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Price and quality decisions by self-serving managers☆

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ABSTRACT

We present a theory of price and quality decisions by managers who are self-serving. In the theory, firms stress the price or quality of their products, but not both. Accounting for this, managers exploit any uncertainty about the cause of market outcomes to credit positive results to the dominant, "strategic" factor and blame negative results on the other—as doing so is psychologically rewarding. The problem with biased attributions, however, is that they prompt biased decisions. We motivate this argument with evidence from one experiment and then develop a model to understand the cost of the bias under different market conditions. Counter to intuition, we find that firms in a competitive setting can profit from the self-serving nature of their managers.

1. Introduction

In many industries, firms anxious of getting "stuck in the middle" approach the market stressing the price or quality of their products, but not both. For example, in retail Walmart claims "price leadership is core to who we are," while Wholefoods considers quality "the highest form of value."[1] In consumer electronics, Asus bets on "aggressive prices that make technology accessible to all," but Apple creates "the kind of wonder that revolutionizes entire industries." The fashion label H&M pursues "the best price for its customers," but DKNY applies "the highest standards of creativity and quality." In industrial equipment, Parker Hannifin warns "you are messing with a company DNA when you touch prices," while to SKF Group "cutting edge quality is our primary differentiator." Finally, EasyJet is the airline that wants to make travel "easy and affordable," but Emirates strives to "inspire travelers with excellence in service."

Accounting for the choice of orientation of their firms, managers may be tempted to explain unexpected outcomes in the market in a manner that is self-serving, crediting positive results to the dominant, "strategic" factor but blaming negative results

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[1] This comparison may not stand the test of time. Amazon recently acquired Wholefoods, and the former claims "offering low prices to our customers is fundamental to our future success."

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on the other. Indeed, research across disciplines has consistently found that managers exploit any ambiguity on the cause of firm performance to present their firms in a positive light (e.g., Bettman & Weitz, 1983; Libby & Rennekamp, 2012). The problem with biased attributions, however, is that they prompt biased decisions, which may be suboptimal for the firm.

We report initial experimental evidence to motivate this argument. Importantly, we then develop a model to understand the profit impact of self-serving price and quality decisions. In the model, the orientation of the firm toward either product factor is determined endogenously, and the manager is uncertain about the cause of the market outcome (expressed as the difference between realized and expected profit) because consumers form subjective valuations of price and quality that can deviate from the levels set by the firm. Uncertainty forces the manager to rely on inference, but this is distorted by the choice of orientation.

The starting point of our analysis is the case of a monopolist, and the cost of the bias to the firm is simply the difference in profit resulting from the adjustments to price or quality prompted by self-serving attributions and those prompted by optimal Bayesian attributions. Notably, we find that the cost of the bias is independent of the choice of orientation. We then introduce competition and show that the unique pure-strategy Nash equilibrium in orientations is that firms emphasize price over quality—orientation now matters. Counter to intuition, we show that in equilibrium firms actually profit from the prejudice of their managers. This is the case because sticky quality decisions that result from a price orientation relax competition in the market, which in turn creates upward pressure on prices and thereby leads to higher profits.

Looking back, social psychologists have long argued that individuals choose causal attributions strategically to manage sensations and impressions of the self (for a review, see Leary, 2007). Heider (1958) made the original observation that explanations are often tainted by "a person's own needs and wishes" (p. 118). Research thereafter formalized this intuition, highlighting several instances where individuals distort reality in a direction that supports their sense of self. A recent meta-analysis found the bias to be unusually large compared to similar cognitive limitations and pervasive among most age groups and cultures (Mezulis, Abramson, Hyde, & Hankin, 2004).

Just as people see themselves readily as the origin of good effects and reluctantly as the origin of ill effects, they see the firms that employ them readily as the origin of success and reluctantly as the origin of failure. For example, complementary studies by Bettman and Weitz (1983), Baginski, Hassell, and Hillison (2000), Baginski, Hassell, and Kimbrough (2004), Barton and Mercer (2005), and Libby and Rennekamp (2012) document the use of internal versus external attributions in public statements and, importantly, the impact of such disclosures on earnings forecasts and valuations by the investing community. In economics, self-serving beliefs help to explain impasses in bargaining (Babcock & Loewenstein, 1997; Babcock, Loewenstein, Issachroff, & Camerer, 1995) and differences between employers and employees on compensation decisions (Charness & Haruvy, 2000). In marketing, Curren, Folkes, and Steckel (1992) show that managers explain the consequences of marketing planning in a self-serving manner, and Biyalogorsky, Boulding, and Staelin (2006) blame the tendency to persist with new product failures in part on the same phenomenon. Finally, the self-serving bias has been linked to overconfidence (Hirshleifer, 2001), which in turn skews decisions about market entry (Camerer & Lovallo, 1999; Simon & Shrader, 2012), mergers and acquisitions (Billett & Qian, 2008; Malmendier & Tate, 2008), business creation (Koellinger, Minniti, & Schade, 2007), innovation (Galasso & Simcoe, 2011; Hirshleifer, Low, & Teoh, 2012), and new product introduction (Simon & Houghton, 2003).

Against this backdrop, we are the first to offer a formal model of the self-serving manager. In fact, while there is ample research that maps the bounded rationality of individuals in general, the majority construes "individuals" as consumers rather than professionals. The managers in our theory stray from Bayesian updating and are not conscious of their limitations. To address such problems, Goldfarb et al. (2012) recommend specifying alternative utility functions or adopting non-equilibrium concepts. However, in our model managers chase the standard profit-maximizing objective function in a standard equilibrium structure. It is the way these managers interpret new information that creates the problem.

Second, while prior research on the self-serving bias distinguishes between attributions that are internal to an organization in conditions of success and attributions that are external to an organization in conditions of failure, we study a setting where managers use factors under their control to explain positive *and* negative performance. To our knowledge, this is therefore the first paper to point out that candidate causes are not objectively internal or external. Rather, beliefs play a significant role.

Third, while the literature contemplates generic attributions such as skill, effort, states of nature, and even good fortune, we stress actions that are concrete, routine, and consequential. Indeed, decisions about the price and quality of a product are among the most common and significant in a firm. In this sense, our paper is closest to a recent study by Jiang and Liu (2019) on the effect of managerial optimism about market demand on price and quality decisions. The authors show that optimism encourages managers to increase quality, but it also induces the rival firm to reduce quality, thereby increasing differentiation and relaxing price competition.

Finally, we stress the relevance of our work for practice. We study not only the presence of a psychological bias and its effect on managerial decisions, but also the impact of these decisions on firm performance. The possibility that firms benefit from managers who have problems with causal reasoning challenges the conventional wisdom that biases should be screened out at recruitment or mitigated through incentives and training. In fact, we show that such "problems" add weight to a firm's choice of orientation in the market. Surprisingly, stressing price over quality allows firms to enjoy higher profits because the self-serving adjustments lead to sticky quality under a price orientation, which relaxes competition and allows managers to charge higher prices.

The remainder of the paper is structured as follows. Section 2 presents the experiment. Section 3 analyzes the profit impact of self-serving attributions and the optimal choice of orientation in a monopoly setting. Section 4 extends this analysis to include competition. Section 5 concludes, highlighting limitations of the research and offering directions for future work.

2. Motivation

We conducted an experiment to motivate our theory and connect it to fundamental principles of causal reasoning in social psychology (Weiner, 1985, 1986). The experiment serves as motivation in the sense that we elicited not only attributions and adjustments separately for price and quality, but also the underlying beliefs that, according to the literature, shape the way people generate explanations in the presence of uncertainty.[2]

We tested three predictions. First, we argue that the orientation of a firm toward price or quality determines how managers use these factors to explain success and failure in the market. Specifically, we anticipated that participants credit a surprisingly positive result primarily to the dominant factor, and blame a surprisingly negative result primarily on the lesser factor.

Second, we argue that this effect is mediated by a shift in the way participants perceive price and quality. In social psychology, causal attributions are distinguished along three dimensions: *locus* (whether an explanation is internal or external), *stability* (whether it endures over time), and *control* (whether it is subject to volitional alteration) (Weiner, 1985, 1986). A candidate explanation that appears internal, stable, and controllable is typically linked to the self and, therefore, associated with success and dissociated from failure, while a candidate explanation that appears external, unstable, and uncontrollable has the opposite use. By extension, price and quality serve the self-serving tendency of a manager to the extent that the choice of orientation by the firm separates the two factors on these dimensions: the dominant factor appears more internal, stable, and controllable than the lesser factor, and this in turn interacts with the valence of the market outcome to determine attributions.

The third prediction relates to adjustments. From a statistical standpoint, the argument is that associating an effect with a particular cause increases the attention paid to that cause (DeGroot & Schervish, 2011). Psychology makes the same claim: a basic tenet of attribution theory as it applies to motivation is that a person's own explanations for an event dictate the effort spent on the same activities (Weiner, 1986). Accordingly, we anticipated that a biased appraisal of the contribution of price and quality decisions to firm performance prompts a similar bias in the adjustments that follow—that is, a positive relationship between attributions and adjustments.

2.1. Participants and method

The sample comprised 306 undergraduate and graduate business students (42% female, 63% graduate, on average 21.6 years old). Participants read a scenario that describes the launch of a new product at a firm in a competitive market. The firm is "large with a significant presence in several geographies across Europe" and "diverse in the sense that it sells a variety of products and services in different categories." The manager in the firm learns from initial testing and extensive research that the most appealing (i.e., profitable) scenario is at a price of €25 and expected sales of 10,000 units in the first year.

We manipulated Orientation (to price or quality) and Market Outcome (positive or negative) in a between-subjects design. We varied Orientation with the following text: "Despite its complexity, the company is clear that it competes in each market based on price (quality). For example, on the company website this statement is immediately visible: 'When it comes to our customers, our priority and obsession is price (quality). Everything that we do is guided by the goal of providing excellent prices (quality), while remaining competitive on quality (price). This goal defines who we are and how we act."' We varied Market Outcome by telling participants that the firm eventually sold 12,500 units (25% above the estimate) or 7,500 units (25% below the estimate) for the year.

