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Price-Quality Competition**

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Self-Serving Behavior in Price-Quality Competition*

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Abstract

Managers like to think well of themselves and of the firms that employ them. Yet, such positive illusions can prejudice the evaluation of market outcomes and, as a result, provoke biased responses. In particular, we examine the possibility that managers self-servingly credit success in the market to product quality but blame failure on price. We draw on the social psychology of causal attributions to substantiate this idea and predict how managers adjust price and quality on the basis of prior results. Next, we report one experiment that tests the different elements of our theory, as well as insights from two surveys and a marketing simulation that add robustness to the findings. Finally, we develop an analytical model of price-quality competition to understand the profit impact of self-serving behavior. Counter to intuition, we find that under certain conditions firms can benefit from the biased actions of their managers.

Keywords: Self-serving behavior, attribution theory, price-quality competition, managerial decision-making.

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1 Introduction

This research is motivated by the following observation: When the performance of a firm in a market exceeds expectations, managers are quick to credit their ability to envision and deliver products of superior quality, seldom considering the possibility that they priced an average offering attractively low. Yet, when the situation is reversed, the same managers are happy to blame the disappointing result on an exaggerated price, seldom considering the alternative that the product is in fact inferior in quality.

Suggestive evidence that the valence of a market outcome prejudices the choice of price and quality as possible causal explanations comes from an initial study of 59 senior executives. These executives were asked to imagine that their company recently launched a new product and that first-year sales at the agreed price of £25.00 were expected to reach 10,000 units. One group was then informed that actual sales exceeded the forecast by 25%, while the second group learned that sales lagged the forecast by 25%. When asked to choose between price and quality as the most likely explanation for the respective outcome, 67% of the executives who experienced success selected quality while 63% of those who experienced failure selected price (Wald $\chi^2(1) = 4.83, p = .028$).

We propose a theory of *self-serving behavior* that explains these observations and predicts how managers adjust previous price and quality decisions in response to market outcomes. The starting point is the idea that managers hold different beliefs about price and quality, such that the latter is perceived to be more internal to the organization, more controllable, and more stable than the former. In other words, quality is relatively more dispositional in nature while price is more situational. Because of this distinction, attributing success to quality and failure to price helps managers sustain a positive image of the firm. It also implies that the preferred response to success is an increase in quality, while the preferred response to failure is a reduction in price.

These three elements of the theory—price and quality beliefs, causal attributions, and responses—are illustrated in a controlled experiment. We then report insights from two brief surveys and Markstrat, a popular marketing simulation, which reproduce and extend these findings. Finally, we develop a multi-period model of oligopolistic price-quality competition with the objective of understanding the profit impact of self-serving behavior. A notable feature of the model is that we offer two approaches to incorporate the phenomenon: as an exogenous decision rule or as the result of non-monetary payoffs in the manager's utility function. A second feature is that we distinguish between two types of actors: principals and managers. Principals make potential long-term price and quality

decisions under uncertainty about the competitor's type, while managers are allowed to make short-term adjustments in response to the market outcome. In our view, the natural benchmark for the analysis is the equilibrium provided by rational actors. This is contrasted to the more interesting situation when managers are self-serving and principals are either myopic or forward looking with respect to this trait. Counter to the simple intuition that self-serving behavior is necessarily inefficient, we find that a firm led by a sophisticated principal can benefit from the limitation of the manager because the initial price and quality decisions are distorted to relax competition.

The idea that individuals choose causal attributions strategically to manage sensations and impressions of the self is certainly not new to social psychology (Blaine and Crocker 1993; Leary 2007). It was Heider (1958, p. 118), in fact, who made the original observation that explanations are often tainted by "a person's own needs and wishes." The research that followed formalized this intuition, documenting several instances where individuals distort reality in a direction that supports their sense of self—a phenomenon commonly referred to as "positive illusions" (Taylor and Brown 1988). In general, the literature reveals that people tend to evaluate themselves more positively than the average person on nearly all socially desirable dimensions (Alicke and Govorum 2005). It also suggests that people are overly confident and overly optimistic (Harvey 1997; Weinstein 1980), and that they routinely misjudge the popularity of their own opinions and their ability to control events (Langer 1975; Marks and Miller 1987).

In management research, the concept of self-serving behavior has been applied primarily to understand the consequences of overconfidence. For example, a series of studies in economics and finance demonstrate that overconfidence spurs excessive action in several different contexts including mergers and acquisitions (Malmendier and Tate 2008), stock trading (Gervais and Odean 2001), market entry (Camerer and Lovallo 1999), entrepreneurship (Cooper, Woo, and Dunkelberg 1988), and innovation (Galasso and Simcoe 2011). Closer to the subject of this paper, we were in part inspired by a recent poll reporting that 95% of managers in Europe blame price competition on the irresponsible actions of rivals rather than on themselves (Simon-Kucher and Partners 2009). A second study, this time involving executives in companies across Asia, Europe, and the United States, produced a similar result: 86% of respondents believed price competition was accountable for the hostile environment (Simon-Kucher and Partners 2011). Curiously, of all the executives in the samples, senior (C-level) directors reported the strongest convictions.

It is important to note that our research examines the causal attributions of managers with respect to firm performance (which we capture using several different indicators),

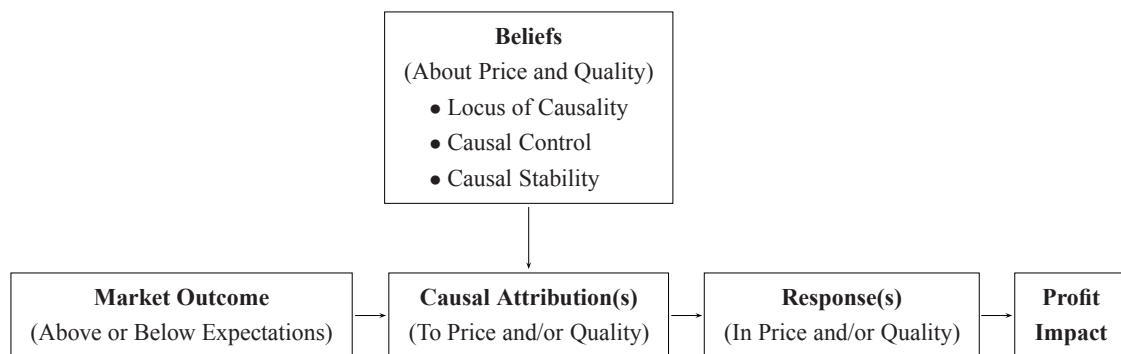


Figure 1: Conceptual Framework.

not with respect to their own character or ability. Early work on implicit egotism raised the possibility that explanations of one’s behavior can spill over into explanations of associated people, objects, or institutions (Greenwald and Banaji 1995). Yet, the scant research in economics and marketing that examines managers’ causal attributions takes the individual as the single unit of analysis (Babcock et al. 1995; Charness and Haruvy 2000; Curren, Folkes, and Steckel 1992; Deshpande and Zaltman 1987).

Furthermore, there are two specific objectives that we want to accomplish. First, we want to explain how managers use price and quality to explain and respond to market outcomes. In particular, we are interested in the inferential process captured by the vertical sequence in Figure 1. The root idea is that price and quality support a manager’s tendency to be self-serving in different ways. To understand this, note that causes in general are described by the extent to which they are (1) internal to the actor—termed locus of causality, (2) subject to volitional alteration—causal control, and (3) enduring over time—causal stability (Weiner 1986, 2000). Based on these characteristics, we argue that causal attributions to quality are primarily dispositional (they reflect on the firm because they are internal, controllable, and stable), while causal attributions to price are primarily situational (they reflect on the environment because they are external, uncontrollable, and unstable). This distinction suggests that a self-serving manager is motivated to use the former to explain success and the latter to explain failure. The rationale for this suggestion is as follows.

