat{q}(F) & if \quad F \in [\underline{F}, \overline{F}] \\ \underline{q} & if \quad F < \underline{F} \equiv \underline{q}\delta - v(\underline{q}) \end{cases} . \tag{13}$$

This equilibrium exhibits three main features. First, because costs are identical, firms produce the same quality, face the same production costs, and charge the same price. But then, because firms sell identical products, price and quality are equally salient in equilibrium. Hence, consumers value the products that are offered correctly (as in the case where $\delta = 1$), and firms make zero profits.

Second, although *in equilibrium* consumers correctly value the goods produced, there is inefficient provision of quality (and therefore lower consumer surplus) relative to the rational case. The reason is that salience makes the firms unwilling to deviate towards the socially efficient quality q^*. When quality is over-provided ($q^S > q^*$), reducing quality and price backfires because consumers' attention is drawn to the quality reduction, rather than to the price cut. This sustains an equilibrium with high quality and high prices. Similarly, when quality is under-provided ($q^S < q^*$), increases in quality and price backfire because consumers focus on the price rather than the quality hike. This sustains an equilibrium with low quality and low prices. Although in equilibrium both attributes are equally salient, we refer to the equilibrium with quality over-provision as quality-salient and to the equilibrium with under-provision as price-salient. This terminology underscores which salience ranking constrains firms from deviating towards the efficient quality level.

The third key feature of the equilibrium is that - unlike in the rational case - quality provision increases in the fixed cost of quality F.[8] Intuitively, F affects average costs and thus, by Lemma 3, the firms' best responses. When F is high, costs and thus prices are high. By the diminishing sensitivity property, the salience of prices is low. The firm has an incentive to boost quality because any extra cost can be "hidden" behind the already high price. As a consequence, the extra price is not salient and quality is over-provided. When in contrast F is low, costs and thus prices are low. By diminishing sensitivity, prices are now very salient. In this case, any price cut is immediately noticed, encouraging firms to cut costs to an extent that quality is under-provided.

To see these effects clearly, consider the case of the quadratic cost function.

Corollary 1 *When $\delta < 1$ and firms have identical quadratic costs $c(q) = F + c \cdot q^2/2$, quality*

[8] The reason is that $\widehat{q}(F)$ satisfies $v'(\widehat{q}) \cdot \widehat{q} - v(\widehat{q}) = F$ and the left hand side is increasing in quality because v is convex.

provision in the symmetric equilibrium is given by:

$$q_2^S = q_1^S = q^S \equiv \begin{cases} \frac{1}{\delta c} & if \quad F \cdot c > \frac{1}{2\delta^2} \\ \sqrt{\frac{2F}{c}} & if \quad \frac{1}{2\delta^2} \leq F \cdot c \leq \frac{\delta^2}{2} \\ \frac{\delta}{c} & if \quad F \cdot c < \frac{\delta^2}{2} \end{cases} . \tag{14}$$

Figure 1 below plots q^S as a function of the unit cost F, and compares it to the surplus maximizing quality, given by $q^* = 1/c$. As evident from the figure, salience causes quality

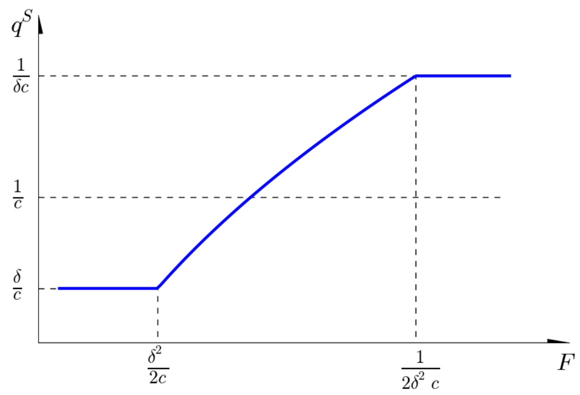

Figure 1: Quality provision in the symmetric equilibrium (quadratic cost).

to be over-provided when the fixed cost F is sufficiently high and under-provided otherwise. Recall that for $\delta = 1$, we have $q^* = 1/c$ and quality provision does not depend on the fixed cost F.

This analysis may help explain why sellers of expensive goods such as fancy hotel rooms or business class airplane seats compete mostly on the quality dimension, often providing customers with visible quality add-ons such as champagne, airport lounges, or treats. These visible quality add-ons help make overall product quality salient, and the profit margin associated with them can be hidden behind the high cost of the baseline good. In contrast, sellers of cheap goods such as low quality clothes or fast food compete on the price dimension, and cut product quality if that allows them to offer substantially lower prices. These cuts are proportionally larger in the price dimension, draw consumers' attention to prices, and thus enable firms that supply these cheap goods to make abnormal profits. In both cases, equilibrium profits disappear as competing firms adopt the same add-on or quality cutting strategies, despite the fact that they are providing inefficient levels of quality.[9]

Similar intuitions may help shed light on the technological and competitive forces leading product attributes to be "shrouded" (e.g. Gabaix and Laibson 2006) or to the introduction of "irrelevant" attributes (e.g. Carpenter, Glazer and Nakamoto, 1994). For instance, in a world where all hotels charge high prices for phone usage, it may be difficult for one hotel to cut phone charges and make that advantage salient to consumers (as opposed to other more important dimensions of hotel quality). In this sense, hotel charges for phone usage are shorouded. On the other hand, being the unique hotel that introduces a charge for pillows is a competitive disadvantage that is likely to draw consumers' attention. In this sense, charging for pillows would not be shrouded. Such trade-offs can be analysed in a setting with horizontal differentiation. We leave this important topic to future work.

So far we considered only the symmetric equilibrium in which the two firms share the same cost functions. The next section considers the effects of changes to cost structures, and in particular the case where firms have asymmetric costs.