The stimulus included several measures. First, participants evaluated price and quality separately as the cause of the market outcome (−3 = "The price (quality) of the product is a lot lower than that of competitors" to 3 = "The price (quality) of the product is a lot higher than that of competitors"). Second, they expressed their response in the coming year (−3 = "Significantly decrease price (quality)" to 3 = "Significantly increase price (quality)"). Third, participants rated the two factors on locus ("Price (Quality) is a defining element of a product's value proposition;" 1 = "Strongly disagree" to 7 = "Strongly agree"), stability ("Price (Quality) is easy to change;" 1 = "Very easy to change" to 7 = "Very hard to change"), and control ("Market forces such as strong competitors and demanding customers play a role in determining the prices (qualities) of the products that firms sell;" 1 = "A very small role" to 7 = "A very large role").

Finally, as a background check participants also judged the gap in sales experienced by the firm (−3 = "A really bad result" to 3 = "A really good result"). These data show only a main effect of Market Outcome, with the mean score in the positive condition ($M = 5.65$, $SE = .08$) significantly higher than the one in the negative condition ($M = 2.73$, $SE = .09$; $F(1, 302) = 611.15$, $p < .001$, $\eta_p^2 = .67$), and both values significantly different from the midpoint of the scale ($t(152) = 21.16$, $p < .001$ and $t(152) = -14.33$, $p < .001$, respectively).

2.2. Results

2.2.1. Attributions

A two-way analysis of variance on Net Attributions, which is the difference between the participants' evaluations of price and quality as the cause of the market outcome (each expressed in absolute terms), shows a main effect of Orientation

[2] Appendix A reports a second experiment that replicates the main findings with a sample of experienced professionals and includes several additional background checks.

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($F(1,302) = 21.98$, $p < .001$, $\eta_p^2 = .07$) and, importantly, the expected interaction between Orientation and Market Outcome ($F(1,302) = 85.15$, $p < .001$, $\eta_p^2 = .22$). Consistent with the first prediction, participants in the price orientation condition reported stronger net attributions (i.e., attributions slanted more toward price) in response to the positive outcome ($M = 1.32$, $SE = .16$) than the negative outcome ($M = -.22$, $SE = .16$; $F(1,302) = 47.15$, $p < .001$, $\eta_p^2 = .14$). While the first of these means is positive and significantly greater than zero (the point where the two factors are considered equally responsible for the market outcome; $t(75) = 8.21$, $p < .001$), the second is negative but only directionally consistent ($p = .233$). Likewise, participants in the quality orientation condition reported weaker net attributions (i.e., attributions slanted more toward quality) in response to the positive outcome ($M = -.88$, $SE = .16$) than the negative outcome ($M = .49$, $SE = .16$; $F(1,302) = 38.20$, $p < .001$, $\eta_p^2 = .11$). In this case, both means are in the predicted direction and statistically different from zero ($t(76) = -5.67$, $p < .001$ and $t(76) = 3.95$, $p < .001$, respectively).

2.2.2. Mediation

We predicted that the effect of orientation on attributions is mediated by the participants' beliefs about price and quality on locus, stability, and control. The second step of this causal chain, the relationship between beliefs and attributions, is itself contingent on the valence of the market outcome. Accordingly, we conducted two tests of moderated mediation using model 14 of the PROCESS macro (Hayes, 2013).[3] In the model, Orientation and Market Outcome are contrast coded, and Net Beliefs is the difference between price and quality on locus, stability, and (the inverted scores of) control, combined into one measure and mean centered (Cronbach's $\alpha = .75$).[4] The dependent variable is Net Attributions.

Muller, Judd, and Yzerbyt (2005) argue that moderated mediation is substantiated by (a) evidence of moderation in at least one path in the causal chain linking the independent variable to the dependent variable through the mediator, and (b) evidence that the remaining path is statistically different from zero. Consistent with these criteria, the data show that the effect of Net Beliefs on Net Attributions is moderated by Market Outcome ($\beta = .48$, $SE = .10$, 95% CI[.29, .68], $p < .001$), and that Orientation has a significant impact on Net Beliefs ($\beta = 1.15$, $SE = .19$, 95% CI[.78, 1.53], $p < .001$).

Alternatively, Hayes (2015) specifies an "index of moderated mediation" that quantifies the relationship between the moderator and the size of the indirect effect of the independent variable on the dependent variable. Specifically, moderated mediation is substantiated when any two conditional indirect effects estimated at different values of the moderator are significantly different from each other. In our data, the conditional indirect effects of Orientation are $\beta = -.14$ ($SE = .10$, 95% CI[−.35, .04]) in the negative Market Outcome condition and $\beta = .42$ ($SE = .13$, 95% CI[.20, .69]) in the positive Market Outcome condition. Accordingly, the index of moderated mediation is .56 ($SE = .18$). Because the bootstrap confidence interval does not include zero (95% CI[.24, .95]), we again find support for the second prediction.

2.2.3. Adjustments

The final prediction is a significant and positive effect of Attributions on Adjustments. We tested this relationship by regressing Net Adjustments on Net Attributions. In the regression, Net Adjustments is the difference between the participants' price and quality responses, each expressed in absolute terms. The two variables are related as anticipated: $\beta = .12$, $SE = .05$, $p = .013$.

2.3. Discussion

This experiment provides initial empirical support for our theory. Next, we want to understand how the attributions and adjustments of self-serving managers impact firm performance. Section 3 considers a monopoly setting. We describe the interaction between the firm and consumers and then formalize the notions of optimal (Bayesian) and self-serving attributions. Finally, we compare the profits across these scenarios. Later, Section 4 extends this analysis to include competition.

3. Monopoly

3.1. Model

Consider a profit-maximizing firm that offers a product (or service) to potential consumers over two periods, indexed by $t = 1, 2$. In each period, the manager designs the product by choosing the price p_t and the quality q_t. The unit production cost is constant and normalized to zero. Providing quality q_t requires an investment and costs $\kappa(q_t) = \frac{k}{2}q_t^2$, where $k > 0$.

In line with standard behavioral results (Hoyer, MacInnis, & Pieters, 2012), we assume that consumers form subjective valuations of price and quality that may differ from the actual levels set by the firm. We let ε_p and ε_q denote the corresponding

[3] The number of bootstrap samples for the percentile confidence intervals is 10,000.

[4] An interesting initial observation is that participants expressed stronger beliefs about quality than they did about price on all causal dimensions: one-sample t-tests comparing the overall mean of the difference between these factors to zero, the neutral point of the scale, shows a significant difference for locus ($M = -.46$, $SD = 2.23$; $t(305) = -3.62$, $p < .001$), stability ($M = -.52$, $SD = 2.44$; $t(305) = -3.70$, $p < .001$), and control ($M = -1.04$, $SD = 1.75$; $t(305) = -10.37$, $p < .001$).

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deviations, which are drawn once and for all in the first period from independent normal distributions with mean zero and variances σ_p^2 and σ_q^2. Consumers have private information about ε_p and ε_q, but the respective parameters of the distributions are common knowledge. The demand for the product in each period is given by

$$D_t(p_t, q_t) = \max\{\alpha + (q_t + \varepsilon_q) - (p_t + \varepsilon_p), 0\}, \tag{1}$$

where $\alpha > 0$ is an exogenous parameter that we view as a proxy for market size.[5] Therefore, the profit to the firm can be expressed as

$$\pi_t(p_t, q_t) = p_t D_t(p_t, q_t) - \frac{k}{2} q_t^2.$$

We impose the assumption that $k > \frac{1}{2}$ such that the profit function is concave and thus has a unique global maximizer.

At the beginning of the first period, the manager chooses p_1 and q_1 based on expected profit. Consumers in turn make purchase decisions based on their subjective valuations $p_1 + \hat{\varepsilon}_p$ and $q_1 + \hat{\varepsilon}_q$.[6] Consequently, the manager learns the discrepancy between realized and expected demand, which is given by $\hat{\varepsilon}_q - \hat{\varepsilon}_p$. The resulting market outcome, expressed as the difference between realized and expected profit, is

$$\pi_1^r - \pi_1^e = p_1 \left(\hat{\varepsilon}_q - \hat{\varepsilon}_p\right). \tag{2}$$

Because the gap in profit is proportional to the gap in demand, we can capture the market outcome simply by $\hat{m} = \hat{\varepsilon}_q - \hat{\varepsilon}_p$. Using properties of the normal distribution, $\hat{m}$ is the realization of a normally distributed random variable with mean zero and variance $\sigma_m^2 = \sigma_p^2 + \sigma_q^2$, where we require that $\sigma_m \le \frac{\alpha}{4}$ to focus on the interesting case where the firm faces positive demand.[7] Intuitively, σ_m^2 represents uncertainty about demand—and hence uncertainty about the market outcome—caused by the subjective valuations of price and quality. The manager observes the market outcome before choosing p_2 and q_2, yet cannot identify $\hat{\varepsilon}_p$ and $\hat{\varepsilon}_q$ separately to derive the corresponding valuations. This forces the manager to rely on causal inference to attribute $\hat{m}$ to price and quality.

3.2. Optimal attributions

The standard assumption in statistical inference is that people use Bayes' rule to update beliefs in light of data (DeGroot & Schervish, 2011). The orientation of the firm is irrelevant in this paradigm. Therefore, $\hat{\varepsilon}_p$ and $\hat{\varepsilon}_q$ are estimated from $\hat{m}$ using

$$\varepsilon_p^o \equiv E[\varepsilon_p|\hat{m}] = E[\varepsilon_p] - \frac{\sigma_p^2}{\sigma_p^2 + \sigma_q^2}\hat{m} \tag{3}$$

$$\varepsilon_q^o \equiv E[\varepsilon_q|\hat{m}] = E[\varepsilon_q] + \frac{\sigma_q^2}{\sigma_p^2 + \sigma_q^2}\hat{m}. \tag{4}$$

These attributions of the market outcome to price and quality are intuitive.[8] First, if $\hat{\varepsilon}_p$ and $\hat{\varepsilon}_q$ are equal to their respective means, then ε_p^o and ε_q^o are equal to zero (since $E[\varepsilon_p] = E[\varepsilon_q] = 0$). Second, in the event of a positive market outcome ($\hat{\varepsilon}_q - \hat{\varepsilon}_p > 0$), Eqs. (3) and (4) imply that ε_p^o is below its mean and ε_q^o is above its mean. The opposite is true in the case of a negative market outcome ($\hat{\varepsilon}_q - \hat{\varepsilon}_p < 0$). Third, σ_p^2 and σ_q^2 determine any difference between $\hat{\varepsilon}_p$ and $\hat{\varepsilon}_q$ and their respective means. In the extreme case where $\sigma_p^2 \to 0$ or $\sigma_q^2 \to 0$, the manager attributes the market outcome exclusively to quality ($\varepsilon_p^o = 0$ and $\varepsilon_q^o = \hat{m}$) or price ($\varepsilon_p^o = -\hat{m}$ and $\varepsilon_q^o = 0$), respectively.