Product quality is often considered a defining feature of the firm. The decisions managers make to improve quality are said to reflect the core competence of the organization and engage the identity and values of its employees. Put differently, what the firm sells is often regarded as an integral part of what the firm is and what it stands for. Quality is also controllable and relatively stable over the life cycle of a product. For these reasons,

attributing success in the market to the quality of a product supports the manager's image of the firm: positive outcomes are the result of *who we are*.

Price, however, is tantamount to "market conditions." Pricing is seldom considered a core competence of the organization; it sits at the fringes. After all, there are many inputs to consider, in particular the concerns of external constituents such as customers and competitors. Pricing decisions are also characteristically hard to control. Yet, price is easy to change at short notice. For these reasons, attributing failure in the market to an excessive price also supports the manager's image of the firm: negative outcomes are the result of *what others do*.

The second objective that we want to accomplish is to quantify the profit impact of self-serving behavior. This is the decision process captured by the horizontal sequence in Figure 1. On this point, our work adds to the literature on bounded rationality in industrial organization (Ellison 2006; Spiegler 2011). Research in this area examines the exploitation of naïve consumers by sophisticated firms through shrouding (Gabaix and Laibson 2006), price dispersion (Spiegler 2006), or some other mechanism that places a cognitive burden on decision-making. It also examines the irrational beliefs and behaviors of managers by developing alternative utility functions or by studying non-equilibrium models (Goldfarb et al. 2012). We contribute to this second set of articles, introducing self-serving behavior to the study of oligopolistic competition with differentiated products (Anderson, de Palma, and Thisse 1992).

The remainder of the paper is structured as follows. Section 2 presents the empirical evidence that motivates our modeling effort. The experiment is the central test of the theory. The surveys and the marketing simulation add robustness to the findings. Section 3 describes the model and the oligopolistic competition in price and quality in detail. The analysis in Section 4 starts with the benchmark case provided by rational actors. We then study the profit impact of self-serving behavior in the presence of a myopic principal who is oblivious to the limitation of the manager, or in the presence of a forward-looking principal who anticipates the constraint and distorts first-period price and quality accordingly. Section 5 concludes, addressing the limitations of our work and offering implications for practice and directions for future research.

2 Empirical Evidence

This section describes our empirical approach and reports different tests of the theory. Our goal is to demonstrate that managers behave self-servingly as defined. To that end,

there are three results that need to be established (see Figure 1). First, we want to show that managers hold different *beliefs* about price and quality on each of the characteristics that define causal attributions: locus of causality, causal control, and causal stability. The prediction is that quality is perceived to be a more internal, more controllable, and more stable decision variable than price. Second, we want to show that *causal attributions* of a market outcome to price and quality are contingent on the valence of that outcome relative to some expectation. Again, we make a clear prediction: managers tend to explain a positive (better than expected) outcome by superior quality and a negative (worse than expected) outcome by an excessive price. Third, we want to show the *responses* that result from this inferential process; in particular, that the attribution of success to quality prompts an increase in quality (with comparatively little adjustment to price), while the attribution of failure to price prompts a reduction in price (with comparatively little adjustment to quality).

The main test of our theory is the experiment, which extends the pilot study described in the Introduction to measure beliefs and responses as well as causal attributions. Thus, the experiment provides a complete empirical picture of the theory. In addition, we analyze data from two surveys and Markstrat. The surveys ask respondents to reflect on their own firms and experiences (rather than on a hypothetical scenario). The goal is to replicate the result of the experiment that pertains to causal attributions using several different indicators of firm performance—not only sales volume as in the experiment, but also markup and profit—and using a within-subjects presentation of market outcome. Finally, Markstrat provides a richer context than what is possible in an experiment or survey. We analyze data from this marketing simulation to (further) demonstrate external validity, in particular with respect to the link between market outcome and price and quality responses.

2.1 Experiment

Participants. The sample for the experiment comprises 57 high-level managers attending executive education programs at a business school in the United Kingdom. The average age of this group is 40.9 years old and the average work experience is 17.6 years. Participants were assigned at random to one of two experimental conditions. They were informed that the research examines managerial behavior in general, that there are no right or wrong answers to the questions asked, and that they should rely exclusively on their impressions and preferences when responding. The experiment was conducted approximately at the halfway point of each program.

Instructions. Participants considered a scenario describing the launch of a new product. The particulars of the product were not specified. The participants first read information about the competitive nature of the marketplace. They were then told that initial testing of the product and extensive market research estimated a profit-maximizing price of £25.00 and first-year sales of 10,000 units. Next, participants were brought forward twelve months to review the actual sales figures for the industry. Importantly, they discovered that the firm realized sales of 12,500 units (25% above the projection) or 7,500 units (25% below the projection), depending on the experimental condition. These differences in sales volume relative to the expectation constitute the between-subjects manipulation of market outcome.

Dependent Measures. The experiment contains five questions that address the elements of our theory. First, participants evaluated price and quality separately as possible explanations for the market outcome depicted in the scenario. We measured these causal attributions on separate -3 (“The price/quality of the product is a lot lower than that of the competition”) to 3 (“The price/quality of the product is a lot higher than that of the competition”) scales for price and quality. Second, participants indicated whether they would respond to the market outcome by adjusting these variables (-3 = “Significantly decrease the price/quality” to 3 = “Significantly increase the price/quality”). Note that we used different scales for price and quality to support several possible types of judgment: depending on the question, participants could provide a stronger or weaker rating to price or quality, rate them equally, or indeed use the midpoint to convey parity with competition or inaction, respectively.

Finally, participants reported beliefs about price and quality on each of the three characteristics of causal attributions: locus of causality, causal control, and causal stability. Specifically, participants evaluated whether “price/quality is a fundamental element of a product’s value proposition” (separate 1 = “Strongly disagree” to 7 = “Strongly agree” scales), whether “market forces such as strong competitors and demanding customers play a role in determining the prices and qualities of the products companies sell” (separate 1 = “A very small role” to 7 = “A very large role” scales), and whether “price and quality are easy to change” (separate 1 = “Very easy to change” to 7 = “Very hard to change” scales).

Background Checks. In addition to these measures, we administered three questions to gauge the external validity of the stimulus. The first question asked participants to judge whether the scenario is an accurate representation of reality (1 = “Not at all, the scenario mirrors reality poorly” to 7 = “Completely, the scenario mirrors reality well”). A simple

one-sample t -test comparing the mean score on this measure ($M = 4.79$) to the neutral point in the scale suggests that this is indeed the case ($t(56) = 4.39, p < .001$). Participants then evaluated the 25% difference between expected and actual sales on a -3 (“A really bad outcome for the company”) to 3 (“A really good outcome for the company”) scale. The data show the predicted effect of market outcome, with participants facing a 25% deficit in sales reporting a lower mean score ($M_- = -.93$) than participants facing a surplus in sales of equal magnitude ($M_+ = 1.96, F(1, 55) = 70.63, p < .001$). Importantly, both of these values are in the expected direction and significantly different from the “neither a bad nor a good outcome for the company” midpoint ($t_+(29) = 8.80, p < .001; t_-(26) = -3.62, p = .001$). Finally, we asked participants whether market outcomes similar to the one depicted in the scenario could be explained by differences in price and quality among competing products ($1 =$ “Not all, price and/or quality differences matter slightly” to $7 =$ “Completely, price and/or quality differences matter greatly”). Again, we observe that participants provided responses that on average are significantly higher than the neutral point in the scale ($M = 4.79, t(56) = 4.39, p < .001$).

Results: Beliefs. We start the main analysis with the participants’ beliefs about price and quality, as these theoretically inform the causal attributions that managers form to explain a market outcome.

The prediction is that quality is viewed as a more internal, more controllable, and more stable decision variable than price. The answers of participants confirm this intuition. Separate mixed-factorial analyses of variance (ANOVAs) with beliefs as the dependent measures, market outcome (negative vs. positive) as the between-subjects factor, and decision variable (price, quality) as the repeated measure show the expected main effects of decision variable. Specifically, we find that quality is (1) a more fundamental element of a product’s value proposition ($M_Q = 6.00$ vs. $M_P = 4.74; F(1, 55) = 40.30, p < .001$), (2) less susceptible to market forces ($M_Q = 4.18$ vs. $M_P = 5.58; F(1, 55) = 28.83, p < .001$), and (3) harder to change ($M_Q = 5.18$ vs. $M_P = 3.21; F(1, 55) = 58.60, p < .001$) than price. No other effect in these analyses is statistically significant.