4.2 Innovation as a Cost Shock

We now use our model to explore the implications of salience for product innovation. Suppose a market is in the long run symmetric equilibrium of Proposition 2. We view innovation as a change in product characteristics and market equilibrium triggered by a cost shock. We distinguish industry-wide cost shocks, such as those caused by deregulation or changes input prices, and firm-specific shocks such as those stemming from the development of a new technology by an individual firm. This taxonomy illustrates clearly the separate effects of the two key forces driving salience: diminishing sensitivity and ordering. Industry-wide shocks in fact work mainly through diminishing sensitivity because they alter the average

[9]The diminishing sensitivity property is also present in Prospect Theory (Tversky and Kahneman, 1981). The distinctive feature of our model is the attention externality, namely the fact that changing attributes of one product alter the valuation of the competing product. This ingredient is important to pin down equilibrium quantities and to generate strong reactions to price or quality changes. The benefit for a firm of increasing quality (and price) is particularly large when it induces the consumer to focus more on the full quality provided. Our model thus features a complementarity between the add-on quality and the baseline quality.

value of different attributes in the market. Firm-specific shocks instead work mostly through ordering: they allow one firm's product to stand out against those of its competitors. The analysis of firm specific shocks allows us to describe the equilibrium in our model when firms have different cost functions.

Real world innovation episodes often combine firm-specific and industry-wide factors. Initially only some firms discover new technologies or change their strategies in response to common shocks, so that the initial phase is effectively firm-specific. Subsequently, the new technologies or strategies spread to other firms, becoming industry-wide phenomena. One could view our analysis as providing snapshots of short and long-run market adjustments to shocks. We leave the modelling of industry dynamics under salience to future research.

In what follows, we restrict our attention to the case of quadratic costs, in which $c_k(q_k) = F_k + \frac{c_k}{2} \cdot q_k^2$, for $k = 1, 2$. We begin our analysis by considering industry-wide shocks to an industry in symmetric equilibrium.

Proposition 3 *Suppose that the market is in the equilibrium described by Equation (14). We then have:*
i) A marginal increase (decrease) in the fixed cost F of all firms weakly increases (decreases) equilibrium quality provision under salient thinking ($\delta < 1$) while it leaves quality unaffected under rationality ($\delta = 1$).
ii) A marginal increase (decrease) in the marginal cost of producing quality c of all firms strictly decreases (increases) equilibrium quality provision. Under salient thinking, the change in quality is larger than under rationality ($\delta = 1$) if and only if in the original equilibrium quality is sufficiently over-provided.

With rational consumers, changes in the fixed cost F do not affect quality provision. With salient thinkers, they do. This follows from the fact that a symmetric shock to the general level of costs shifts competition from quality to prices or vice-versa. A drastic increase in F reduces, by diminishing sensitivity, the salience of price differences. This makes it very attractive for firms to upgrade their quality. Conversely, a drastic reduction in F increases the salience of price differences. This makes it very attractive for firms to cut their prices. Somewhat paradoxically, a drop in costs translates into lower quality provision.

As an example, the transportation costs involved in exporting German cars to the United States (akin to a rise in F relative to the home market) may cause the car manufacturers to compete on quality provision in the US market, more than in the domestic market, by adding quality add-ons to their cars. Similarly, truffles are served in omelettes in Provence, while truffle "shavings" are added to elegant dishes in the United States; lobster is more likely to be served boiled in Boston than in Chicago. Conversely, a reduction in the tariffs on textile imports from China (akin to a drop in F) may induce clothing manufacturers in Europe to intensify price competition relative to the situation with higher tariffs.

The effect of a drop in the marginal cost of producing quality c is more standard. As in the rational case, this shock increases quality provision. However, salience modulates the strength of this effect. The boost in quality provision is amplified at very high cost levels, when there is over-provision of quality, while it is dampened in all other cases. This effect is again due to diminishing sensitivity: by reducing the level of prices, reductions in c render consumers more attentive to price differences, reducing firms' incentive to increase quality.

Consider next the effect of a firm-specific shock. Suppose that, starting from a symmetric equilibrium, firm 1 acquires a cost advantage over its competitor. This enables firm 1 to monopolize the market (see proofs in Appendix A). To analyze the new equilibrium, we allow firm 1 to freely adjust its quality but keep the quality of firm 2 fixed.[10] For brevity, we report only the effects of reductions in the variable cost of providing quality.

Proposition 4 *Suppose that, starting from the symmetric equilibrium of Equation (14), the variable cost of firm* 1 *drops to* $c_1 < c_2 = c$ *and firm* 1 *can optimally reset its quality and price. There are two cases:*

i) The cost shock is large, $c_1 < c/2$. *Then, firm* 1 *monopolizes the market by boosting both its quality and its price.*

ii) The cost shock is small, $c_1 > c/2$. *Then, there is a threshold* $\widehat{F} > 0$ *such that firm* 1

[10]Forcing firm 2 to keep the initial quality is not a significant restriction. Having a dominated technology, firm 2 is in fact certain of losing the market. As a consequence, it is weakly optimal for it not to alter its quality provision. In general, in a game in which firm 2 can freely choose its quality in response to the cost shock, there are several quality levels consistent with equilibrium. To make predictions one needs an equilibrium refinement criterion. Assuming that firm 2 does not adjust to the cost shock is one possible refinement criterion, based on the idea that firms face some inertia in adjusting their quality level, and so they keep quality constant unless it is strictly beneficial for them to do otherwise. See Online Appendix 3 for a more detailed characterization of asymmetric equilibria.

boosts its quality and price if and only if $F \geq \widehat{F}$. If $F < \widehat{F}$, firm 1 keeps its quality constant at the competitor's level δ/c, and monopolizes the market by slightly cutting its price.

The size of the cost shock plays a critical role. If the variable cost reduction is drastic, or if the fixed cost of quality is high (i.e. $F \geq \widehat{F}$), firm 1 can win the market by boosting quality provision. In this case, prices tend not to be salient, because average costs are high, and therefore quality differences can be large. A substantial quality upgrading alters the market outcome, changing the equilibrium from price- to quality- salient. As firm 1 provides extra quality, its product's overall quality becomes salient, raising consumers' willingness to pay even for infra-marginal quality units. In this sense, the quality add on acts as a complement to baseline quality, greatly increasing the price that firm 1 can charge for its product. This logic provides the testable predictions: i) quality add-ons are prevalent for higher quality (and more expensive) goods, and ii) the level of add-ons provided should respond positively to increases to the fixed cost of quality, and to reductions of the marginal cost of quality.