The manager adjusts price and quality in the second period given the information learned from $\hat{m}$ according to Eqs. (3) and (4). Specifically, the manager solves

$$\begin{aligned} \max_{p_2, q_2} \quad \pi_2(p_2, q_2; \hat{m}) &= p_2\left(\alpha + \left(q_2 + \varepsilon_q^o\right) - \left(p_2 + \varepsilon_p^o\right)\right) - \frac{k}{2}q_2^2. \\ &= p_2(\alpha + \hat{m} + q_2 - p_2) - \frac{k}{2}q_2^2, \end{aligned} \tag{5}$$

[5] Appendix B derives this demand function from model primitives.

[6] Realizations of random variables are denoted with a "hat."

[7] Appendix C shows that using the normal distribution rather than the truncated normal distribution does not qualitatively affect the results under this condition.

[8] Appendix D derives these rules using the properties of the bivariate normal distribution.

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where $\varepsilon_q^o - \varepsilon_p^o = \hat{m}$ by construction. Note that the manager chooses p_2 and q_2 based on actual rather than expected profit, as the uncertainty about demand is resolved in the second period. The profit-maximizing price and quality are denoted by $p_2^*(\hat{m})$ and $q_2^*(\hat{m})$, respectively. The optimized profit in the second period is $\pi_2^*(\hat{m})$.

In the first period, the manager sets price and quality to maximize the expected overall profit

$$\max_{p_1, q_1} \quad \Pi_1(p_1, q_1) = p_1(\alpha + q_1 - p_1) - \frac{k}{2} q_1^2 + \int_{-\infty}^{\infty} \pi_2^*(\hat{m}) f(\hat{m}) d\hat{m}, \tag{6}$$

where the last summand is the expected second-period profit derived from adding (the density-weighted) $\pi_2^*(\hat{m})$ across all possible market outcomes. As price and quality do not carry over to the second period, this term is a constant that can be ignored when setting p_1 and q_1. We denote the expected first-period profit by π_1^*, and the optimized expected overall profit by Π_1^*. The next result captures the profit impact of optimal attributions.

Lemma 1. *When the manager uses optimal attributions to explain firm performance, the optimized expected overall profit of a monopolist is*

$$\Pi_1^* = \frac{(2\alpha^2 + \sigma_m^2)k}{2(2k-1)}.$$

Proof. The proof of this and all other results are provided in Appendix E. □

Lemma 1 implies that a larger market size or lower investment cost makes the firm better off. The impact of uncertainty about the market outcome is less intuitive yet follows from the fact that a higher σ_m^2 increases the likelihood of a higher price and demand in the second period, which translates into a higher expected profit π_2^*, and thus a higher expected overall profit Π_1^*. Surprisingly, a firm can actually benefit from the presence of uncertainty about demand.

3.3. Self-serving attributions

The experiment reported in Section 2 suggests that managers update their beliefs about market outcomes in a manner that is inconsistent with Bayes' rule. Based on this evidence, a self-serving manager estimates $\hat{\varepsilon}_p$ and $\hat{\varepsilon}_q$ from $\hat{m}$ using

$$\varepsilon_p^s \equiv E[\varepsilon_p | \hat{m}, \gamma] = \begin{cases} -\frac{(1-\gamma)\sigma_p^2}{(1-\gamma)\sigma_p^2 + \gamma\sigma_q^2} \hat{m}, & \text{if } \hat{m} > 0 \\ -\frac{\gamma\sigma_p^2}{\gamma\sigma_p^2 + (1-\gamma)\sigma_q^2} \hat{m}, & \text{if } \hat{m} < 0 \end{cases} \tag{7}$$

$$\varepsilon_q^s \equiv E[\varepsilon_q | \hat{m}, \gamma] = \begin{cases} \frac{\gamma\sigma_q^2}{(1-\gamma)\sigma_p^2 + \gamma\sigma_q^2} \hat{m}, & \text{if } \hat{m} > 0 \\ \frac{(1-\gamma)\sigma_q^2}{\gamma\sigma_p^2 + (1-\gamma)\sigma_q^2} \hat{m}, & \text{if } \hat{m} < 0, \end{cases} \tag{8}$$

where $\gamma \in \{0, 1\}$ reflects the orientation of the firm: $\gamma = 0$ denotes a "price orientation" and $\gamma = 1$ a "quality orientation." To grasp the intuition behind these attributions, suppose that $\hat{m} > 0$.[9] Because the self-serving manager prefers to attribute a positive result to the product factor that matches the orientation of the firm, $\hat{m}$ is explained by price when $\gamma = 0$ and quality when $\gamma = 1$. This updating rule captures the idea that a self-serving motivation alone is not sufficient to produce self-serving attributions; it must be that candidate explanations differ in ways that the decision-maker can exploit (Weiner, 1985, 1986). Moreover, note that self-serving attributions are equivalent to optimal attributions when price and quality are equally important, or $\gamma = \frac{1}{2}$.

The self-serving manager adjusts price and quality given the information learned from the market outcome $\hat{m}$ according to Eqs. (7) and (8). We study adjustments under a price orientation first, and then under a quality orientation. The superscripts '−' and '+' index variables according to the valence of $\hat{m}$.

[9] The logic is the same when the firm experiences $\hat{m} < 0$, but leads to the opposite pattern of attributions.

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3.3.1. Price orientation

In the second period, the manager considers adjusting price (but not quality) in response to $\hat{m}^+$ and quality (but not price) in response to $\hat{m}^-$, solving the constrained optimization problems

$$\max_{p_2} \quad \pi_2(p_2; q_1|\hat{m}^+) = p_2(\alpha + \hat{m} + q_1 - p_2) - \frac{k}{2}q_1^2 \tag{9}$$

$$\max_{q_2} \quad \pi_2(q_2; p_1|\hat{m}^-) = p_1(\alpha + \hat{m} + q_2 - p_1) - \frac{k}{2}q_2^2. \tag{10}$$

Note that the bias causes a distortion in the choice of the decision variable *and* in perceived demand. This is the case because the manager carries one of the decisions from the first to the second period, despite the fact that uncertainty about $\hat{m}$ is resolved. The corresponding optimized profits are denoted by $\pi_2^+(q_1^*|\hat{m})$ and $\pi_2^-(p_1^*|\hat{m})$.

We assume that the manager does not anticipate making self-serving attributions or, for that matter, the adjustments prompted by these attributions. This is in line with the observation that people seldom introspect (Meyer & Hutchinson, 2016). In fact, social psychologists argue that people's tendency to be self-serving leads them to think that they are not self-serving, or at least to think that they are less susceptible than the average peer (Pronin, Lin, & Ross, 2002). Accordingly, in the first period the manager sets price and quality to maximize

$$\max_{p_1, q_1} \quad \Pi_1(p_1, q_1) = p_1(\alpha + q_1 - p_1) - \frac{k}{2}q_1^2 + \int_{-\infty}^{\infty} \pi_2^*(\hat{m})f(\hat{m})d\hat{m}.$$

This objective function is the same as Eq. (6) in the benchmark case, which implies that price and quality in the first period are also the same. Given that the manager makes self-serving attributions in the second period, the optimized expected overall profit is in effect given by

$$\Pi_1^s = \pi_1^* + \int_{-\infty}^{0} \pi_2^-(p_1^*|\hat{m})f(\hat{m})d\hat{m} + \int_{0}^{\infty} \pi_2^+(q_1^*|\hat{m})f(\hat{m})d\hat{m}. \tag{11}$$

The next result captures the profit impact of optimal attributions.

Lemma 2. *When the manager uses self-serving attributions to explain firm performance, the optimized expected overall profit of a monopolist is*

$$\Pi_1^s = \frac{8\alpha^2 k + (2k-1)\sigma_m^2}{8(2k-1)}.$$

This result shows that Π_1^s has the same qualitative properties as Π_1^* in the benchmark case: the optimized expected overall profit increases in market size and uncertainty about the market outcome, and decreases in the cost parameter. Accordingly, a firm can benefit from uncertainty about demand even when the manager resorts to self-serving attributions.

3.3.2. Quality orientation

In the second period, the manager considers adjusting quality (but not price) in response to $\hat{m}^+$ and price (but not quality) in response to $\hat{m}^-$, solving

$$\max_{q_2} \quad \pi_2(q_2; p_1|\hat{m}^+) = p_1(\alpha + \hat{m} + q_2 - p_1) - \frac{k}{2}q_2^2 \tag{12}$$

$$\max_{p_2} \quad \pi_2(p_2; q_1|\hat{m}^-) = p_2(\alpha + \hat{m} + q_1 - p_2) - \frac{k}{2}q_1^2. \tag{13}$$

The corresponding optimized profits are denoted by $\pi_2^+(p_1^*|\hat{m})$ and $\pi_2^-(q_1^*|\hat{m})$. In the first period, using a similar logic as in the case of a price orientation, the manager sets the same price and quality as in the benchmark case.

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3.4. The impact of the bias

We now compare the optimized expected overall profits across the benchmark and self-serving cases. First, we establish the following result:

Lemma 3. *When the manager uses self-serving attributions to explain firm performance, the expected overall profit under a price orientation and a quality orientation are the same.*

Note that Lemma 3 has an important managerial implication: In a monopoly market, the choice of the orientation does not affect the performance of the firm when managers make self-serving attributions. This implies the following proposition:

Proposition 1. *The optimized expected overall profit of a monopolist is lower in the context of self-serving attributions than of optimal attributions, as*

$$\Pi_1^* - \Pi_1^s = \frac{(2k+1)\sigma_m^2}{8(2k-1)} > 0.$$

Proposition 1 shows that the managerial bias reduces profit. Intuitively, because the manager does not foresee making self-serving adjustments following the market outcome, the price and quality chosen in the first period are the same across the two scenarios. This implies that the cost of the bias is caused by the (distorted) adjustments in the second period. While the expected price is higher than in the benchmark case under a price orientation, the opposite is true under a quality orientation. Moreover, given that the expected quality is set at the same level as in the benchmark case irrespective of orientation, the overall expected profit caused by distorted price adjustments is lower than the one caused by optimal adjustments.