Results: Causal Attributions. The next step is to analyze the participants’ explanations for the market outcome. The type of beliefs recorded in the experiment suggests that causal attributions to quality are in fact primarily dispositional, while causal attributions to price are primarily situational. As such, a self-serving manager should be motivated to explain success by quality and failure by price.

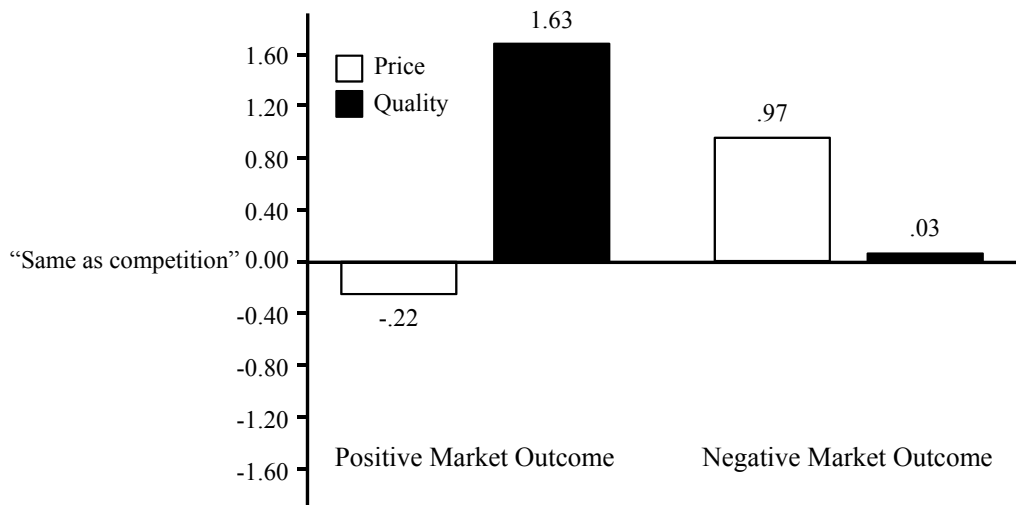


Figure 2: Causal Attributions in the Experiment.

For the following analysis, and that of responses, we convert absolute scores to deviations from the midpoint of the scale. This transformation allows us to meaningfully assess the valence and strength of the answers against the midpoint of the scale and against each other.

A mixed-factorial ANOVA with causal attribution as the dependent measure, market outcome as the between-subjects factor, and decision variable as the repeated measure shows the expected two-way interaction: $F(1,55) = 21.16, p < .001$. This interaction, which is the only significant effect in the analysis, is displayed in Figure 2. Specifically, participants explained the 25% surplus in sales more as the consequence of (high) quality than of (low) price, relative to competition: $M_Q = 1.63$ vs. $M_P = -.22$; $F(1,26) = 17.71, p < .001$. Only the mean score for quality is statistically different from the “no difference from the competition” midpoint of the scale in this instance ($t(26) = 7.84, p < .001$; $p_P = .265$). At the same time, participants explained the 25% deficit in sales more as the consequence of (high) price than of (low) quality, relative to competition: $M_P = .97$ vs. $M_Q = .03, F(1,29) = 6.12, p = .019$. The mean score for price is the only value that is statistically different from the midpoint of the scale ($t(29) = 3.99, p < .001$; $p_Q = .891$).

Results: Responses. We conclude by examining the participants’ responses to the market outcome. Common sense suggests that managers aim to repeat behaviors that carry positive consequences and reverse behaviors that carry negative consequences. Given the pattern of causal attributions shown in Figure 2, this simple intuition implies the following

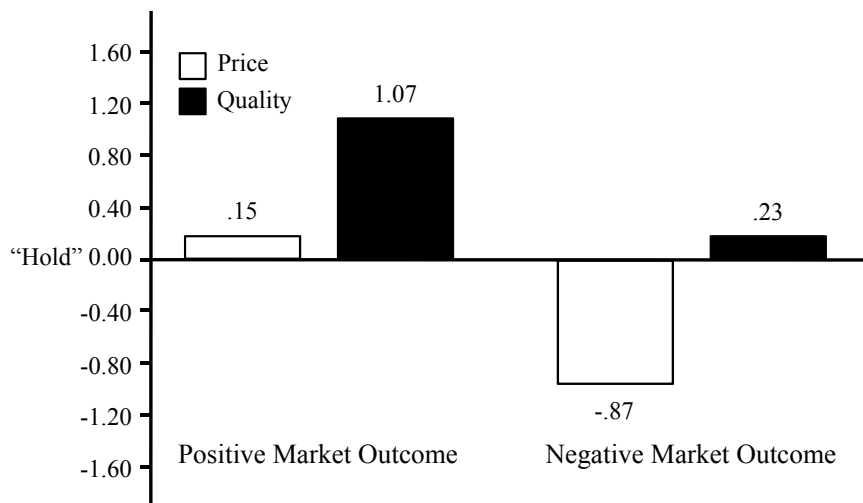


Figure 3: Responses in the Experiment.

prediction: participants facing a surplus in sales respond primarily by investing in quality (as opposed to price), while participants facing a deficit in sales exhibit the opposite behavior.

Figure 3 displays the mean responses collected in the experiment. A mixed-factorial ANOVA with response as the dependent measure, market outcome as the between-subjects factor, and decision variable as the repeated measure shows a main effect of decision variable: $F(1,55) = 10.87, p = .002$. This is the only significant effect in the analysis. Specifically, participants assigned to the positive market outcome condition responded to the scenario with a stronger (and positive) adjustment to quality than price: $M_Q = 1.07$ vs. $M_P = .15, F(1,26) = 11.18, p = .003$. Only the mean score for quality is statistically different from the "hold" midpoint of the scale in this condition ($t(26) = 4.89, p < .001; p_P = .404$). However, participants assigned to the negative market outcome condition responded to the scenario with a moderately stronger (and negative) adjustment to price than quality: $M_P = -.87$ vs. $M_Q = .23, F(1,29) = 2.89, p = .100$. In this condition, only the mean score for price is statistically different from the midpoint of the scale ($t(29) = 3.26, p = .003; p_Q = .387$).

Discussion. The outcome of the experiment is consistent with our conceptualization of self-serving managers. The participants in our sample rated quality as a more internal, more controllable, and more stable decision variable than price. They also preferred to explain success in the market by quality and failure by price. Finally, the positive market

outcome prompted a desire to increase quality, with no commensurate change in price, while the negative market outcome had the opposite effect.

This last finding is of particular importance moving forward because it shows an asymmetry in the way managers use price and quality to prolong success or reverse failure in the market. Sections 3 and 4 develop a model of price-quality competition that assumes this phenomenon and examines its impact on firm profit. Before that, however, we study data collected in two surveys and Markstrat to generalize the experiment in at least two respects. First, we want to demonstrate the same pattern of causal attributions for other market outcomes. Our analytical model treats sales volume, markup, and profit as interchangeable indicators of firm performance. Accordingly, the surveys cover all three of these indicators, while our study of Markstrat focuses on net contribution (profit) as well as share price index. Second, we want to demonstrate external validity. The experiment already included measures to check the realism of the stimulus. The surveys and, in particular, a marketing simulation such as Markstrat provide further reassurance.

2.2 Survey 1

Background and Sample. The sample consists of mid-level managers attending a one-day marketing practice conference in May 2011 in the United Kingdom. The organizer hosts a similar event twice yearly for the purpose of sharing best practices in the discipline and to provide a forum for networking among professionals. Twenty-one sectors are represented in the sample, of which travel and hospitality (14% of responses), transport and logistics (12%), and media and entertainment (9%) are the three largest members.