Matters are different when the cost shock is small, $c_1 > c/2$, and the fixed cost is low (i.e., $F < \widehat{F}$). Now prices tend to be salient because of low average cost of quality, and the small cost advantage also makes it very costly for firm 1 to engineer a drastic increase in quality. In this case, quality upgrades make the associated price hikes salient, and thus backfire. As a consequence, it is optimal for firm 1 to keep its quality constant at the symmetric equilibrium level, and to capture the market by lowering its price below the competitor's. This outcome, which is puzzling in a rational model, looks natural from the perspective of salience: in a price-salient equilibrium quality upgradings are neglected, and firms exploit lower costs to cut prices.

An important implication of this analysis is that price-salient equilibria are very stable, particularly for low cost industries. To escape a commoditized market, an individual firm must develop a drastic innovation that allows it to provide sufficiently higher quality than its competitors, and at such reasonable prices that quality can become salient. Small cost reducing innovations neither beat the "commodity magnet"nor lead to marginal quality improvements. They just translate into lower prices.

This result more generally illustrates the working of our model when costs are asymmetric. The low cost firm wins the market, but whether it does so by setting higher quality or lower price depends on the extent of its cost advantage. If it has a large cost advantage, the low cost firm captures the market by setting a salient high quality. If the cost advantage is small, the low cost firm captures the market by setting a salient low price.

In Proposition 4, the strategy of the losing firm 2 is held at the quality it would set in a symmetric equilibrium where both firms have cost $\mathbf{c}_2(q)$. This is a plausible refinement to study the effect of an innovation shock, but may be less appealing to study the equilibrium arising under permanently different cost functions. In Online Appendix 3, we describe asymmetric equilibria more generally, where the high cost firm 2 is not constrained to the quality level given by (14). Although the results focus on the case where $F = 0$, they closely mirror Proposition 4. The only difference is that when the cost advantage of firm 1 is low, equilibria may arise in which – instead of producing the same quality – the low cost firm wins the market by providing *less* quality than the high cost firm. This is a further departure from the rational benchmark: the low cost firm may deliberately provide lower quality precisely to make its lower price salient to the consumer.

5 Applications

We now apply our model to discuss some actual innovations. In Section 5.1 we discuss entry of Southwest into the airline market and entry of Starbucks into the coffee market. In Section 5.2 we show that our model can capture some features of recent financial innovations in securities markets.

5.1 Southwest and Starbucks

The rise of low cost airlines in the U.S. is directly linked to deregulation that started in the late seventies. Deregulation enabled carriers to freely set routes and prices, but also freed entry into the industry. Aside from the removal of price controls, these developments entailed a major reduction in the costs of operating an airline. New entrants such as Southwest implemented large price cuts. Traditional carriers, burdened with legacy costs, were unable to respond. Prices have declined steadily since deregulation, but some aspects of the quality of airline service have also declined.

Our model accounts for these events as the outcome of a transition from a quality to a price salient equilibrium. In the pre-deregulation era, the equilibrium was quality salient. High operating costs F rendered small differences in airfares non-salient. Airlines competed by offering visible extra services to consumers. High quality and high prices went hand in hand. Deregulation shifted the equilibrium from quality to price salient. The drop in operating costs F created the opportunity for new entrants to implement large price cuts. In the new price salient equilibrium, firms cut their quality to reduce prices even further. The budget air travel market thus became commoditized, characterized by low prices and low quality.[11]

These phenomena can also be described by a standard model with heterogeneous consumers. In this setting, equilibrium fares are initially so expensive that only wealthy (and thus price inelastic) consumers can afford to fly. Airlines cater to these consumers by providing high quality. As deregulation causes operating costs F to fall, poorer (and thus price-elastic) consumers enter the market. This intensifies price competition. If the inflow of price elastic consumers is large, quality provision may also drop.

In comparing these alternative accounts, note that only the salience model can explain why the market became *commoditized*, in the specific sense of inducing all consumers – even the wealthier ones – to become more price sensitive. In the standard model, original consumers continue to be price insensitive, and price competition intensifies just because price-sensitive consumers join the market.[12] At the same time, it is clear that after deregulation less affluent consumers increasingly used air travel, which is consistent with the rational explanation. A cleaner way to test our model is to consider markets where the composition

[11]Competition on quality in the pre-deregulation era might also be viewed as driven by price controls. When considering the role of price controls, two points should be noted. First, in the pre-deregulation era price controls merely specified a standard of "reasonableness" for prices. In principle, this rule did not prevent airlines to engage in small scale price competition (potentially affecting the standard price level itself). Of course, salience could be a reason why competition did not ignite a succession of "reasonable" price cuts: being small, such price cuts would not be noticed by consumers. In this sense, price controls and salience may be complementary forces.

[12]Commoditization seems critical to create a strong incentive for companies to cut quality. If all legacy consumers were willing to buy expensive high-quality tickets, one might have expected deregulation to increase the size of business class or create a large market segment specialized in serving price insensitive flyers. If instead all consumers become relatively more price sensitive, the reduction in quality occurs across the board, sparing perhaps only existing business class seats, which remain characterized by a high fixed cost F of airplane space.

of demand does not change over time.

To this end, consider the evolution of the coffee shop market. In the 1970's, sellers of drip coffee at neighbourhood coffee-shops and fast food restaurants offered low quality coffee at low prices. In this initial regime, innovations, such as free refills, effectively translated into price cuts instead of quality increases. In the 1980's, firms such as Starbucks and Pete's Coffee & Tea figured out how to deliver a much higher quality coffee at only a reasonable extra cost. This included serving expresso drinks but also training baristas to ensure consistency of the product, and providing a "cafe" experience through a comfortable in-shop environment. These firms gained market share by boosting the quality of their coffee as well as their prices.

Our model suggests the following account. The low quality and thus low prices prevailing in the 70's locked coffee sellers into a price salient equilibrium. The market was commoditized so that, consistent with Proposition 4, marginal innovations took the form of price reductions rather than quality upgrades. After inventing a way to drastically reduce the costs of producing quality, Starbucks could engineer a salient quality improvement. In the new quality salient equilibrium, much higher prices could be charged. Starbucks' well-documented growth trajectory, while extreme, reflects the growth of the premium coffee market, which was successfully de-commoditized.

It is not easy to describe these events based solely on consumer heterogeneity. Arguably, the composition of coffee buyers has been stable over time. As a result, it is difficult to explain why innovations in the coffee market changed from price-cutting to quality-improving. De-commodization in this market seems to require a generalized increase in the taste for quality, which is precisely what the salience model endogenously generates.