Proposition 1 also shows how the cost of the bias is driven by uncertainty about demand and investment cost. First, higher uncertainty increases the cost of the bias: it reinforces excessive adjustments to price and, therefore, further distorts profit. Second, a higher investment cost has the opposite effect: it discourages the manager from investing in quality in the first period and, therefore, it reduces the distortion of price in the second period. Finally, note that the cost of the bias does not depend on market size. This is intuitive, as in the absence of uncertainty profits in the benchmark and self-serving cases must be the same.

4. Competition

We extend the initial analysis to include competition among firms. We first describe the interaction between the firms and the consumers, and then study the impact of self-serving attributions on profit. Finally, we analyze the optimal choice of orientation.

4.1. Model

We now consider a market with two single-product firms $i = A, B$ that compete on price and quality over two periods. In each period, the managers choose the price p_{it} and quality q_{it} of the product sold by their respective firm. The investment to provide quality q_{it} is $\kappa(q_t) = \frac{k}{2}q_{it}^2$, where $k > \frac{2}{3}$. This parameter restriction ensures that the profit function of each firm is concave and thus has a unique global maximizer.

The products are differentiated horizontally and vertically. Horizontal differentiation is à la Hotelling, with the firms located at the extremes of the characteristics space $[0, 1]$, that is, $x_A = 0$ and $x_B = 1$. Vertical differentiation reflects the notion that higher quality enhances the worth of the product in the minds of consumers. The market consists of a mass of consumers, which we normalize to unity. Each consumer purchases one unit of the preferred product in each period. Individual preferences are described by a conditional indirect utility function of the form

$$v_{it}(x) = q_{it} + \varepsilon_{iq} - (p_{it} + \varepsilon_{ip}) - \frac{1}{2}|x - x_i|,$$

where $x \in [0, 1]$ is the consumer's preferred product characteristic and $|x - x_i|$ describes the horizontal mismatch of the consumer from purchasing the product of firm i.[10] We assume that the preferred product characteristics are drawn independently across consumers from a uniform distribution over the interval $[0, 1]$. Similar to the monopoly case, we let ε_{ip} and ε_{iq} denote the difference between the subjective valuations of price and quality by consumers and the corresponding levels set by firms. These deviations are drawn (once and for all) in the first period from independent normal distributions with mean zero and variances

[10] See Anderson, de Palma, & Thisse (1992) for an in-depth treatment of Hotelling-type models.

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$\sigma_p^2/2$ and $\sigma_q^2/2$, respectively. Consumers have private information about x, ε_{ip}, and ε_{iq}, but their distributions are assumed to be common knowledge.

To derive demands, we determine the location $\hat{x}$ of the consumer who is indifferent between buying from firm A and from firm B for given perceived prices and qualities. Clearly, the location of the indifferent consumer $\hat{x}$ is a solution to the indifference condition $v_{At}(\hat{x}) = v_{Bt}(\hat{x})$, which ensures that the indirect utilities from the products are the same. With linear mismatch, the consumer located at $\hat{x}$ segments the market: Consumers located to the left of $\hat{x}$ purchase from firm A, while consumers located to the right of $\hat{x}$ purchase from firm B. Firm A thus faces $\hat{x}$ consumers, while firm B faces $1-\hat{x}$ consumers. Demand of firm i as a function of prices $\mathbf{p}_t = (p_{At}, p_{Bt})$ and qualities $\mathbf{q}_t = (q_{At}, q_{Bt})$ is therefore given by

$$D_{it}(\mathbf{p}_t, \mathbf{q}_t) = \frac{1}{2} + (q_{it} - p_{it}) - (q_{jt} - p_{jt}) + \xi_{iq} - \xi_{ip},$$

where $\xi_{iq} \equiv \varepsilon_{iq} - \varepsilon_{jq}$ and $\xi_{ip} \equiv \varepsilon_{ip} - \varepsilon_{jp}$. The market outcome to firm i is defined as $\hat{m}_i = \hat{\xi}_{iq} - \hat{\xi}_{ip}$. Note that $\hat{m}_i = -\hat{m}_j$, which implies that the two firms experience opposite outcomes. The market outcome $\hat{m}_i$ is normally distributed with mean zero and variance $\sigma_m^2 \equiv \sigma_p^2 + \sigma_q^2$, where we require that $\sigma_m \le \frac{3k-2}{8k}$.

4.2. Optimal attributions

In the second period, the manager of firm i adjusts price and quality given the information learned from $\hat{m}_i$ using Bayes' rule according to Eqs. (3) and (4).[11] Specifically, the manager solves

$$\max_{p_{i2}, q_{i2}} \quad \pi_{i2}(p_{i2}, q_{i2} | \hat{m}_i) = p_{i2} D_{i2}(\mathbf{p}_2, \mathbf{q}_2 | \hat{m}_i) - \frac{k}{2} q_{i2}^2. \tag{14}$$

Note that the manager chooses p_{i2} and q_{i2} based on actual rather than expected profit as the uncertainty about demand is resolved in the second period. The optimized profit in the second period is denoted by $\pi_{i2}^*(\hat{m}_i)$.

In the first period, the manager of firm i sets price and quality to maximize the expected overall profit

$$\begin{aligned} \max_{p_{i1}, q_{i1}} \quad \Pi_{i1}(p_{i1}, q_{i1}) = {} & p_{i1} D_{i1}^e(\mathbf{p}_1, \mathbf{q}_1) - \frac{k}{2} q_{i1}^2 \\ & + \int_{-\infty}^{\infty} \pi_{i2}^*(\hat{m}_i) f(\hat{m}_i) d\hat{m}_i, \end{aligned} \tag{15}$$

where D_{i1}^e is the expected demand. We denote the expected first-period profit by π_{i1}^*, and the optimized expected overall profit by Π_{i1}^*. The analysis leads to this result.

Lemma 4. *When managers use optimal attributions to explain firm performance, the optimized expected overall profit of firm i in a duopoly is*

$$\Pi_{i1}^* = \frac{2k-1}{4k} \left(1 + \frac{2k^2 \sigma_m^2}{(3k-2)^2} \right).$$

Lemma 4 shows that greater uncertainty about demand results in a higher profit for the firm. The result that the firm can benefit from uncertainty therefore carries over the competitive case. Intuitively, higher uncertainty about demand makes the firms more asymmetric when the uncertainty is resolved in the second period, which boosts the expected overall profit. However, the impact of the investment cost is ambiguous. Note that Π_{i1}^* increases with the mass of consumers if the size of the market is not normalized.

4.3. Self-serving attributions

Managers who are self-serving adjust price and quality given the information learned from $\hat{m}_i$ according to Eqs. (7) and (8). We assume again that the choice of variable to adjust is discrete, and that managers do not anticipate making or acting on self-serving attributions. In a competitive setting with two firms where each firm can either have a price orientation or a quality orientation, there are four possible combinations of orientations: both firms have a price orientation (*PO*,*PO*), both firms have a quality orientation (*QO*,*QO*), or one firm has a quality orientation while the other firm has a price orientation—the "mixed orientations" (*PO*,*QO*) and (*QO*,*PO*). Fig. 1 summarizes the possible combinations of orientations, and we now address each of them in turn.

[11] In contrast to the monopoly case, the manager estimates $\hat{\xi}_{ip}^o$ and $\hat{\xi}_{iq}^o$ at the market level, not $\hat{\varepsilon}_{ip}^o$ and $\hat{\varepsilon}_{iq}^o$ at the firm level.

		Firm B: PO	Firm B: QO
Firm A	PO	Π_{A1}^{PP}, Π_{B1}^{PP}	Π_{A1}^{PQ}, Π_{B1}^{PQ}
	QO	Π_{A1}^{QP}, Π_{B1}^{QP}	Π_{A1}^{QQ}, Π_{B1}^{QQ}

Fig. 1. Possible combinations of orientations and corresponding profits. The acronym *PO* denotes a price orientation, whereas *QO* stands for a quality orientation.

4.3.1. Matching price orientation

In the second period, the manager of firm i adjusts price (but not quality) in response to $\hat{m}_i^+$ and quality (but not price) in response to $\hat{m}_i^-$. Following the definition of Nash equilibria, we assume that managers hold correct beliefs about the adjustments of their counterparts. Intuitively, this means that managers put themselves in the shoes of the opponent and correctly predict its self-serving adjustments given its orientation and market outcome. Said differently, managers believe that the competitor acts in the same way as they do. Because managers do not see their own bias, they do not see it in the competitor either.

The manager of firm i therefore solves the constrained optimization problems

$$\max_{p_{i2}} \quad \pi_{i2}(p_{i2}, q_{j2}|\hat{m}_i^+) = p_{i2}D_{i2}(p_{i2}, p_{j1}, q_{i1}, q_{j2}) - \frac{k}{2}q_{i1}^2 \tag{16}$$

$$\max_{q_{i2}} \quad \pi_{i2}(p_{j2}, q_{i2}|\hat{m}_i^-) = p_{i1}D_{i2}(p_{i1}, p_{j2}, q_{i2}, q_{j1}) - \frac{k}{2}q_{i2}^2. \tag{17}$$

Again, note that the bias distorts not only the choice of the decision variable, but also perceived demand. This is the case because some decisions in the first period carry over to the second. The corresponding optimized profits are denoted by $\pi_{i2}^+(\hat{m}_i)$ and $\pi_{i2}^-(\hat{m}_i)$.

In the first period, the manager of firm i sets the price and quality according to Eq. (15), while the optimized expected overall profit is in effect given by

$$\Pi_{i1}^{PP} = \pi_{i1}^* + \int_{-\infty}^{0} \pi_{i2}^-(\hat{m}_i)f(\hat{m}_i)d\hat{m}_i + \int_{0}^{\infty} \pi_{i2}^+(\hat{m}_i)f(\hat{m}_i)d\hat{m}_i, \tag{18}$$

as indicated in Fig. 1. We derive the following result.