Data. We collected 187 valid responses to a brief questionnaire. Unlike participants in the experiment, who encountered a single market outcome, respondents to the survey assessed the likely cause of both a positive and a negative sales or profit result. We administered two questions with the same underlying structure but different wording to match the setting. For instance, the positive result was presented as follows: “In your experience, if a (new) product or service performs in excess of expectations in terms of sales volume or profit, do managers tend to credit this positive outcome to superior quality or to a lack of price pressure?” For each question, respondents were instructed to reflect on their own experiences and choose one of three possible causal explanations: price, quality, or price and quality.

Results. The within-subjects presentation of market outcome arguably provides a conservative test of the prediction that success and failure are predominantly attributed to quality and price, respectively. It is a conservative test because respondents had the opportunity to contrast the two settings and adjust their answers to appear consistent, if so they desired. Notwithstanding, a related-samples non-parametric test of marginal homogeneity shows that the distributions of responses across questions are not equally likely ($p < .001$). Specifically, we find that 66.8% of respondents attributed high sales or profit relative to expectations to quality, while only 5.9% selected price as the cause. Conversely, 41.7% of respondents attributed low sales or profit relative to expectations to price, while only 24.1% selected quality.

2.3 Survey 2

Background and Sample. From May to June 2011, Simon-Kucher and Partners, a global consulting company, conducted an online survey to gauge the opinions of senior executives on topics including profit orientation, pricing power, competition, inflation, and business outlook. The sample consists of existing and former clients of the company, members of the Professional Pricing Society, and alumni of a business school in Spain. Both consumer (38% of 2,657 responses) and business (62%) markets were surveyed. The five countries with the largest representation were the United States (17%), France (12%), Spain (10%), the United Kingdom (9%), and Germany (8%). The sector with the highest representation was financial services (19%), followed by healthcare (15%) and travel and hospitality (7%). Forty-one percent of firms in the sample had revenues in excess of €1 billion. Thirty-one percent of responses came from C-level directors.

Data. We examine 679 valid responses to two questions related to pricing power, a construct commonly used by financial analysts to describe a firm's (profitable) ability to raise price above cost. For the purpose of the survey, pricing power was defined as "the ability of a company to capture the money it deserves for the value it delivers to customers." For our purpose, pricing power is equivalent to markup, one of the three indicators of firm performance that we consider in our modeling effort.

The executives were asked to assess their company's performance on pricing power using a five-point scale, with higher numbers indicating better performance. Those that provided high ratings (score of 4 or 5) or low ratings (score of 1 or 2) were then asked to select a maximum of three explanations from the following list: "our brand has a strong (weak) positioning in the market," "we sell a differentiated (commodity) product," "we

operate in a price-friendly (price-aggressive) environment,” and “our customers have little (considerable) power to negotiate prices”—where display logic matched the exact wording of these explanations to the respondents’ preceding assessment of pricing power. We coded the first and second explanation as quality related, and the third and fourth explanation as price related. In addition, we classified a respondent’s overall explanation as being in favor of quality, in favor of price, or balanced depending on the number of explanations provided of each type.

Results and Discussion. The prediction is that executives provide price explanations for low pricing power and quality explanations for high pricing power. A multinomial logistic regression of causal attributions on pricing power confirms this idea. Specifically, we see that executives who reported low pricing power blamed the situation on price-related reasons in 64.5% of cases, but on quality-related reasons in only 10.7% of cases (Wald $\chi^2(1) = 25.31, p < .001$). Conversely, executives who reported high pricing power credited the situation to quality-related reasons in 70.9% of cases, but to price-related reasons in only 12.3% of cases (Wald $\chi^2(1) = 87.27, p < .001$).

The pattern of results in the two surveys with respect to sales volume, profit, and markup is analogous to the one obtained in the experiment. It is also worth noting that respondents in the surveys evaluated the performance of their own firms drawing on their own experiences, not the performance of a hypothetical organization drawing on information provided in the stimulus. We now turn our attention to the analysis of Markstrat data. Simulation games represent a third, realistic context where to test the predictions of our theory. Specifically, they replicate environments that are rich in information and where decisions are made by groups rather than by individuals. These are two qualities that can enhance the external validity of our findings.

2.4 Markstrat

Background and Sample. Markstrat is a simulation game that lets teams of players take control of a virtual organization, making decisions on its behalf. The simulation is well known and often used as a research setting (Gatignon 1987). We created a dataset of 36 different simulations played over a three-year period from 2010 to 2012 by 1,296 graduate students enrolled in master of business administration or executive master of business administration programs at a business school in the United Kingdom. The average age of the sample is 34 years old, the average work experience is 10.6 years, and the average GMAT score is 666 (out of a possible 800).

Data. Each simulation game in our data represents one industry and spans eight decision rounds. Industries are comprised of six competing firms. Students are assigned to firms in groups of six to form management teams. Generally, the task of management teams in each period is to review the performance of the firm and make decisions with respect to marketing (price, production, advertising, etc.), research and development, sales force and distribution, and market research. A step-by-step guide to the Markstrat simulation is available from the manufacturer, StratX. For simplicity, we study the period 3 inflation-adjusted decisions of all (216) firms in our data. This decision round was selected at random after first omitting period 1 (because player groups are encouraged to maintain the status quo at the onset) and period 8 (because of possible endgame tactics) from consideration.

Independent and Dependent Measures. In Markstrat, the performance of a firm is evaluated primarily on net contribution and share price index, but also on sales volume, total revenue, share of market, and return on investment. Because these metrics are related, we limit our attention to the two variables that most preoccupy management teams. Specifically, the independent measures in our analysis are the changes in net contribution and share price index from period 1 to period 2. We assume that management teams contemplating period 3 decisions interpreted positive and negative changes in these variables as positive and negative market outcomes, respectively.

To find evidence of self-serving behavior that is consistent with the finding in the experiment, we need to establish that management teams spent more on quality and made smaller price cuts as market outcomes improved. To that end, we created a dependent measure that combines the percentage changes in average selling price and advertising expenditure from period 2 to period 3. In the case of a positive outcome, this measure was calculated by subtracting the absolute percentage change in average selling price (which our theory expects to be minimal in that context) from the percentage change in quality (which is expected to be substantial). In the case of a negative outcome, however, this measure was calculated by adding the absolute percentage change in quality (which is expected to be minimal) to the percentage change in average selling price (which is expected to be substantial). We use advertising expenditure to represent quality because, like price, this is a short-term decision variable. The choice is also consistent with our treatment of quality in Section 3, where we draw a distinction between long-term intrinsic quality, which managers cannot influence, and short-term quality improvements, which they can adjust together with price.

Results. Separate linear regressions of combined price-quality responses on the chosen indicators of market outcome show the predicted positive effects of net contribution

($\beta = .001$, $p = .023$) and share price index ($\beta = .002$, $p = .022$). That is, the better the market outcome, the more management teams emphasized quality adjustments over price adjustments—a result that is consistent with that of the experiment and provides further motivation for the analysis presented in the following sections. Our objective in the remainder of the paper is to understand the profit impact of biased responses to market outcomes.

3 Model

This section introduces the ingredients of the model. We begin by detailing the assumptions regarding firms and consumers, followed by the sequence of events.

3.1 Firms

We consider a market with two single-product firms $i = A, B$ that compete in price and overall quality (henceforth referred to simply as “quality”) over two periods $t = 1, 2$. In each firm there are two actors, a principal and a manager, who choose the price p_{it} and quality improvement Q_{it} for their product. Specifically, the principals make potential long-term decisions about prices and quality improvements in the first period, which they then communicate along with expected profits to their managers. The managers alone can make adjustments in response to the market outcome.

We assume that firm i is of a low type $k = L$ or a high type $k = H$, which is the principal’s private information. The type of firm i is captured by its intrinsic quality q_i^k , where $q_i^H > q_i^L$. We further assume that principals hold identical beliefs that the rival’s intrinsic quality is initially high with probability λ and low with probability $1 - \lambda$, where $\lambda \in (0, 1)$, which is also their private information.