To take stock, the market wide predictions of the salience model are sometimes similar to those generated by a rational model of consumer heterogeneity, as in the case of airlines, and sometimes different, as in the case of the coffee market. Critically, in all applications the distinctive prediction of the salience model is that market changes trigger common shifts in the price sensitivity of all consumers. This provides a novel prediction of our model, which can in principle be tested with individual-level data.[13]

[13]More broadly, salience and consumer heterogeneity may play complementary roles, in the sense that salience may amplify existing heterogeneity. If one firm reduces price to attract price sensitive consumers, and in the process makes price salient for all consumers, other firms face pressure to cut prices further.

5.2 Financial Innovation

Our model can shed light on the working of financial innovation, and in the phenomenon of "reaching for yield." We describe innovations that occurred in the safe (AAA) asset market, involving the creation of mortgage backed securities (MBS). A security i is characterized by the expected return R_i it yields to investors (net of intermediation fees), and its risk (variance) v_i. The investor's "rational" valuation of asset (R_i, v_i) is mean-variance, namely:

$$u_i(R_i, v_i) = R_i - v_i. \tag{15}$$

Under salient thinking, the investor overweights the more salient attribute, which can be either risk or return. Suppose that the investor chooses between two securities $i = 1, 2$ and the salience function is $\sigma(\cdot, \cdot)$. The following cases can occur. If $\sigma(R_1, R_2) > \sigma(v_1, v_2)$, returns are salient and the investor values asset i at $R_i - \delta \cdot v_i$. If $\sigma(R_1, R_2) < \sigma(v_1, v_2)$, risk is salient and the investor values asset i at $\delta \cdot R_i - v_i$. Finally, if $\sigma(R_1, R_2) = \sigma(v_1, v_2)$, risk and return are equally salient and the investor's valuation is rational.

There are two financial intermediaries $i = 1, 2$, each producing an identical security delivering a gross expected return $\overline{R}$ with risk v. This is the no-innovation benchmark, in which both intermediaries produce an identical "standard" asset (perhaps because it is prohibitively costly to innovate). Given our emphasis on safe assets, we think of these standard securities as government-issued debt.

Intermediaries compete by offering a net return $R_i \leq \overline{R}$ to investors, who must decide with which intermediary to invest. If $R_i < \overline{R}$, the net return offered by firm i entails a positive intermediation fee. If $R_i = \overline{R}$, this fee is zero. Competition then works as in Section 2, where quality and cost are fixed.[14] Each intermediary offers a net of fee return R_i, which is analogous to product quality, at the cost to the investor of bearing risk v, which is analogous to price. As a consequence, the upside of the asset with the highest ratio of return to risk

Similarly, salience amplifies the perceived differentiation in markets where products are very similar. By focusing the consumers' attention on the (potentially small) differences between goods, salience allows for high markups which would otherwise require very high (even implausible) levels of consumer heterogeneity.

[14]The only difference is that in the setting of Section 2, firms' pricing strategies determine the cost for consumers to buy the good, while here the firms' pricing strategies determine the "quality" of the asset for the investor (namely the investor's return), while cost is exogenously given by the asset's risk.

R_i/v_i is salient, causing that asset to be overvalued relative to its competitor's. Because firms are identical and returns are given exogenously, the following equilibrium benchmark holds both in the rational case and with salient thinkers.

Lemma 4 *With no innovation, firms pledge their net returns to the investor,* $R_1 = R_2 = \overline{R}$, *the investor is indifferent between the two firms, and firms make zero profits.*

As in standard Bertrand competition, the two firms selling the same asset make zero profits, offering the totality of the return $\overline{R}$ to the investor (under salient thinking, the logic is the same as that of Proposition 1).

Against this benchmark, we model financial innovation as the creation by one firm of a technology to generate excess return at only a moderate extra risk. We allow the innovating firm, say 1, to increase the return of its asset to:

$$\overline{R} + \alpha,$$

where α is the new asset's excess return. The asset's risk then increases to:

$$v + \frac{c}{2} \cdot \alpha^2,$$

where c captures the (low) marginal cost - in terms of added risk - of creating excess return α. Firm 2 continues to produce the standard asset $(\overline{R}, v)$. The no-innovation benchmark can be viewed as the extreme case where c is prohibitively high for both firms.

With fully rational investors, the working of innovation is straightforward. In the spirit of Lemma 2, the innovating firm: i) captures the entire market by offering the investor a net return of $\overline{R} + (c/2) \cdot \alpha^2$ (which compensates the investor for bearing the extra risk), and ii) sets α to maximize its profit:

$$\max_{\alpha} \ \alpha - (c/2) \cdot \alpha^2 \tag{16}$$

which implies $\alpha^* = 1/c$. The lower is the extra risk c, the greater is the excess return promised by the new asset. As firm 1 manufactures an asset with a better return/risk combination, its profit and thus social welfare rise (the investor is left indifferent).

In the case of salient thinking, the critical question is whether, compared to the standard security, the new security's risk or return is salient. Depending on which attribute is salient, the firm will have an incentive to create a particular return vs. risk profile. The reason is that under salience the investor's risk appetite endogenously depends on the salient features of the new asset. The new equilibrium is as follows.

Proposition 5 *The innovating firm* 1 *captures the market and makes positive profits. The optimal excess return satisfies:*

$$\alpha^* = \begin{cases} \frac{1}{\delta \cdot c} & for \quad \overline{R} < \delta \cdot v \\ \frac{v}{\overline{R}} \cdot \frac{1}{c} & for \quad \overline{R} \geq \delta \cdot v \end{cases} . \tag{17}$$

Relative to the rational benchmark, under salient thinking there is excessive risk taking if $\overline{R} < v$ *and too little risk taking if* $\overline{R} > v$.

The innovation is particularly successful when investors focus on the extra return offered by the new asset and underweight the extra risk that comes with it. As Proposition 5 illustrates, this is the case precisely when the net return $\overline{R}$ of the standard asset is low. Diminishing sensitivity generates a "reach for yield" at low interest rates: an excess return of, say, 0.5% is much more salient when the baseline return is 1% than when the baseline return is 6%.[15,16]

Critically, Proposition 5 shows that in this case financial intermediaries have an incentive to manufacture excessively risky products. When investors focus on return, they underweight

[15] If one views the baseline return $\overline{R}$ as a net return generated after defraying the intermediary's operating costs, the same intuition may explain why banks take more risk when their operating costs are higher. If intermediaries react to higher operating costs (i.e. a lower $\overline{R}$) by cutting the net return paid to investors (as the rational model would predict), consumers would find this an unattractive deal, reducing their demand, and the intermediary's profit. If instead the intermediary takes more risk, investors focus on its excess return. Because the investors underweight the asset's risk, the intermediary can increase fees. These fees allow the intermediary not only to cover its higher operating costs, but also generate profits.