Proposition 2. *When both firms have a price orientation, the optimized expected overall profit of firm i in a duopoly is higher in the context of self-serving attributions than of optimal attributions.*

Proposition 2 shows that the firms benefit from the decisions of self-serving managers. The profit for each firm is higher than in the benchmark case, as self-serving adjustments increase the expected prices, while the expected qualities and demands are the same. Intuitively, the biased adjustments that follow a positive market outcome relax competition because the first-period quality decisions are carried over to the second period by the managers, which leads to an excessive increase in price, and in turn higher profits for both firms. Said differently, when the two firms have a price orientation the managerial bias softens price competition and, therefore, improves performance.

4.3.2. Matching quality orientation

In the second period, the manager of firm i adjusts quality (but not price) in response to $\hat{m}_i^+$ and price (but not quality) in response to $\hat{m}_i^-$. The manager of firm i therefore solves

$$\max_{q_{i2}} \quad \pi_{i2}(p_{j2}, q_{i2}|\hat{m}_i^+) = p_{i1}D_{i2}(p_{i1}, p_{j2}, q_{i2}, q_{j1}) - \frac{k}{2}q_{i2}^2 \tag{19}$$

$$\max_{p_{i2}} \quad \pi_{i2}(p_{i2}, q_{j2}|\hat{m}_i^-) = p_{i2}D_{i2}(p_{i2}, p_{j1}, q_{i1}, q_{j2}) - \frac{k}{2}q_{i1}^2. \tag{20}$$

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In the first period, the manager sets the same price and quality as in the case where both firms have a price orientation—a consequence of ignoring that decisions carry over to the second period. The analysis leads to the following result.

Proposition 3. *When both firms have a quality orientation, the optimized expected overall profit of firm i in a duopoly is lower in the context of self-serving attributions than of optimal attributions.*

Taken together, Propositions 2 and 3 show that the cost of the managerial bias in a competitive setting depends on the orientation of the firm. This stands in contrast to result in the monopoly setting. While a price orientation helps the firms to increase profit over the benchmark of optimal attributions, a quality orientation has the opposite effect because the first-period decisions about price are carried over to the second period, which intensifies competition. The profit for each firm is lower than in the benchmark case as self-serving adjustments decrease the expected prices, while the expected qualities and demands are the same. Intuitively, the biased adjustments that follow a positive market outcome intensify competition and lead to an excessive reduction in price, which yields lower profits for both firms.

4.3.3. Mixed orientation

So far, we have focused on symmetric orientations. We now explore the asymmetric cases where one firm has a price orientation while the other firm has a quality orientation. We present the case where firm i has a quality orientation and firm j has a price orientation. The manager of firm i therefore solves

$$\max_{q_{i2}} \quad \pi_{i2}(q_{i2}, q_{j2} | \hat{m}_i^+) = p_{i1} D_{i2}(p_{i1}, p_{j1}, q_{i2}, q_{j2}) - \frac{k}{2} q_{i2}^2 \tag{21}$$

$$\max_{p_{i2}} \quad \pi_{i2}(p_{i2}, p_{j2} | \hat{m}_i^-) = p_{i2} D_{i2}(p_{i2}, p_{j2}, q_{i1}, q_{j1}) - \frac{k}{2} q_{i1}^2. \tag{22}$$

Again, the manager does not consider that the decisions carry over to the second period when making setting price and quality in the first period. The following result holds.

Proposition 4. *When the firms have opposite orientations in a duopoly, the optimized expected overall profit of the firm with the quality orientation is higher in the context of self-serving attributions than of optimal attributions, whereas the optimized expected overall profit of the firm with the price orientation is lower compared to the benchmark case.*

Proposition 4 shows that the firm with the quality orientation benefits from the managerial bias, while the opposite holds for the firm with the price orientation. Intuitively, the firm with the quality orientation benefits from the increase in the expected price of its rival (caused by the excessive adjustment following a positive market outcome). The firm with the price orientation is worse off because its competitor prices more aggressively following a negative market outcome.

4.4. Equilibrium orientation

Unlike the monopoly setting, orientation matters for profitability in a competitive market. Conventional wisdom suggests that firms should strive for an asymmetric orientation to exploit “market niches” (Porter, 2004). However, the next result shows that this intuition does not necessarily apply.

Proposition 5. *In a competitive market environment, the unique pure-strategy Nash equilibrium in orientations is that both firms adopt a price orientation.*

The interesting aspect of Proposition 5 is that the matching price orientation emerges in equilibrium because both firms benefit from managers who are self-serving. The reason for this is that distorted adjustments relax competition and motivate managers to charge higher prices—a positive externality that results in higher profits for all. From a practical standpoint, this result implies that firms have an incentive to engage in “tacit collusion” by not screening out self-serving managers or establishing mechanisms that mitigate their bias, as doing so allows firms to enjoy a higher industry profit in equilibrium.

5. Conclusion

A classic piece of advice in competitive strategy is that firms should focus, and that sustainable advantage in the market invariably comes from leadership in either price or quality (Porter, 2004). However, managers internalize the orientation of their firms and are unable or unwilling to interpret events in a manner that is objective: they want to credit surprisingly positive results to the dominant factor and blame surprisingly negative results on the other. In each case, the choice of orientation is vindicated, but biased explanations prompt biased decisions and, therefore, put future performance in jeopardy.

We motivated this argument with evidence from one experiment. First, we showed that causal attributions are determined by the orientation of the firm and the valence of the market outcome. Second, we showed that this inferential process is mediated by beliefs about locus, stability, and control. Finally, we showed that there is a positive relationship between attributions and the type of adjustment: participants indicated stronger adjustments to the factor they deemed responsible for the market outcome.

We then developed a two-period model to understand the profit impact of self-serving managers. One of the key insights is that informing managers of their bias improves firm performance in a monopoly, but doing the same in a competitive setting is detrimental. Under competition, firms exploit the self-serving nature of their managers to free ride on the higher industry profit prompted by the upward pressure on equilibrium prices.

The main modeling challenge was to create an environment where the market outcome deviates from expectations. This "gap" triggers the inferential process of the manager, and from here our goal was to understand whether and how self-serving attributions and adjustments impact firm performance. The simplest possible structure that captures these components is a two-period game with uncertainty about the market outcome. This also represents the lower bound of the cost to the firm. Clearly, we can improve realism by adding periods and assuming that consumers form subjective valuations of price and quality at each round, but this does not further our understanding of the phenomenon unless managers are allowed to introspect and learn about their bias.

On this point, future work could construct a new model that incorporates introspection (à la Gervais & Odean, 2001), and study how this additional dimension affects attributions, price and quality decisions, and ultimately firm performance. However, it appears that most markets afford few opportunities to learn from mistakes and, when they occur, there is too much noise from the environment to learn from them (Meyer & Hutchinson, 2016). Moreover, questioning the resilience of a behavioral anomaly makes sense when the effect is self-defeating, which is not the case here. Finally, the degree to which managers are biased is affected by their appreciation that a problem exists. Motivated reasoning probably skews the search for information and the standards of proof in favor of hypotheses that reinforce past behaviors, which weakens the ability to introspect. In fact, even though self-serving attributions at times reflect calculated attempts to defend the sense of self, in many instances they are not calculated and probably not even conscious (Shepperd, Malone, & Sweeny, 2008).

Ideally, one settles this debate by checking whether the phenomenon replicates in the field. However, experiments that study managerial decisions outside of the laboratory present nontrivial challenges in logistics and tractability. One solution is to study data from business simulation games (Curren, Folkes, & Steckel, 1992). This is a promising direction for future research, provided course that the players in the game express their beliefs about the orientation of their fictional firms. A different approach is to build on our experimental procedure by exposing participants to multiple rounds of decisions in an incentive-compatible setting.

A second limitation of the model is the assumption that the parameters ε_p and ε_q of the consumers' subjective valuations are common knowledge. Relaxing this informational assumption would certainly complicate the inference process for managers: they would need to estimate the mean and the variance of the subjective deviations by consumers as well as make attributions to price and quality. Analyzing the interplay of market research and self-serving attributions is certainly another interesting topic for future research.

Third, our analytical results are to some extent driven by the notion that managers resolve to adjust price or quality, but not both. While this approach improves tractability and provides a natural upper bound for the cost of the bias, allowing for continuous adjustments is likely to be a relevant topic for future research. In our mind, one option is to make adjustments that are proportional to the extent of the attributions. A second option is to put a cap on any given adjustment. A third option is to let managers adjust freely, but incur a non-monetary cost if they correct the "wrong" factor.

Fourth, while we are interested in the effect of orientation, there are other levers or settings that allow managers to exploit their self-serving tendency. For instance, one could envision settings where different managers have different decision responsibilities.[12] Alternatively, one could consider a setting where price and quality decisions are allocated to different internal units, and these then conflict in their explanations of success and failure. Third, one could apply to the idea of split decision-making to different units a long the supply chain and consider a channel framework where downstream managers credit success to their own decisions but blame failure on the decisions of upstream suppliers. These and possibly other perspectives reflect real circumstances and would generate results that complement our approach.

Finally, an unexpected result in the experiment is that participants rated quality as more internal, stable, and controllable than price. One possible explanation is that firms have more opportunities to stand out on quality than they do on price, making the former more salient. At the same time, there may be a belief among managers that price is tantamount to "market conditions" and therefore more situational in nature, while quality better reflects the values of a firm and therefore more dispositional. While casual observation lends credence to this idea, there is an opportunity to test its validity and possible ramifications.

[12] Appendix F considers a delegation setting and shows that forward-looking headquarters can reduce the cost of self-serving decision managers to the firm.

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Appendix A. Replication

The sample for the second experiment comprised 194 experienced professionals rather than students. They were recruited at three open-enrollment executive education programs taught at the same business school, and the average work experience was 17.6 years ($n = 57$), 16 years ($n = 68$), and 11.5 years ($n = 69$). The scenario and measures were the same as in the original experiment, except that we included several additional background checks and did not manipulate the orientation of the firm. Given the considerable experience of the audience, we used their existing beliefs about price and quality on locus, stability, and control directly as an independent variable.