On their part, managers observe the market outcome before making any adjustment. Specifically, they observe realized profits and learn the firms’ respective types from first-period prices and quality improvements. However, because managers have no insight into what principals know or believe, they rely on inference to explain the discrepancy between realized and expected profits. We argue that this inferential process can be self-serving.

It is common in practice to encounter situations where managers cannot decipher or are simply uninformed about the assumptions underlying initial decisions of principals. Two examples are cases of market entry and new product launches. It also occurs in the context of new ventures, where principal-owners tend to be involved initially in the business but at

some point delegate authority to a management team. Finally, in multi-national or multi-brand organizations there is often a corporate office that sets broad strategic directives across markets, while everyday decisions remain the responsibility of local staff that is “closer to the action.”

To model competition, we build on Buehler and Halbheer’s (2012) assumptions that products are horizontally and vertically differentiated as follows. Horizontal differentiation is à la Hotelling, with the firms located at the extremes of the product characteristics space, namely at $x_A = 0$ and $x_B = 1$. Vertical differentiation captures the notion that quality improvements enhance the value of the product in the eyes of consumers. Specifically, for each product i in period t , quality is captured by an index

$$\theta_{it} = q_i^k + \omega Q_{it} \quad (1)$$

that weights intrinsic quality q_i^k and quality improvements Q_{it} , where $\omega > 0$ measures consumers’ sensitivity to the latter. Our treatment of quality reflects the intuition that innovations vary significantly in the speed in which they are conceived and implemented. We assume that intrinsic quality is technology driven and exogenously given. The firm therefore cannot adjust q_i^k in the short run, but it can influence quality by investing in quality improvements Q_{it} , just as it can adjust price in the short run. Quality improvements can take different forms, including some enhancements to the product itself or changes to packaging, service quality, and commercial activities (advertising, product endorsements, etc.). The investment cost function for a quality improvement is given by $k(Q_{it}) = \beta Q_{it}^2$, where $\beta > 0$. The marginal cost of output with intrinsic quality q_i is $c_i \geq 0$.

3.2 Consumers

We consider a market with a mass of consumers N that we normalize to unity without loss of generality. Consumers make a discrete choice and buy one unit of their preferred good in each period. Individual preferences are described by a conditional indirect utility function of the form

$$v_{it} = \theta_{it} - \tau |x - x_i| + y - p_{it}, \quad (2)$$

where θ_{it} is the quality, $x \in [0, 1]$ is the preferred product characteristic, and y is income (Anderson, de Palma, and Thisse 1992). With respect to quality θ_{it} , we assume that the consumer observes its components, the intrinsic quality q_i^k and the quality improvement Q_{it} , before making purchase decisions. Finally, the parameter τ measures sensitivity to horizontal mismatch $|x - x_i|$. Each consumer is characterized by the preferred product

characteristic x , which is drawn independently from a uniform distribution over the interval $[0, 1]$. We assume that consumer tastes are private information but their distribution is common knowledge.

We define $D_{it}(\mathbf{p}_t, \boldsymbol{\theta}_t)$ as the demand for the product of firm i in period t as a function of prices $\mathbf{p}_t = (p_{At}, p_{Bt})$ and qualities $\boldsymbol{\theta}_t = (\theta_{At}, \theta_{Bt})$. Demand can be derived from the conditional indirect utility function in (2) and is given by

$$D_{it}(\mathbf{p}_t, \boldsymbol{\theta}_t) = \frac{1}{2} + \frac{(\theta_{it} - p_{it}) - (\theta_{jt} - p_{jt})}{2\tau}, \quad i \neq j. \quad (3)$$

Notice that asymmetries in demand stem from differences in “quality-price margins” (Anderson and de Palma 2001), defined as $\theta_{it} - p_{it}$. The extent to which a competitive advantage allows a firm to engage in business stealing is determined by the factor $(2\tau)^{-1}$, an index of substitutability between products (Laffont et al. 2001).

Substituting the qualities from (1) into the demand function $D_{it}(\mathbf{p}_t, \boldsymbol{\theta}_t)$, we can write (3) as a function of prices and quality improvements as $D_{it}(\mathbf{p}_t, \mathbf{Q}_t)$, where $\mathbf{Q}_t = (Q_{At}, Q_{Bt})$ denotes the vector of quality improvements.

3.3 Timeline

At the beginning of the first period, after learning the type of their firm, principals choose prices and quality improvements. Based on these decisions, principals communicate expected profits to their firm’s manager. At the end of the first period, managers observe the market outcome that results from consumers’ purchase decisions and learn the competitor’s type. However, as discussed, managers lack insight into the principals’ decision making and therefore rely on inference to resolve the discrepancy between realized and expected profits. The managers’ choices of causal attributions influence whether prices and quality improvements are adjusted. Figure 4 summarizes this sequence of events.

4 Analysis

We now examine the profit impact of self-serving behavior. We first consider the benchmark case provided by rational actors. In our context, actors are “rational” in the sense that managers are not self-serving—that is, they respond to the market outcome by adjusting prices and quality improvements optimally—and principals are aware of this. The next step is to relax this assumption and study equilibrium in the presence of self-serving managers and principals who may or may not anticipate this problem. We use the terms “forward

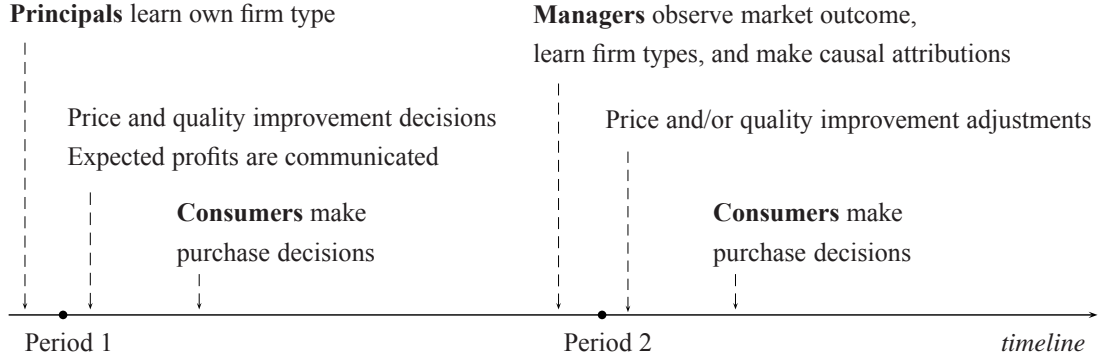


Figure 4: Sequence of Events.

looking” and “myopic,” respectively, to describe the principals’ level of sophistication. Finally, we show that under certain conditions a firm can benefit from the price and quality adjustments of a self-serving manager.

We present the case in which all asymmetries in the model stem from the demand side. Thus, we assume that firms are symmetric in the sense that intrinsic quality is the same for a given type k . This means that $q_i^L = q^L$ and $q_i^H = q^H$ for $i = A, B$. In addition, we assume that firms have identical marginal costs c_i , normalized to zero without loss of generality.

The parameter values are restricted in two ways. First, we assume that $\beta > \frac{\omega^2}{8\tau}$. This condition ensures that profit functions are strictly concave and that a unique equilibrium exists. Second, we impose that $q^H - q^L < \frac{3}{2}$. This condition ensures that the market is covered and that both firms have positive sales in equilibrium.

We focus on how the principals’ uncertainty about the rival’s intrinsic quality affects the profit impact of self-serving behavior. To illustrate this point, we assume that $\omega = 1$, $\tau = 1$, and that $\beta = \frac{1}{2}$. Robustness analysis shows that the specific choice of parameter values does not qualitatively affect our results. Proofs are relegated to the Appendix to facilitate exposition.