[16] Proposition 5 also shows that financial innovations geared at creating excess returns are much less successful when net returns are already high. In this case, the investor is much less sensitive to a given increase in return, and the innovating firm must keep the risks of the new asset very low, lest the investors focus on them. In this case, there is too little risk taking, in the sense that the intermediary selects an excess return in (17) below its rational counterpart in (16). Although for simplicity we have not allowed for this possibility, here the intermediary may find it profitable to reduce excess returns and risks relative to the standard asset.

risk. As a consequence, the intermediary is able to extract large fees without compensating investors for the risk they are bearing.

An important implication of this analysis is that, when investors' attention is drawn to returns, risks are relatively speaking neglected, and investors are disappointed when particularly bad returns render risk salient. In Gennaioli, Shleifer, and Vishny (2012, 2013), we modeled this neglect of risk investors' disregard of tail events. We also presented some evidence consistent with the prediction that downside risks were neglected in the period preceding the 2007 – 2008 financial crisis. The salience approach makes a similar point in a perhaps subtler way. During the "reach for yield" episodes where interest rates are low, investors are prone to be inattentive to risks. When investors underweighting risks, they engage in too much risk taking. When bad states of the world materialize, these investors wish they had paid more attention.

6 Conclusion

We have shown how salience changes some of the basic predictions of a standard model of competition with vertical product differentiation. Yet the paper has only begun to explore the consequences of salience for market competition. Rather than summarizing our results, in conclusion we mention some issues we have not addressed, but which may be interesting to investigate. These include dynamics of competition, welfare, horizontal product differentiation, and advertising. We have not solved any of these problems, so the discussion here is strictly conjectural.

In a dynamic setting, the salience of a firm's strategy is not only shaped by the background of its competitors, but also by past market outcomes. As we formalized in BGS (2013), the price of a product is salient not only if the product looks expensive relative to substitute goods available today, but also if it looks expensive relative to yesterday's prices. This result has interesting implications for the dynamics of entry and imitation. In particular, these dynamics may be very different depending on whether the original innovation ultimately leads to quality-salient or price-salient long run equilibrium. If an innovator finds a way to escape the commodity magnet and produce higher quality at a higher price, the pace at which this change is implemented, and imitated, might be relatively slow. The reason is that firms need to keep quality rather than price salient, and prevent consumers from becoming focused on price increases. This slows down innovation. As an extreme example, if consumers are used to free education, as they are in Europe, charging for education might be extremely difficult even with significant quality improvements because the focus will be entirely on prices. (Of course, once prices are high enough, the pace of innovation and price increases accelerates.) In contrast, precisely because consumers are focused on prices and neglect quality, innovation that reduces price and quality will be extremely fast. The slide to the commodity magnet will be faster than in a rational model.

We have shown that – under the natural assumption that consumer welfare is measured by the undistorted utility – quality provision is generally inefficient in a duopoly, as a consequence of competition for attention between the two firms. An assessment of the welfare consequences of competition when consumers are salient thinkers would require a deeper understanding of the model with heterogeneous consumers, and in particular of monopoly and free entry.

Our approach might also be used to study horizontal differentiation, and to investigate the marketing dictum of "differentiate in any way you can" (Levitt 1983). If a firm horizontally differentiates its product from competitors, then differences along the differentiated attribute become salient, and will attract consumers' attention. At the same time, differences in prices, which are similar across alternatives, will become non salient. In fact, firms might differentiate their products precisely to segment the market between consumers attracted to different attributes, and thus earn higher profits. This approach has clear applications to product markets, but it might also shed light on political competition, where it can reverse the median voter result in a plausible way. It would suggest that politicians might perhaps converge to the median voter viewpoint on some positions, but also seek to differentiate their views on dimensions that voters might find salient (and attractive). The two parties in the United States converge on their views on Social Security, for example, making sure that voters do not pay attention to that issue, but then seek to differentiate on the issues they choose, such as immigration or gay marriage.

Finally, salience may have significant implications for how we think about advertising, which deals precisely with drawing consumer attention to products and their attributes. Economists distinguish two broad approaches to advertising: informative and persuasive. The former focuses on provision of hard information about the product; the latter deals with its more emotional appeal. Salience suggests that in fact the two approaches are intimately related, and usually integrated: a key purpose of advertising is to inform about and thus draw attention to the attributes of the product that the seller wants the consumer to think about, but not others. Gas stations sell *regular* and *super* gasoline, even though the difference in octane content is only about 3%. Advertising of attributes is simultaneously informative (sometimes about prices, sometimes about quality, rarely both) and persuasive in that the salience of the attributes being advertised is enhanced. The purpose of advertising is precisely to let some desirable attributes of the product stand out for the potential customers.

In all these situations, firms compete to attract attention to the attributes they want consumers to attend to, and to distract attention from their less attractive attributes.

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A Proofs

Lemma 1 (price competition under rationality). When $\delta = 1$ there are no salience distortions and utility is given by Equation (1). We also assume that firms do not price below cost (as that might imply negative profits)[17], so we restrict $p_k \geq c_k$ for $k = 1, 2$.

If $q_1 - c_1 > q_2 - c_2$ then firm 1 sets price $p_1 = c_2 + (q_1 - q_2)$ and firm 2 sets price $p_2 = c_2$. Firm 2 has no incentive to deviate to another price, since it cannot satisfy the participation constraint while making non-negative profits, (and). Firm 1 has no incentive to deviate from p_1, since it cannot increase price without violating the participation constraint, and it cannot decrease price without reducing profits. If $q_1 - c_1 < q_2 - c_2$, the argument carries through switching firms 1 and 2. Finally, if $q_1 - c_1 = q_2 - c_2$, then both firms price at cost and share the market. We assume that having market share has some value to the firm, so that each firm strictly prefers to share the market while making zero profits to having zero market share. In this case, neither firm has an incentive to deviate: increasing price would violate the participation constraint, decreasing the price would imply making negative profits. ■

Proposition 1 (price competition under salient thinking). When $\delta < 1$, utility is given by Equation (2), where salience determines the relative weight of quality and price. We proceed under assumption A.1. As we show below, this assumption further implies that, in equilibrium, the good that wins the price competition sets the price so that its relative advantage is salient (i.e. the salience constraint weakly binds).