With respect to the background checks, participants in the first and second group judged the gap in sales experienced by the firm on the same scale as the one used in the first experiment. The data again show a higher mean score in the context of a positive result ($M = 1.69$, $SD = .88$) than a negative one ($M = -.89$, $SD = 1.22$; $F(1, 123) = 183.88$, $p < .001$, $\eta_p^2 = .60$), with both values significantly different from the neutral midpoint of the scale ($t(61) = 15.16$, $p < .001$ and $t(62) = -5.79$, $p < .001$, respectively).

In addition, we asked participants in the first group "To what extent do you relate to the situation?" (1 = "Not at all, the situation mirrors reality poorly" to 7 = "Completely, the situation mirrors reality well"). A one-sample t-test comparing the overall mean ($M = 4.79$, $SD = 1.36$) to the midpoint of the scale suggests that the scenario was sufficiently realistic ($t(56) = 4.39$, $p < .001$), with no significant difference between experimental conditions ($p = .522$). The same participants also reported whether market outcomes of the type portrayed in the scenario are explained by differences in price and quality among competing products (1 = "Not at all, price and quality differences matter slightly" to 7 = "Completely, price and quality differences matter greatly"). Again, on average responses were significantly higher than the midpoint of the scale ($M = 4.79$, $SD = 1.36$; $t(56) = 4.39$, $p < .001$) and independent of the experimental condition ($p = .655$).

Finally, participants in the third group expressed their confidence in the attributions of the market outcome (1 = "Not at all" to 7 = "Completely") and whether the scenario provided sufficient information to express these judgments (1 = "Definitely not" to 7 = "Definitely yes"). A one-sample t-test shows that overall mean confidence ($M = 4.71$, $SD = 1.59$) is significantly higher than the midpoint of the scale ($t(68) = 3.71$, $p < .001$). The same is true for impressions of the information provided ($M = 4.68$, $SD = .96$; $t(68) = 5.88$, $p < .001$). In both cases, we did not observe a significant difference between experimental conditions ($p = .182$ and $p = .835$, respectively).

With respect to the main measures, we examined the causal explanations of participants by regressing Net Attributions on Net Beliefs (Cronbach's $\alpha = .73$), Market Outcome, and the corresponding interaction term. The regression shows a simple negative effect of Market Outcome ($\beta = -.54$, $SE = .09$; $p < .001$) and, importantly, a significant interaction ($\beta = .21$, $SE = .06$; $p < .001$). Consistent with our argument, the slope of Net Beliefs is significant and positive in the positive outcome condition ($\beta = .20$, $SE = .08$; $p = .013$), and significant and negative in the negative outcome condition ($\beta = -.22$, $SE = .08$; $p = .010$). This pattern implies that an increase in the perception that price is more internal, stable, and controllable relative to quality increased use of the former as explanation for the strong result and use of the latter as explanation for the weak result.[13]

Second, we tested the link between causal explanations and responses by regressing Net Adjustments on Net Attributions and found the expected positive effect: $\beta = .23$, $SE = .07$, $p = .001$.

Appendix B. Demand

Suppose that there are $\alpha + (q_t + \varepsilon_q)$ potential consumers whose willingness to pay for the product is uniformly distributed over the interval $\left[0, \frac{\alpha+(q_t+\varepsilon_q)}{\beta}\right]$. Given ε_p, the consumers' perceived price is $p_t + \varepsilon_p$ and demand is $D_t(p_t, q_t) = \max\{\alpha + (q_t + \varepsilon_q) - \beta(p_t + \varepsilon_p), 0\}$, where the max function ensures that demand is non-negative. Setting β to unity yields the demand function in Eq. (1).

Appendix C. Market outcome

The market outcome can be viewed as a realization of a normally distributed random variable if the realized demand is positive with probability one. Intuitively, this requires that the market outcome is not "too negative."

Using a standard result, the probability that a normally distributed random variable with mean zero and variance σ_m^2 takes a value smaller than $n \geq 1$ standard deviations from the mean is

$$\Pr\{\hat{m} \leq -n\sigma_m\} = \frac{1}{2}\left(1 - Erf\left(\frac{n}{\sqrt{2}}\right)\right), \tag{C.1}$$

13 Again, we found that participants expressed stronger beliefs about quality than they did about price on all causal dimensions: one-sample t-tests comparing the overall mean of the difference between these factors to zero shows a significant difference for locus ($M = -.76$, $SD = 1.64$; $t(193) = -6.47$, $p < .001$), stability ($M = -1.96$, $SD = 2.33$; $t(193) = -11.69$, $p < .001$), and control ($M = -1.03$, $SD = 1.63$; $t(193) = -8.84$, $p < .001$).

where

$$Erf(x) := \frac{2}{\sqrt{\pi}}\int_0^x \exp(-t^2)dt$$

is the error function encountered in integrating the normal distribution (see, for instance, Greene, 2003, p. 926). It is well known that the probability in Eq. (C.1) rapidly converges to zero as n increases. For example, if $n = 3$ the probability is already as low as 1.35×10^{-3}, meaning that, on average, less than two out of a 1000 draws can be expected to be smaller than $-3\sigma_m$.

Throughout the paper, we make the conservative assumption that $n = 4$. In this case $\Pr\{\hat{m} \le -4\sigma_m\} = 31.67 \times 10^{-6}$, which is essentially zero for our purpose. Therefore, by putting an upper bound on the variance of the market outcome, realized demand is positive with probability tending to one, and the market outcome can be viewed as a draw from an untruncated normal distribution.

Appendix D. Optimal attributions

Recall that, if X and Y are jointly normal random variables, then the conditional expectation of X given $Y = y$ is normal with

$$E[X|Y] = E[X] + \rho\frac{\sigma_X}{\sigma_Y}(y - E[Y]), \tag{D1}$$

where $\rho = E[XY](\sigma_X\sigma_Y)^{-1}$ is the correlation coefficient of X and Y (Mood & Graybill, 1963, Theorem 9.3, p. 202).

To establish Eq. (3), set $X \equiv \varepsilon_p$, $Y = \varepsilon_q - \varepsilon_p$, and $y = \hat{\varepsilon}_q - \hat{\varepsilon}_p$. The distributional assumptions imply $E[\varepsilon_p] = E[\varepsilon_q - \varepsilon_p] = 0$, $E[\varepsilon_p(\varepsilon_q - \varepsilon_p)] = -\sigma_p^2$ and $\sigma_Y^2 = \sigma_p^2 + \sigma_q^2$. Therefore, the conditional expectation in Eq. (D.2) can be expressed as

$$E[\varepsilon_p|\hat{m}] = E[\varepsilon_p] - \frac{\sigma_p^2}{\sigma_p^2 + \sigma_q^2}\hat{m},$$

where $\hat{m} = \hat{\varepsilon}_q - \hat{\varepsilon}_p$. The proof of Eq. (4) is similar and therefore omitted.

Appendix E. Proofs

Proof of Lemma 1. In the second period, the optimal price and quality follow from the (necessary and sufficient) first-order conditions of profit maximization. Solving Eq. (5) yields the optimal price and quality

$$p_2^*(\hat{m}) = \frac{(\alpha + \hat{m})k}{2k - 1} \tag{E.3}$$

$$q_2^*(\hat{m}) = \frac{\alpha + \hat{m}}{2k - 1}. \tag{E.4}$$

By substitution, the second-period demand and the optimized profit are given by

$$D_2^*(\hat{m}) = \frac{(\alpha + \hat{m})k}{2k - 1} \tag{E.5}$$

$$\pi_2^*(\hat{m}) = \frac{(\alpha + \hat{m})^2 k}{2(2k - 1)}. \tag{E.6}$$

Note that $D_2^*(\hat{m}) \ge 0$ if and only if $\hat{m} \ge -\alpha$. Using Appendix C and the assumption that $\sigma \le \frac{\alpha}{4}$, demand is positive with probability one.

By definition, the expected second-period profit is given by

$$\int_{-\infty}^{\infty} \pi_2^*(\hat{m})f(\hat{m})d\hat{m}. \tag{E.7}$$

Because the market outcome $\hat{m}$ follows a normal distribution with mean zero and variance σ_m^2, the density of $\hat{m}$ is given by

$$f(\hat{m}) = \frac{1}{\sqrt{2\pi\sigma_m^2}}\exp\left(-\frac{\hat{m}^2}{2\sigma_m^2}\right)d\hat{m}. \tag{E.8}$$

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Using Eqs. (E.6) and (E.8), the expected second-period profit in Eq. (E.7) can be written as

$$\int_{-\infty}^{\infty} \pi_2^*(\hat{m})f(\hat{m})d\hat{m} = \frac{k}{2(2k-1)} \int_{-\infty}^{\infty} (\alpha^2 + 2\alpha\hat{m} + \hat{m}^2)f(\hat{m})d\hat{m}. \tag{E.9}$$

Since the density integrates to one by definition,

$$\alpha^2 \int_{-\infty}^{\infty} f(\hat{m})d\hat{m} = \alpha^2,$$

and noting that

$$\int_{-\infty}^{\infty} \hat{m}f(\hat{m})d\hat{m} \equiv E[\hat{m}] = 0$$

and

$$\int_{-\infty}^{\infty} \hat{m}^2 f(\hat{m})d\hat{m} \equiv E[\hat{m}^2] = \sigma_m^2$$

under our distributional assumption, the expected second-profit in Eq. (E.9) simplifies to

$$\int_{-\infty}^{\infty} \pi_2^*(\hat{m})f(\hat{m})d\hat{m} = \frac{(\alpha^2 + \sigma_m^2)k}{2(2k-1)}. \tag{E.10}$$

Given that the expected second-period profit is simply a constant, the optimal price and quality levels can be obtained from Eqs. (E.3) and (E.4) by setting $\hat{m} = 0$:

$$p_1^* = \frac{\alpha k}{2k-1} \tag{E.11}$$

$$q_1^* = \frac{\alpha}{2k-1}. \tag{E.12}$$

Similarly, the expected first-period demand and profit can be derived as

$$D_1^* = \frac{\alpha k}{2k-1} \tag{E.13}$$

$$\pi_1^* = \frac{\alpha^2 k}{2(2k-1)}. \tag{E.14}$$

Finally, the expected overall profit follows from adding up the profits in Eqs. (E.10) and (E.14), and is given by

$$\Pi_1^* = \frac{(2\alpha^2 + \sigma_m^2)k}{2(2k-1)}.$$

Clearly, Π_1^* is increasing in market size α and uncertainty σ_m^2, while it is decreasing in the cost parameter k. □