4.1 Rational Actors

Principals make first-period price and quality improvement decisions under uncertainty about the competitor’s type and taking into account the managers’ second-period adjustments. Managers implement optimal second-period price and quality improvement adjustments under complete information. We use backward induction to solve for the subgame perfect equilibrium.

| | | | |
|--------|----------|------------------------------------|------------------------------------|
| | | Firm B | |
| | | <i>L</i> | <i>H</i> |
| Firm A | <i>L</i> | π_{A2}^{LL} π_{B2}^{LL} | π_{A2}^{LH} π_{B2}^{LH} |
| | <i>H</i> | π_{A2}^{HL} π_{B2}^{HL} | π_{A2}^{HH} π_{B2}^{HH} |

Figure 5: Market Structures and Corresponding Profits.

There are four possible structures of the market conditional on the realization of firm types: both firms are of type *L* (which we label structure *LL*), firm *A* is of type *L* and firm *B* is of type *H* (structure *LH*), firm *A* is of type *H* and firm *B* is of type *L* (structure *HL*), and both firms are of type *H* (structure *HH*). We write the demand functions as $D_{it}^{kl}(\mathbf{p}_t, \mathbf{Q}_t)$ to capture this contingency. For example, $D_{i2}^{HL}(\mathbf{p}_2, \mathbf{Q}_2)$ is firm *i*'s demand in period $t = 2$ when firm *A* is of type *H* and firm *B* is of type *L*. Figure 5 uses the same notation for the profit functions and provides the profits under each market structure.

Second Period. Firm types are common knowledge at the beginning of the second period. A rational manager *i* maximizes product market profit net of the cost to provide the quality improvement, thereby choosing price and quality improvement so as to

$$\max_{p_{i2}, Q_{i2}} \pi_{i2}^{kl}(\mathbf{p}_2, \mathbf{Q}_2) = (p_{i2} - c_i)D_{i2}^{kl}(\mathbf{p}_2, \mathbf{Q}_2) - \beta(Q_{i2})^2, \quad (4)$$

where *kl* indexes demand (and by extension profit) for a given structure of the market. We denote firm *i*'s optimal price and quality improvement in the second period by \hat{p}_{i2}^{kl} and \hat{Q}_{i2}^{kl} , respectively. The optimized second-period profit is denoted by $\hat{\pi}_{i2}^{kl}$.

First Period. Principals do not know the competitor's type in the first period. Therefore, in contrast to the second period, the initial decision problem is one of incomplete information (Fudenberg and Tirole 1991). That is, principals condition their decisions on their own firm type, taking into account that the competitor is of type *H* with probability λ or of type *L* with probability $1 - \lambda$. In the Bayesian equilibrium, a rational principal *i* chooses price and quality improvement to maximize the overall expected profit:

$$\begin{aligned} \max_{p_{i1}, Q_{i1}} \pi_{i1}^k(\mathbf{p}_1, \mathbf{Q}_1) = & (1 - \lambda)[(p_{i1} - c_i)D_{i1}^{kL}(\mathbf{p}_1, \mathbf{Q}_1) - \beta(Q_{i1})^2 + \hat{\pi}_{i2}^{kL}] \\ & + \lambda[(p_{i1} - c_i)D_{i1}^{kH}(\mathbf{p}_1, \mathbf{Q}_1) - \beta(Q_{i1})^2 + \hat{\pi}_{i2}^{kH}]. \end{aligned} \quad (5)$$

We denote firm i 's optimal price and quality improvement in the first period by \hat{p}_{i1}^k and \hat{Q}_{i1}^k , respectively. The corresponding optimized expected profit is denoted by $\hat{\pi}_{i1}^k$.

It is important to note that, when managers are rational, the subgame perfect equilibrium coincides with the solution obtained by solving for equilibrium separately in each period. Thus, in this benchmark case it does not matter whether principals are myopic or forward looking. However, as we now demonstrate, the distinction has important implications when managers are self-serving.

4.2 Myopic Principals

There is overwhelming evidence in the literature that people lack the ability to do backward induction (Smith 2010). With that basic finding in mind, we now analyze the profit impact of self-serving behavior by managers in the context of myopic principals—i.e., principals who do not anticipate the managers' limitation. In particular, we present two approaches to model the phenomenon. First, we assume that self-serving behavior is a decision rule that is set exogenously as a consequence of the empirical findings. Second, we treat it as an endogenous outcome of a maximization problem in which managers derive utility from profit and non-monetary payoffs.

Second Period. Firm types are common knowledge at the start of the second period. In addition, managers have learned whether their firm's first-period realized profit exceeds or lags expected profit: the market outcome. The following result summarizes what managers learn.

Lemma 1 (Market Outcome). *At the end of the first period, the profit of both firms is above expectations under market structure LL, the profit of firm A is below expectations and the profit of firm B is above expectations under market structure LH, the profit of firm A is above expectations and the profit of firm B is below expectations under market structure HL, or the profit of both firms is below expectations under market structure HH.*

To grasp the intuition behind Lemma 1, consider the perspective of firm A when it is of type L . (The opposite logic applies when the perspective shifts to firm B.) If firm B is also of type L , it is a weak competitor holding a lower quality-price margin than expected. Therefore, the first-period demand for firm A's product is above expectations. Due to demand-markup complementarities (Athey and Schmutzler 2001), this result implies a higher than expected markup and profit. However, if firm B is of type H , it is a strong competitor holding a higher quality-price margin than expected. As a result, the demand for firm A's product, as well as its markup and profit, is below expectations.

This explanation demonstrates that market outcomes are qualitatively equivalent when firm performance is measured by sales volume, markup, or profit—a characteristic of the model that is consistent with our empirical results.

With the information available available to them, managers cannot resolve the discrepancy between realized and expected profits. Instead, they infer what role, if any, price and quality improvements played in causing the market outcome. In line with our theory, we assume that manager i chooses to maintain first-period price and adjust the quality improvement if confronted with a positive market outcome. Conversely, manager i chooses to maintain first-period quality improvement and adjust price if confronted with a negative market outcome.

We present the managers' profit maximization problems for market structure LH . In this case, the manager of firm A maintains the (given) first-period quality improvement \bar{Q}_{A1}^L and the manager of firm B maintains the (given) first-period price \bar{p}_{B1}^H . Specifically, the managers solve the following:

$$\begin{aligned}\max_{p_{A2}} \pi_{A2}^{LH}(p_{A2}, Q_{B2}) &= (p_{A2} - c_A)D_{A2}^{LH}(p_{A2}, \bar{p}_{B1}^H, \bar{Q}_{A1}^L, Q_{B2}) - \beta(\bar{Q}_{A1}^L)^2 \\ \max_{Q_{B2}} \pi_{B2}^{LH}(p_{A2}, Q_{B2}) &= (\bar{p}_{B1}^H - c_B)D_{A2}^{LH}(p_{A2}, \bar{p}_{B1}^H, \bar{Q}_{A1}^L, Q_{B2}) - \beta(Q_{B2})^2.\end{aligned}$$

It should be evident that these profit maximization problems are constrained versions of the problem (4) faced by rational managers. We denote the managers' optimal adjustments by \bar{p}_{A2}^{LH} and \bar{Q}_{B2}^{LH} and the corresponding optimized firm profits by $\bar{\pi}_{A2}^{LH}$ and $\bar{\pi}_{B2}^{LH}$. Importantly, the optimal adjustments are functions of the first-period decisions \bar{p}_{B1}^H and \bar{Q}_{A1}^L . In other words, the decision problems are linked across periods. However, principals are myopic and do not take this link into consideration when setting first-period prices and quality improvements.