If $q_1/c_1 > q_2/c_2$, then assumption A.1 implies that firm 1 gains the market by setting p_1 sufficiently close to c_1. This ensures that quality is salient for both goods, and as a consequence consumers choose good 1. Since firm 2 loses the market, it sets price at $p_2 = c_2$. Firm 1 then hikes up price subject to the constraint that quality is salient

[17] Formally, if firm k loses the market in equilibrium, setting $p_k = c_k$ is a weakly dominant strategy for firm k. If $q_1 - c_1 > q_2 - c_2$ then firm 1 sets price $p_1 = p_2 + (q_1 - q_2)$ and firm 2 sets price p_2 in the range $p_2 \in [c_1 - (q_1 - q_2), c_2]$. In equilibrium, $p_2 > c_2$ cannot obtain since by reducing its price firm 2 could then profitably capture the market. Moreover, $p_2 < c_1 - (q_1 - q_2)$ can also not obtain in equilibrium since it would imply that both firms price below cost, making it beneficial for either firm to raise prices. Within the range $[c_1 - (q_1 - q_2), c_2]$, setting $p_2 = c_2$ is weakly dominant since a tremble play by firm 1 results in zero, instead of negative, profits.

and to the participation constraint (conditional on quality being salient), namely $p_1 = \min\left\{c_2 \cdot q_1/q_2, c_2 + \frac{1}{\delta}(q_1 - q_2)\right\}$, see constraints (4,5). Firm 1 has no incentive to deviate from this price. To see why, suppose the salience constraint is binding, $c_2 \cdot q_1/q_2 < c_2 + \frac{1}{\delta}(q_1 - q_2)$. Then raising the price p_1 above the salience constraint makes price salient, and the participation constraint becomes $p_1 < c_2 + \delta(q_1 - q_2)$. However, A.1 requires $c_2 + \delta(q_1 - q_2) < c_1$, which together with $\frac{q_1}{c_1} > \frac{q_2}{c_2}$ implies that the participation constraint is violated. By increasing price to the point where it becomes salient, firm 1 shifts the consumer's attention to its downside, and lowers the consumer's valuation to the point where it loses the market. Suppose instead that the participation constraint is binding. Then, by construction, any deviation in price leads to a decrease in profits.[18]

When $q_2/c_2 > q_1/c_1$, and as a result firm 1 sets price $p_1 = c_1$ and firm 2 sets price $p_2 = \min\{c_1 \cdot q_2/q_1, c_1 + \delta(q_2 - q_1)\}$, see constraints (6,7). Now price is salient, because firm 2 has lower price, lower quality but higher quality price ratio than firm 1. To see why this is an equilibrium, an argument similar to the above carries through. For instance, suppose that salience is binding for firm 2, namely, $c_1 \cdot q_2/q_1 < c_1 + \delta(q_2 - q_1)$. Then reducing p_2 decreases profits, while increasing p_2 takes firm 2 into a quality salient equilibrium, where the participation constraint reads $p_2 \leq c_1 + \frac{1}{\delta}(q_2 - q_1)$. Because the consumer now overvalues the quality differences across goods, his relative valuation of good 2 decreases drastically. Assumption A.1 then ensures the participation constraint is violated. Firm 1 has no incentive to change price, since increasing the price does not win the market, and decreasing the price might lead to negative profits if it does sell the good (notice the asymmetry in the firms' best responses, which comes from the fact that firm 2 can explore asymmetries in salience ranking when it is dominated, but firm 1 cannot). ■

Lemma 2 (quality competition under rationality). We are interested in pure strategy,

[18] Firm 2 might hike up its price to the point where the price of good 1 is salient. That would require setting $p_2 > p_1$, making good 2 a dominated good. When one good dominates the other, their salience rankings may be different, potentially allowing good 2 to be quality salient while good 1 is price salient. In fact, diminishing sensitivity implies that: i) the salience of quality is larger for the lower quality firm 2 than for firm 1, and ii) as firm 2 raises p_2 over p_1, price salience increases for firm 1 faster than for firm 2. So there is a range of prices where good 2 may be quality salient while the dominating good 1 is price salient, in which case good 2 is overvalued relative to good 1. This feature of the model occurs because salience distortions depend only on salience ranking. As we show in BGS (2013), under continuous salience weighting valuation is monotonic. To avoid this problem, we restrict optimisation in the price competition stage to $p_2 \leq p_1$.

sub-game perfect Nash equilibria. Consider first the case where firms have the same cost structure. In the price competition stage, the firm that generates the highest surplus wins the market or shares it. As a consequence, in the first stage of the game each firm $i = k, -k$ sets quality q^* to maximize its own surplus $q_i - c_i(q_i)$. Since firms are identical, both set the same quality q^* that satisfies $c_1'(q^*) = c_2'(q^*) = 1$.

Suppose now firm 1 has lower costs than firm 2. In the price competition stage, firm 1 wins the market, sets price $p_1 = c_2(q_2)+(q_1-q_2)$ and generates profits $c_2(q_2)-c_1(q_1)+(q_1-q_2)$. Consider now the choice of quality. As explained in footnote 7, we assume that the firm that loses the market chooses a surplus maximizing quality (this corresponds to a trembling hand perfect equilibrium). Profits are maximised when quality q_1^* satisfies $c_1'(q_1^*) = v_1'(q_1^*) = 1$. In particular, if firm 1 has the same marginal cost function but a lower fixed cost than firm 2, then in the first stage both firms set quality q^* satisfying $v_1'(q^*) = v_2'(q^*) = 1$. In this case, firm 1 sets price $p_1 = F_2 - F_1$. If firm 1 has lower marginal costs, then it commits to a higher quality, $q_1^* > q_2^*$ since $v_1'(q_1^*) = v_2'(q_2^*) = 1$ but $v_1'(q) \leq v_2'(q)$. ■