Proof of Lemma 2. In the event of a positive market outcome, the manager solves Eq. (9) to find the optimal price

$$p_2^+(q_1^*) = \frac{1}{2}(\alpha + \hat{m} + q_1^*). \tag{E.15}$$

By substitution,

$$\pi_2^+(q_1^*|\hat{m}) = \frac{1}{4}\left((\alpha + \hat{m} + q_1^*)^2 - 2k(q_1^*)^2\right). \tag{E.16}$$

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Substituting q_1^* given in Eqs. (E.12) into (E.16) and averaging across positive market outcomes yields

$$\int_0^\infty \pi_2^+(q_1^*|\hat{m})f(\hat{m})d\hat{m} = \frac{2\alpha^2 k + 4\sqrt{\frac{2}{\pi}}\alpha k\sigma_m + (2k-1)\sigma_m^2}{8(2k-1)}. \tag{E.17}$$

In the event of a negative market outcome, the manager solves Eq. (10) to find the optimal quality

$$q_2^-(p_1^*) = \frac{p_1^*}{k}.$$

By substitution,

$$\pi_2^-(p_1^*|\hat{m}) = \frac{p_1^*(p_1^* + 2(\alpha + \hat{m} - p_1^*)k)}{2k}. \tag{E.18}$$

Substituting p_1^* given in Eq. (E.11) into Eq. (E.18) and averaging across negative market outcomes yields

$$\int_{-\infty}^0 \pi_2^-(p_1^*|\hat{m})f(\hat{m})d\hat{m} = \frac{\alpha\left(\sqrt{2\pi}\alpha - 4\sigma_m\right)k}{4\sqrt{2\pi}(2k-1)}. \tag{E.19}$$

The expected second-period profit that results from self-serving attributions follows from adding up Eqs. (E.17) and (E.19):

$$\int_{-\infty}^0 \pi_2^-(p_1^*|\hat{m})f(\hat{m})d\hat{m} + \int_0^\infty \pi_2^+(q_1^*|\hat{m})f(\hat{m})d\hat{m} = \frac{4\alpha^2 k + (2k-1)\sigma_m^2}{8(2k-1)}. \tag{E.20}$$

Finally, the optimized expected overall profit in Eq. (11) can be derived as

$$\Pi_1^s = \frac{8\alpha^2 k + (2k-1)\sigma_m^2}{8(2k-1)} \tag{E.21}$$

from adding up Eqs. (E.14) and (E.20). □

Proof of Lemma 3. In the event of a positive market outcome, the manager solves Eq. (12) to find the optimal quality

$$q_2^+(p_1^*) = \frac{p_1^*}{k}.$$

By substitution,

$$\pi_2^+(p_1^*|\hat{m}) = \frac{p_1^*(p_1^* + 2(\alpha + \hat{m} - p_1^*)k)}{2k}. \tag{E.22}$$

Substituting p_1^* given in Eq. (E.11) into Eq. (E.22) and averaging across positive market outcomes yields

$$\int_0^\infty \pi_2^+(q_1^*|\hat{m})f(\hat{m})d\hat{m} = \frac{\alpha\left(\sqrt{2\pi}\alpha + 4\sigma_m\right)k}{4\sqrt{2\pi}(2k-1)}. \tag{E.23}$$

In the event of a negative market outcome, the manager solves Eq. (13) to find the optimal price

$$p_2^-(q_1^*) = \frac{1}{2}(\alpha + \hat{m} + q_1^*).$$

By substitution,

$$\pi_2^-(q_1^*|\hat{m}) = \frac{1}{4}\left((\alpha + \hat{m} + q_1^*)^2 - 2k(q_1^*)^2\right). \tag{E.24}$$

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Substituting q_1^* given in Eq. (E.12) into Eq. (E.24) and averaging across negative market outcomes yields

$$\int_{-\infty}^{0} \pi_2^-(q_1^*|\hat{m})f(\hat{m})d\hat{m} = \frac{2\alpha^2 k - 4\sqrt{\frac{2}{\pi}}\alpha k\sigma_m + (2k-1)\sigma_m^2}{8(2k-1)}. \tag{E.25}$$

The expected second-period profit that results from self-serving attributions follows by adding up Eqs. (E.23) and (E.25) as follows:

$$\int_{-\infty}^{0} \pi_2^-(q_1^*|\hat{m})f(\hat{m})d\hat{m} + \int_{0}^{\infty} \pi_2^+(q_1^*|\hat{m})f(\hat{m})d\hat{m} = \frac{4\alpha^2 k + (2k-1)\sigma_m^2}{8(2k-1)}. \tag{E.26}$$

Since the expected second-period profit under a price orientation in Eq. (E.26) coincides with the corresponding profit under a price orientation in Eq. (E.20), the optimized expected overall profit under a quality orientation is the same as Π_1^s in Eq. (E.21). □

Proof of Proposition 1. The proof of Lemma 3 shows that the expected overall profit under a price or quality orientation are the same. Therefore, it suffices to compare Π_1^* (given in Lemma 1) to Π_1^s (given in Lemma 2) to calculate the profit impact of self-serving attributions to the firm, which is given by

$$\Pi_1^* - \Pi_1^s = \frac{(2k+1)\sigma_m^2}{8(2k-1)}.$$

The cost of the managerial bias to the firm is positive as $\sigma_m^2 > 0$ and $k > \frac{1}{2}$ by assumption. □

Proof of Lemma 4. In the second period, the managers solve Eq. (14) to determine the optimal adjustments to price and quality as a function of the market outcome. The optimal price and quality are

$$p_{i2}^*(\hat{m}_i) = \frac{1}{2} + \frac{k\hat{m}_i}{3k-2}$$
$$q_{i2}^*(\hat{m}_i) = \frac{1}{2k} + \frac{\hat{m}_i}{3k-2}.$$

By substitution, the demands and profits can be derived as

$$D_{i2}^*(\hat{m}_i) = \frac{1}{2} + \frac{k\hat{m}_i}{3k-2}$$
$$\pi_{i2}^*(\hat{m}_i) = \frac{(2k-1)((3+2\hat{m}_i)k-2)^2}{8(3k-2)^2 k}. \tag{E.27}$$

The expected second-period profit can be found by adding up the profits across market outcomes, that is

$$\int_{-\infty}^{\infty} \pi_{i2}^*(\hat{m}_i)f(\hat{m}_i)d\hat{m}_i = \frac{(2k-1)((3k-2)^2 + 4k^2\sigma_m^2)}{8(3k-2)^2 k}. \tag{E.28}$$

The prices, qualities, and demands are positive if $|\hat{m}_i| \le \frac{3k-2}{2k}$; a condition that holds with probability tending to one as $\sigma_m \le \frac{3k-2}{8k}$ (see Appendix C). Specifically, note that $\Pr\{|\hat{m}_i| \ge 4\sigma_m\} = 63.34 \times 10^{-6}$, which is essentially zero.

In the first period, the managers solve Eq. (15) to determine the optimal price and quality. Noting that the expected second-period profit is simply a constant, it thus follows from Eq. (E.27) that $\pi_{i1}^* = \pi_{i2}^*(0)$. Finally, the optimized expected overall profit Π_{i1}^* can be obtained by adding up π_{i1}^* and the expected second-period profit in Eq. (E.28). □

Proof of Proposition 2. In the event of a positive market outcome, the manager of firm *i* solves Eq. (16) to find the optimal price

$$p_{i2}^+(q_{i1}^*) = \frac{1}{4}(1 + 2\hat{m}_i + 2p_{j1}^* + 2q_{i1}^* - 2q_{j2}).$$

The manager of firm *j* chooses the optimal quality according to

$$q_{j2}^+(p_{j1}^*) = \frac{p_{j1}^*}{k}.$$

By substitution,

$$\pi_{i2}^{+}(\hat{m}_i) = \frac{2k(1+\hat{m}_i)^2 - 1}{8k}. \tag{E.29}$$

In the event of a negative market outcome, the manager of firm i solves Eq. (17) to find the optimal quality

$$q_{i2}^{+}(p_{i1}^{*}) = \frac{p_{i1}^{*}}{k}.$$

The manager of firm j chooses its optimal price according to

$$p_{j2}^{-}(q_{j1}^{*}) = \frac{1}{4}(1 - 2\hat{m}_i + 2p_{i1}^{*} - 2q_{i2} + 2q_{j1}^{*}).$$

By substitution,

$$\pi_{i2}^{-}(\hat{m}_i) = \frac{1}{8}\left(2 - \frac{1}{k} + 2\hat{m}_i\right). \tag{E.30}$$

The expected second-period profit follows by adding up Eqs. (E.29) and (E.30) as follows:

$$\int_{-\infty}^{0} \pi_{i2}^{-}(\hat{m}_i)f(\hat{m}_i)d\hat{m}_i + \int_{0}^{\infty} \pi_{i2}^{+}(\hat{m}_i)f(\hat{m}_i)d\hat{m}_i = \frac{1}{8}\left(2 - \frac{1}{k} + \sqrt{\frac{2\sigma_m^2}{\pi}} + \sigma_m^2\right).$$

In the first period, the manager of firm i solves Eq. (15) to determine the optimal price and quality. From Lemma 4, we know that $\pi_{i1}^{*} = \pi_{i2}^{*}(0)$. The optimized expected overall profit then follows from adding up π_{i1}^{*} and the expected second-period profit in Eq. (E.30):

$$\Pi_{i1}^{PP} = \frac{1}{8}\left(4 - \frac{2}{k} + \sqrt{\frac{2\sigma_m^2}{\pi}} + \sigma_m^2\right). \tag{E.31}$$

Comparing Π_{i1}^{PP} to the corresponding profit Π_{i1}^{*} in the benchmark case yields

$$\Pi_{i1}^{*} - \Pi_{i1}^{PP} = \frac{1}{8}\left(\frac{((8-k)k-4)\sigma_m^2}{(3k-2)^2} - \sqrt{\frac{2\sigma_m^2}{\pi}}\right).$$