First Period. Principals do not know their competitor's type in the first period. A myopic principal i chooses price and quality improvement to maximize the expected first-period profit:

$$\begin{aligned}\max_{p_{i1}, Q_{i1}} \pi_{i1}^k(\mathbf{p}_1, \mathbf{Q}_1) &= (1 - \lambda)[(p_{i1} - c_i)D_{i1}^{kL}(\mathbf{p}_1, \mathbf{Q}_1) - \beta(Q_{i1})^2] \\ &\quad + \lambda[(p_{i1} - c_i)D_{i1}^{kH}(\mathbf{p}_1, \mathbf{Q}_1) - \beta(Q_{i1})^2].\end{aligned}\tag{6}$$

This problem is equivalent to (5) in the context of rational principals. To understand this point, recall that first-period decisions do not have commitment value in the benchmark case and that a myopic principal ignores this strategic effect. We denote the optimal deci-

sions by \bar{p}_{i1}^k and \bar{Q}_{i1}^k and the corresponding optimized expected profit by $\bar{\pi}_{i1}^k$. The overall expected profit is given by $\bar{\Pi}_{i1}^k \equiv \bar{\pi}_{i1}^k + (1 - \lambda)\bar{\pi}_{i2}^k + \lambda\bar{\pi}_{i2}^k$.

Profit Impact. A comparison of the overall expected profits to those in the benchmark case allows us to calculate the profit impact of self-serving behavior. We derive the following result.

Proposition 1 (Profit Comparison). *If principals are myopic and managers are self-serving, then the overall expected profit of firm i at equilibrium is lower than in the benchmark case of rational actors, irrespective of the probability λ with that the rival offers high intrinsic quality.*

The result that self-serving behavior depresses profit relative to the benchmark case is intuitive: managers could always do better by adjusting price and quality improvement in response to a market outcome. Table 1 provides a numerical example to illustrate this conclusion when firm A is of type L and firm B is of type H . Specifically, the overall expected profit of firm A is 0.43 with self-serving managers and 0.47 with rational managers. For firm B the respective profits are 1.07 and 1.13. In addition, the table provides a summary of the equilibrium along with the optimal price and quality adjustment decisions. It also highlights the gaps between realized and expected profits that motivate causal attributions, illustrating the discussion that follows Lemma 1. To put Proposition 1 into perspective, note that a principal's myopia does not affect the profit impact of self-serving behavior, which results simply from a distorted price or quality improvement adjustment. However, myopia prevents the principal from exploiting the manager's limitation.

Non-monetary payoffs. At this point, we propose an alternative characterization of self-serving behavior as the outcome of the maximization problem of a manager who derives utility from profit and non-monetary payoffs (Aghion and Bolton 1992; Mosen and Downs 1965). Specifically, suppose that the utility function of manager i is

$$u_i^{kl}(\mathbf{p}_2, \mathbf{Q}_2 | \hat{p}_{i1}^k, \hat{Q}_{i1}^k) = \pi_{i2}^{kl}(\mathbf{p}_2, \mathbf{Q}_2) - \mathbb{I}_{\{\hat{p}_{i2}^{kl} \geq \hat{p}_{i1}^k\}} u_p - \mathbb{I}_{\{\hat{Q}_{i2}^{kl} \leq \hat{Q}_{i1}^k\}} u_Q, \quad (7)$$

where the profit $\pi_{i2}^{kl}(\mathbf{p}_2, \mathbf{Q}_2)$ is given in (4) and $\mathbb{I}_{\{\hat{p}_{i2}^{kl} \geq \hat{p}_{i1}^k\}} u_p$ and $\mathbb{I}_{\{\hat{Q}_{i2}^{kl} \leq \hat{Q}_{i1}^k\}} u_Q$ represent non-monetary payoffs. These payoffs, which depend on the market outcome and the manager's responses (via the indicator functions $\mathbb{I}_{\{\cdot\}}$) reflect the psychological costs to increase price u_p and to reduce quality u_Q vis-à-vis the levels set by the principal, respectively.

The rationale for non-monetary payoffs is linked to the nature of self-serving behavior. Managers choose causal attributions and responses that help them support a positive image

Table 1: Rational and Self-Serving Managers under Market Structure LH .

| | Firm A | | | Firm B | | |
|-------------------------|----------|----------|------|----------|----------|------|
| | Period 1 | Period 2 | | Period 1 | Period 2 | |
| | | RA | SSA | | RA | SSA |
| Price | 0.75 | 0.63 | 0.63 | 1.25 | 1.38 | 1.25 |
| Quality improvement | 0.38 | 0.31 | 0.38 | 0.63 | 0.69 | 0.63 |
| Quality | 1.63 | 1.56 | 1.63 | 2.63 | 2.69 | 2.63 |
| Quality - price | 0.88 | 0.94 | 1.00 | 1.38 | 1.31 | 1.38 |
| Expected demand | 0.38 | | | 0.63 | | |
| Realized demand | 0.25 | 0.31 | 0.31 | 0.75 | 0.69 | 0.69 |
| Expected profit | 0.21 | | | 0.59 | | |
| Realized profit | 0.12 | 0.15 | 0.13 | 0.74 | 0.71 | 0.66 |
| Overall expected profit | | 0.47 | 0.43 | | 1.13 | 1.07 |
| Overall realized profit | | 0.26 | 0.24 | | 1.45 | 1.41 |

Notes: Rational adjustments (RA) and self-serving adjustments (SSA). The parameter values are $q^H = 2$, $q^L = 1.25$, and $\lambda = 0.5$.

of their firm. Specifically, a manager who experiences a positive outcome in the market prefers to explain, and hopes to prolong, success by a dispositional factor: quality. Adjusting price in this context is inconsistent with the motivation and produces the psychological cost u_p . Conversely, a manager who experiences a negative outcome in the market prefers to explain, and hopes to turnaround, failure by a situational factor: price. Adjusting the quality improvement in this context is inconsistent with the motivation and produces the psychological cost u_Q .

Non-monetary payoffs influence price and quality improvement decisions insofar as they discourage managers from implementing optimal adjustments. The next result states the conditions under which self-serving behavior makes a manager better off.

Lemma 2 (Rationalizing Biased Responses). *For every level of uncertainty λ , there are threshold levels $\bar{u}_p(\lambda)$ and $\bar{u}_Q(\lambda)$ to non-monetary costs such that it is optimal for a manager to engage in self-serving behavior if $u_p > \bar{u}_p(\lambda)$ and $u_Q > \bar{u}_Q(\lambda)$.*

Therefore, when non-monetary costs are sufficiently high, self-serving behavior emerges endogenously and the principals' myopia results in lower expected firm profits (see Proposition 1). The following analysis studies the possibility that principals are forward

looking and set first-period prices and quality improvements accounting for the managers' self-serving nature.

4.3 Forward-Looking Principals

We demonstrated that a manager's self-serving behavior results in lower expected firm profit when the principal does not anticipate this limitation. We now consider the case of a sophisticated principal who is forward looking. Specifically, we investigate how a sophisticated principal can exploit the manager's self-serving nature in order to increase expected firm profit. To solve for the subgame perfect equilibrium, we start by analyzing the managers' adjustments and follow with the principals' decisions.

Second Period. Firm types are common knowledge at the beginning of the second period. In addition, the market outcome has been evaluated (see Lemma 1). Again, there are four possible structures of the market and we present the managers' profit maximization problems for structure LH . In the presence of self-serving behavior, the manager of firm A maintains the (given) first-period quality improvement \tilde{Q}_{A1}^L and the manager of firm B maintains the (given) first-period price \tilde{p}_{B1}^H . Specifically, the managers solve the following:

$$\begin{aligned} \max_{p_{A2}} \pi_{A2}^{LH}(p_{A2}, Q_{B2}) &= (p_{A2} - c_A) D_{A2}^{kl}(p_{A2}, \tilde{p}_{B1}^H, \tilde{Q}_{A1}^L, Q_{B2}) - \beta(\tilde{Q}_{A1}^L)^2 \\ \max_{Q_{B2}} \pi_{B2}^{LH}(p_{A2}, Q_{B2}) &= (\tilde{p}_{B1}^H - c_B) D_{A2}^{kl}(p_{A2}, \tilde{p}_{B1}^H, \tilde{Q}_{A1}^L, Q_{B2}) - \beta(Q_{B2})^2. \end{aligned}$$

We denote the managers' optimal adjustments by \tilde{p}_{A2}^{LH} and \tilde{Q}_{B2}^{LH} and the corresponding optimized firm profits by $\tilde{\pi}_{A2}^{LH}$ and $\tilde{\pi}_{B2}^{LH}$. In contrast to the previous case, forward-looking principals consider the link between maximization problems across periods and set first-period prices and quality improvements accordingly.