Lemma 3 (best response under salient thinking). Consider two firms, k and $-k$ with cost functions $c_k(\cdot)$, $c_{-k}(\cdot)$. Denote firm $-k$'s average costs by $A_{-k} = c_{-k}(q_{-k})/q_{-k}$. In deriving firm k's best response on quality, we consider prices $p_k^*(q_k, q_{-k})$ and $p_{-k}^*(q_k, q_{-k})$ to be set competitively at the price competition stage as a function of qualities q_k^*, q_{-k}^*. When quality is salient ex post (at the price competition stage), firm k's best response features $q_k^* \geq q_{-k}^*$ and $p_k = c_{-k}(q_{-k}) + \min\left\{A_{-k}, \frac{1}{\delta}\right\}(q_k - q_{-k})$. To see this, note that when $A_{-k} < \frac{1}{\delta}$ the price condition becomes the (binding) salience constraint, $p_k/q_k = A_{-k}$, while for $A_{-k} > \frac{1}{\delta}$ it becomes the (binding) participation constraint conditional on quality being salient. In particular, the price condition above ensures that firm k provides a weakly higher quality to price ratio than firm $-k$.

In contrast, when price is salient ex post, firm k's best response features $q_k^* \leq q_{-k}^*$ and $p_k = c_{-k}(q_{-k}) + \max\{A_{-k}, \delta\}(q_k - q_{-k})$. Again, this ensures firm k has a weakly higher quality to price ratio than firm $-k$.

We now consider firm k's best response case by case: if $A_{-k} \in \left[\delta, \frac{1}{\delta}\right]$, firm k sets quality $c_k'(q_k^*) = A_{-k}$. Since costs are convex, the marginal cost $c_k'(q)$ is increasing in quality q.

Thus, if $c'_k(q^*_{-k}) < A_{-k} = c'_k(q^*_k)$ it follows that $q^*_k > q^*_{-k}$ and quality is salient. Similarly, if $c'_k(q^*_{-k}) > A_{-k} = c'_k(q^*_k)$ it follows that $q^*_k < q^*_{-k}$ and price is salient.

If $A_{-k} > 1/\delta$, two possibilities arise. If $c'_k(q^*_{-k}) > A_{-k}$ then firm k sets quality so that $c'_k(q^*_k) = A_{-k}$ leading to a price salient outcome, in which $q^*_k < q^*_{-k}$. If instead $c'_k(q^*_{-k}) < A_{-k}$, then firm k maximizes profits by setting quality such that $c'_k(q^*_k) = 1/\delta$, as long as quality is salient and in particular $q^*_k > q^*_{-k}$. As q^*_{-k} increases, firm k can no longer maintain a salient advantage, either by increasing quality or by cutting quality. Therefore, its best response is to set $q^*_k = q^*_{-k}$.

If $A_{-k} < \delta$, again two possibilities arise. If $c'_k(q^*_{-k}) < A_{-k}$ then firm k sets quality so that $c'_k(q^*_k) = A_{-k}$ leading to a quality salient outcome, in which $q^*_k > q^*_{-k}$. If instead $c'_k(q^*_{-k}) < A_{-k}$, then firm k maximizes profits by setting quality such that $c'_k(q^*_k) = \delta$, as long as price is salient and in particular $q^*_k < q^*_{-k}$. As q^*_{-k} decreases, firm k can no longer maintain a salient advantage and its best response is to set $q^*_k = q^*_{-k}$. ■

Proposition 2 (symmetric equilibrium under salient thinking). We first show that any pure strategy subgame perfect equilibrium is symmetric. In equilibrium consumers must be indifferent between the two products and firms share the market (this is because, as is standard, we assume that each firm prefers to share the market while making zero profits to being driven out of the market). In particular, no firm's advantage can be salient. As a consequence, the two following conditions must hold: $q_1/c_1(q_1) = q_2/c_2(q_2)$ and $q_1 - c_1(q_1) = q_2 - c_2(q_2)$. Together, these conditions imply $q_1 = q_2$ and necessarily $c(q_1) = c(q_2)$.

We now show that in (symmetric) equilibrium, both firms provide equilibrium quality q^S given in equation (13). In fact, if firms provide any other quality, Lemma 3 shows that it is optimal to deviate. We begin by examining firm 1's incentives to deviate from this configuration. Consider the case where firm 2's average cost $c(q^S)/q^S$ lie in the interval $[\delta, 1/\delta]$. This translates into the restriction that $F \in [\delta \underline{q} - v(\underline{q}), \overline{q}/\delta - v(\overline{q})]$. Then, according to Lemma 3, firm 1's best response is to set quality q^* such that $c'(q^*) = c(\hat{q})/\hat{q}$ which precisely implies $q^* = \hat{q}$ (recall that, because costs are convex, the average-cost-minimizing quality satisfies $c'(\hat{q}) = c(\hat{q})/\hat{q}$).

Consider now the case where $c(q^S)/q^S > 1/\delta$, or equivalently $F > \overline{q}/\delta - v(\overline{q})$. Now firm

1's best response is to set $c'(q^*) = \frac{1}{\delta}$, provided $q^* \geq q^S$. But in fact, q^* and q^S satisfy the same condition, $c'(q^*) = c'(q^S) = c'(\overline{q}) = 1/\delta$, and therefore the best response coincides again with the equilibrium quality $\overline{q}$. Finally, when $c(q^S)/q^S < \delta$ or equivalently $F < \delta\underline{q} - v(\underline{q})$, firm 1's best response is to set $c'(q^*) = \delta$, provided $q^* \leq q^S$. An analogous argument then shows that $q^* = \underline{q}$, concluding the argument that this configuration is an equilibrium. ■

Corollary 1 (symmetric equilibrium for quadratic costs). Consider quadratic costs, where $v(q) = \frac{c}{2}q^2$. Then $c'(q) = c \cdot q$ so that $\overline{q} = \frac{1}{\delta c}$, and $\underline{q} = \frac{\delta}{c}$. Moreover, $\overline{F} = \frac{1}{2\delta^2 c}$ and $\underline{F} = \frac{\delta^2}{2c}$. Finally, $\hat{q}$ satisfies $c'(\hat{q}) = c(\hat{q})/\hat{q}$, which yields $\hat{q} = \sqrt{2F/c}$. ■

Proposition 3 (industry wide cost shocks). Under the symmetric equilibrium of Equation (14), consider an increase in the fixed cost of all firms, from F_0 to $F_1 > F_0$. If the interval $[F_0, F_1]$ has a non-empty overlap with the interval $[\underline{F}, \overline{F}]$, then equilibrium quality strictly increases from $\max\{\delta/c, \sqrt{2F_0/c}\}$ to $\min\{\sqrt{2F_1/c}, 1/(\delta c)\}$. Otherwise, equilibrium quality provision does not change, staying at δ/c if $F_1 < \underline{F}$ or at $1/(\delta c)$ if $F_0 > \overline{F}$.