This difference is negative under our assumptions that $k > \frac{2}{3}$ and $\sigma_m \le \frac{3k-2}{8k}$. □

Proof of Proposition 3. In the event of a positive market outcome, the manager of firm i solves Eq. (19) to find the optimal quality

$$q_{i2}^{+}(p_{i1}^{*}) = \frac{p_{i1}^{*}}{k}.$$

The manager of firm j chooses the optimal price according to

$$p_{j2}^{-}(q_{j1}^{*}) = \frac{1}{4}(1 - 2\hat{m}_j + 2p_{i1}^{*} - 2q_{i2} + 2q_{j1}^{*}).$$

By substitution,

$$\pi_{i2}^{+}(\hat{m}_i) = \frac{1}{8}\left(2 - \frac{1}{k} + 2\hat{m}_i\right). \tag{E.32}$$

In the event of a negative market outcome, the manager of firm i solves Eq. (20) to find the optimal price

$$p_{i2}^{-}(q_{i1}^{*}) = \frac{1}{4}(1 + 2\hat{m}_i + 2p_{j1}^{*} + 2q_{i1}^{*} - 2q_{j2}).$$

The manager of firm j chooses its optimal quality according to

$$q_{j2}^{+}(p_{j1}^{*}) = \frac{p_{j1}^{*}}{k}.$$

By substitution,

$$\pi_{i2}^{-}(\hat{m}_i) = \frac{2k(1+\hat{m}_i)^2 - 1}{8k}. \tag{E.33}$$

The expected second-period profit follows by adding up Eqs.(E.32) and (E.33) as follows:

$$\int_{-\infty}^{0} \pi_{i2}^{-}(\hat{m}_i) f(\hat{m}_i) d\hat{m}_i + \int_{0}^{\infty} \pi_{i2}^{+}(\hat{m}_i) f(\hat{m}_i) d\hat{m}_i = \frac{1}{8}\left(2 - \frac{1}{k} - \sqrt{\frac{2\sigma_m^2}{\pi}} + \sigma_m^2\right).$$

Using a similar logic as in Proposition 2, the optimized expected overall profit can be derived as

$$\Pi_{i1}^{QQ} = \frac{1}{8}\left(4 - \frac{2}{k} - \sqrt{\frac{2\sigma_m^2}{\pi}} + \sigma_m^2\right). \tag{E.34}$$

Comparing Π_{i1}^{QQ} to the corresponding profit Π_{i1}^{*} in the benchmark case yields

$$\Pi_{i1}^{*} - \Pi_{i1}^{PP} = \frac{1}{8}\left(\frac{((8-k)k-4)\sigma_m^2}{(3k-2)^2} + \sqrt{\frac{2\sigma_m^2}{\pi}}\right).$$

This difference is positive under our assumptions that $k > \frac{2}{3}$ and $\sigma_m \leq \frac{3k-2}{8k}$. □

Proof of Proposition 4. In the event of a positive market outcome, the manager of firm i solves Eq. (21) to find the optimal quality

$$q_{i2}^{+}(p_{i1}^{*}) = \frac{p_{i1}^{*}}{k}.$$

The manager of firm j chooses the optimal quality according to

$$q_{j2}^{-}(p_{j1}^{*}) = \frac{p_{j1}^{*}}{k}.$$

By substitution,

$$\pi_{i2}^{+}(\hat{m}_i) = \frac{1}{8}\left(2 - \frac{1}{k} + 4\hat{m}_i\right)$$

and

$$\pi_{j2}^{-}(\hat{m}_i) = \frac{1}{8}\left(2 - \frac{1}{k} - 4\hat{m}_i\right).$$

In the event of a negative market outcome, the manager of firm i solves Eq. (22) to find the optimal price

$$p_{i2}^{-}(q_{i1}^{*}) = \frac{1}{6}(3 + 2\hat{m}_i + 2q_{i1}^{*} - 2q_{j1}^{*}).$$

The manager of firm j chooses its optimal price according to

$$p_{j2}^{+}(q_{j1}^{*}) = \frac{1}{6}(3 - 2\hat{m}_i - 2q_{i1}^{*} + 2q_{j1}^{*}).$$

By substitution,

$$\pi_{i2}^{-}(\hat{m}_i) = \left(\frac{1}{2} + \frac{\hat{m}}{3}\right)^2 - \frac{1}{8k}$$

and

$$\pi_{j2}^{+}(\hat{m}_i) = \left(\frac{1}{2} - \frac{\hat{m}}{3}\right)^2 - \frac{1}{8k}.$$

Similar analysis as in Propositions 2 and 3 yields the corresponding optimized expected overall profits. Specifically, we obtain

$$\Pi_{i1}^{QP} = \frac{1}{36}\left(18 - \frac{9}{k} + 3\sqrt{\frac{2\sigma_m^2}{\pi}} + 2\sigma_m^2\right) \tag{E.35}$$

and

$$\Pi_{j1}^{QP} = \frac{1}{36}\left(18 - \frac{9}{k} - 3\sqrt{\frac{2\sigma_m^2}{\pi}} + 2\sigma_m^2\right). \tag{E.36}$$

Finally, under our assumptions that $k > \frac{2}{3}$ and $\sigma_m \leq \frac{3k-2}{8k}$, it follows that $\Pi_{i1}^{*} - \Pi_{i1}^{QP} < 0$ and $\Pi_{j1}^{*} - \Pi_{j1}^{QP} > 0$, which establishes the claim. □

Proof of Proposition 5. We establish the claim by showing that using a price orientation (*PO*) is a dominant strategy for each firm. For firm *A*, this is the case if $\Pi_{A1}^{PP} - \Pi_{A1}^{QP} > 0$ and $\Pi_{A1}^{PQ} - \Pi_{A1}^{QQ} > 0$ (see Fig. 1). Using Eqs. (E.31) and (E.35), we obtain

$$\Pi_{A1}^{PP} - \Pi_{A1}^{QP} = \frac{1}{72}\left(3\sqrt{\frac{2\sigma_m^2}{\pi}} + 5\sigma_m^2\right).$$

Next, using Eqs. (E.34) and (E.36), we have that

$$\Pi_{A1}^{PQ} - \Pi_{A1}^{QQ} = \frac{1}{72}\left(3\sqrt{\frac{2\sigma_m^2}{\pi}} - 5\sigma_m^2\right).$$

Note that these conditions are independent of the cost parameter *k*. Since $\sigma_m \leq \frac{3k-2}{8k} \leq \frac{3}{8}$, using a *PO* is indeed a dominant strategy for firm *A*. Since the payoffs are symmetric, the same holds for firm *B*, which establishes the claim. □

Appendix F. Delegation

We consider a setting where headquarters sets price and quality in the first period and a division manager makes adjustments in the second period. This arrangement is common in multi-national or multi-brand firms, which tend to allocate strategy to a central office and implementation to a local or specialized team. It is also common in entrepreneurial ventures, where owners are initially involved in questions of business entry or product launches but later empower a subordinate and exit.

Specifically, we make the following assumptions: At the beginning of the first period, headquarters sets price and quality based on expected demand and communicates expected sales to the division managers. Next, consumers make purchase decisions and the market outcome is realized. In the second period, the division manager adjusts the two product factors given the information learned from $\hat{m}$ according to Eqs. (7) and (8). Importantly, we assume that headquarters anticipates the self-serving attributions and corresponding adjustments of the division manager.

For a firm with a price orientation, headquarters chooses the first-period price and quality to maximize expected overall profit

$$\begin{aligned}\max_{p_1,q_1} \quad \Pi_1(p_1,q_1) &= p_1(\alpha + q_1 - p_1) - \frac{k}{2}q_1^2 \\ &\quad + \int_{-\infty}^{0} \pi_2^{-}(p_1|\hat{m})f(\hat{m})d\hat{m} + \int_{0}^{\infty} \pi_2^{+}(q_1|\hat{m})f(\hat{m})d\hat{m},\end{aligned} \tag{F.37}$$

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where $\pi_2^-(p_1|\hat{m})$ and $\pi_2^+(q_1|\hat{m})$ relate to a negative and positive market outcome, respectively. The optimized expected overall profit is Π_1^d, which leads to our next result.

Proposition A1. *The optimized expected overall profit of a monopolist with forward-looking headquarters and a self-serving division manager is higher than that of a firm with a self-serving manager alone; that is*

$$\Pi_1^d - \Pi_1^s = \frac{(6k+1)\sigma_m^2}{4(18k-1)\pi} > 0.$$

The typical concern with delegation is that the need for coordination puts an addition strain on a business. However, Proposition A1 shows that delegation reduces the adverse effect of self-serving attributions on profit. Intuitively, this is the case because the foresight of headquarters leads to price and quality levels in the first period that soften the negative impact of the subsequent adjustments. However, note that profit is still lower in the presence of delegation than in the benchmark case $\left(\Pi_1^d < \Pi_1^*\right)$.

Proof of Proposition A1. Substituting the expressions for $\pi_2^-(p_1|\hat{m})$ and $\pi_2^+(q_1|\hat{m})$ from Eqs. (E.24) and (E.22) into Eq. (F.37), and maximizing the objective function with respect to price and quality, yields the optimal first-period decisions

$$p_1^d = \frac{\left((18k-1)\alpha - 3(2k-1)\sqrt{\frac{2\sigma_m^2}{\pi}}\right)k}{1+4k(9k-5)}$$
$$q_1^d = \frac{\alpha}{2k-1} + \frac{\sqrt{\frac{2\sigma_m^2}{\pi}}}{18k-1}.$$

By substitution, the expected overall profit is given by

$$\Pi_1^d = \frac{\alpha^2 k}{2k-1} + \frac{(6k(2+3\pi)+2-\pi)\sigma_m^2}{8(18k-1)\pi}. \tag{F.38}$$

Subtracting Π_1^s given in Proposition 2 from Π_1^d in Eq. (F.38) yields

$$\Pi_1^d - \Pi_1^s = \frac{(6k+1)\sigma_m^2}{4(18k-1)\pi},$$

which is positive under our assumptions. Finally, the second-period values can be derived by following the same steps as in the proof of Proposition 2. □

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