Note that, when $\delta < 1$, the equilibrium quality can be written as $\frac{1}{c} \cdot A(c, F)$, where $A(c, F) = \max\{\delta, \min\{\sqrt{2Fc}, 1/\delta\}\}$. As a consequence, following an increase in the marginal cost of producing quality for all firms, quality provision strictly decreases. Consider a marginal increase in c. When is the change in quality provision in reaction to the cost shock larger than in the rational case? When $\delta = 1$, quality provision equals $1/c$. Therefore, the change in quality provision increases when $\delta < 1$ if and only if $A(c, F) > 1$, namely when quality is over provided to begin with (i.e. if $F > \frac{1}{2c}$). ■

Proposition 4 (firm specific cost shocks). Starting from the symmetric equilibrium of Equation (14), let the marginal cost of firm 1 drop to $c_1 < c_2 = c$. This implies that, at the symmetric quality level, firm 1's marginal costs are below firm 2's average costs. From Lemma 3 we know that firm 1 responds to the cost shock by weakly increasing quality. We first compute firm 1's best response from the equilibrium quality provision, and then show that firm 2 has no incentive to deviate.

When the fixed costs are sufficiently high, $F > \frac{\delta^2}{2c}$, the average costs of firm 2 satisfy $c(q^S)/q^S > \delta$. It then follows from Lemma 3 that firm 1's best response is to engineer a salient quality increase. When $c(q^S)/q^S < 1/\delta$, firm 1 sets $q_1^* = q^S \cdot \frac{c}{c_1} > q^S$. Firm 2 has no incentive to deviate because it is already minimizing average cost, so it cannot engineer a quality innovation that gives it a salient advantage which, together with the fact that it has higher costs, precludes any profitable deviation. When the average costs of firm 2 exceed $1/\delta$, firm 1 boosts quality to $1/\delta c_1$, which is above firm 2's quality provision of $1/\delta c$. Firm 2 again has no incentive to deviate, since increasing quality (thereby diminishing average costs below that of its competitor, if possible) is never profitable: if firm 2 engineers a salient quality advantage then it decreases perceived surplus, while if it creates a salient price advantage it cannot price above cost.

Consider now the case where $F < \frac{\delta^2}{2c}$. While firm 2 sets $q^S = \delta/c$, firm 1's best response is to set $q_1^* = \frac{c(q^S)/q^S}{c_1}$, provided $q_1^* > q^S$. This requires $F > \frac{\delta^2}{c}\left(\frac{c_1}{c} - \frac{1}{2}\right)$. Thus, if firm 1's cost advantage is sufficiently large, namely $c_1 < c/2$, then firm 1 strictly increases quality provision. If instead firm 1's cost advantage is small, $c_1 > c/2$, then for low enough levels of the fixed cost F, it is optimal for firm 1 to keep quality provision at the equilibrium level prior to the shock, $q_1^* = \delta/c$, and translate its cost advantage into profits by setting price $p_1 = c(\delta/c)$. Finally, firm 2 has no incentive to deviate because decreasing quality (thereby diminishing average costs) also decreases perceived surplus. ■

Lemma 4 (returns competition under rationality). This setting is similar to the price competition game of Lemma 1. While the costs facing investors are fixed at v (the security's risk), intermediaries compete in terms of the return they provide investors. Since intermediaries provide identical securities, this competition game only admits symmetric equilibria. In particular, both firms offer the maximum return to investors, $R_i - F = \overline{R} - F$, and share the market. No intermediary has an incentive to deviate from this configuration: increasing the returns offered to investors would lead to negative profits, while decreasing the returns would lead to the loss of the market share. ■

Proposition 5 (financial innovation under salient thinking). Suppose firm 2 creates a security of fixed total return and cost, $(\overline{R} - F, -v)$. Firm 1 develops a financial innovation and can create a family of securities $(\overline{R} + \alpha - F, -v - \frac{c}{2} \cdot \alpha^2)$, indexed by α, the increase in returns relative to the competition. The firms play a two stage game: in the first stage firm 1 chooses α, and in the second stage both firms choose how big a return to pledge to investors. Firm 1 pledges return $R_\alpha - F$ where $R_\alpha \in [\overline{R}, \overline{R} + \alpha]$ so that in the return competition stage it sells security $(R_\alpha - F, -v - \frac{c}{2} \cdot \alpha^2)$ and maximizes profits $\overline{R} + \alpha - R_\alpha$.

To determine the optimal choice of α, we begin by noticing that, for α sufficiently small, the marginal cost of quality for firm 1 is lower than its average cost. This is because returns increase linearly in α, while risk increases quadratically. As a result, firm 1 finds it optimal to provide a salient increase in returns. The pledged returns R_α must satisfy both the constraint that returns are salient, and the participation constraint. The salience constraint reads $R_\alpha - F > (\overline{R} - F) \cdot \frac{v + \frac{c}{2}\alpha^2}{v}$ (recall that firm 1 provides higher returns at a higher risk), while the valuation constraint reads $R_\alpha > \overline{R} + \delta \frac{c}{2} \alpha^2$. The valuation constraint is binding when $\overline{R} > F + \delta v$. In this case, firm 1 must provide at least $R_\alpha = \overline{R} + (\overline{R} - F)\frac{\delta c}{2}\alpha^2$. To maximize profits $\overline{R} + \alpha - R_\alpha$, firm 1 sets $\alpha = \frac{1}{\delta c}$.

The salience constraint is binding when $\overline{R} \geq F + \delta v$. In this case, firm 1 must provide at least $R_\alpha = F + (\overline{R} - F)\left(1 + \frac{c}{2v}\alpha^2\right)$. To maximize profits $\overline{R} + \alpha - R_\alpha$, firm 1 sets $\alpha = \frac{1}{\overline{R} - F} \cdot \frac{1}{c}$.

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