First Period. Principals do not know their competitor's type in the first period. As such, they condition decisions solely on their own firm type, taking into account that the competitor can be of type H with probability λ , or type L with probability $1 - \lambda$. Importantly, principals know that one of the first-period decisions carries over to the second period.

We take the perspective of firm A under market structure LH . In the Bayesian equilibrium, a forward-looking principal chooses price and quality improvement to maximize overall expected profit:

$$\begin{aligned} \max_{p_{A1}, Q_{A1}} \pi_{A1}^L(\mathbf{p}_1, \mathbf{Q}_1) &= (1 - \lambda)[(p_{A1} - c_A) D_{A1}^{LL}(\mathbf{p}_1, \mathbf{Q}_1) - \beta(Q_{A1})^2 + \tilde{\pi}_{A2}^{LL}] \\ &+ \lambda[(p_{A1} - c_A) D_{A1}^{LH}(\mathbf{p}_1, \mathbf{Q}_1) - \beta(Q_{A1})^2 + \tilde{\pi}_{A2}^{LH}], \end{aligned} \quad (8)$$

Table 2: Forward-Looking Principals under Market Structure *LH*.

| | Firm A | | Firm B | |
|-------------------------|----------|----------|----------|----------|
| | Period 1 | Period 2 | Period 1 | Period 2 |
| Price | 0.86 | 0.66 | 1.36 | 1.36 |
| Quality improvement | 0.40 | 0.40 | 0.57 | 0.68 |
| Quality | 1.65 | 1.65 | 2.57 | 2.68 |
| Quality - price | 0.79 | 0.98 | 1.20 | 1.32 |
| Expected demand | 0.40 | | 0.60 | |
| Realized demand | 0.29 | 0.33 | 0.71 | 0.67 |
| Expected profit | 0.26 | | 0.66 | |
| Realized profit | 0.17 | 0.14 | 0.81 | 0.68 |
| Overall expected profit | | 0.50 | | 1.17 |
| Overall realized profit | | 0.31 | | 1.48 |

Notes: Managers implement self-serving adjustments. The parameter values are $q^H = 2$, $q^L = 1.25$, and $\lambda = 0.5$.

where $\tilde{\pi}_{A2}^{LH} = \pi_{A2}^{LH}(p_{A2}(p_{B1}, Q_{A1}), p_{B1}, Q_{A1}, Q_{B2}(p_{B1}, Q_{A1}))$ by definition (and similarly for $\tilde{\pi}_{A2}^{LL}$). We denote firm A's optimal decisions by \tilde{p}_{A1}^k and \tilde{Q}_{A1}^k and the corresponding optimized overall expected profit by $\tilde{\pi}_{A1}^L$.

Acknowledging the link across periods, principal A takes into account that the choice of first-period quality improvement affects not only first-period profit, but also second period profit. (A similar reasoning applies to price.) This strategic effect impacts profit in three ways. First, there is a direct effect of first-period quality improvement Q_{A1} being carried over into the second period. Second, there is a price-mediated indirect effect through one's best-reply function $p_{A2}(p_{B1}, Q_{A1})$. Third, there is a quality improvement-mediated indirect effect through the rival's best-reply function, which affects its choice of quality improvement in the second-period and hence firm A's profit. Clearly, there are similar strategic effects of the choice of Q_{A1} on $\tilde{\pi}_{A2}^{LL}$ in (8).

Table 2 continues the previous example and summarizes the equilibrium when principals are forward-looking for structure *LH*. Contrasting the optimal price and quality improvement decisions of forward-looking and myopic principals (cf. Table 1) shows how the anticipation of self-serving behavior distorts first-period decisions.

Profit Impact. A comparison of the overall expected profits to those in the benchmark case allows us to calculate the profit impact of self-serving behavior. Clearly, the comparison depends on whether firm i is of type L or H . We consider each case in turn.

Lemma 3 (Type L). *Suppose that firm i is of type L , principals are forward looking, and managers are self-serving. Then, there is an upper bound of uncertainty $\bar{\lambda}$ such that, in equilibrium, the overall expected profit of firm i is higher than in the benchmark case of rational actors if $\lambda < \bar{\lambda}$.*

Higher profit is the consequence of distorted price and quality improvement decisions in the first period. That is, a forward-looking principal exploits the self-serving nature of the manager to strategically alter competition in the second period. Taking the suboptimal adjustments of the manager into account, principal i initially chooses a higher price (which carries over in structure LL) and a higher quality improvement (which carries over in structure LH) than would otherwise be the case. These upward distortions translate into higher overall expected profit if $\lambda < \bar{\lambda}$; that is, if the probability that the rival's intrinsic quality is of type H is sufficiently low. In this situation, competition is likely to be symmetric and firm i obtains a higher profit than compared to structure LH . Once λ surpasses this threshold, however, averaging first-period decisions across both possible states depresses profit.

Figure 6 illustrates the optimal price-quality bundles of principals together with the corresponding second-period adjustments of managers for firm A and firm B when the structure of the market is LH . Note, for example, that the principal of firm A exercises a greater (upward) distortion of price than quality, relative to the benchmark case. This decision improves overall expected profit from 0.21 to 0.26 (cf. Tables 1 and 2). In this illustration, the threshold is $\bar{\lambda} = 0.85$.

Lemma 4 (Type H). *Suppose that firm i is of type H , principals are forward looking, and managers are self-serving. Then, there is a lower bound of uncertainty $\underline{\lambda}$ such that, in equilibrium, the overall expected profit of firm i is higher than in the benchmark case of rational actors if $\lambda > \underline{\lambda}$.*

The intuition for this result is similar to that for Lemma 3: a forward-looking principal distorts first-period price and quality improvement decisions to strategically alter competition in the second period. Taking the suboptimal adjustments of the manager into account, principal i initially chooses a higher price (which carries over in structure HL) and a lower quality improvement (which carries over in structure HH) than would otherwise be the

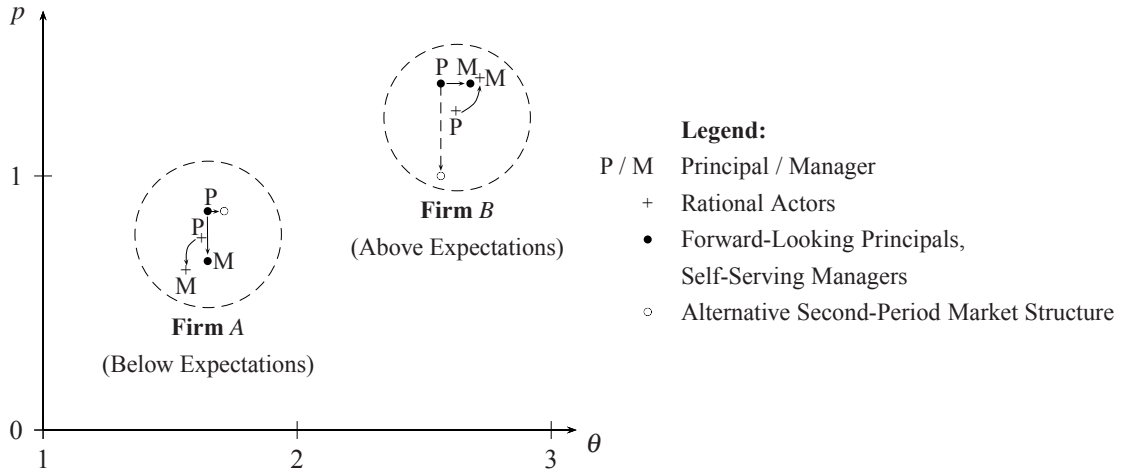


Figure 6: Price-Quality Bundles under Market Structure LH .

case. These distortions translate into higher overall expected profits if $\lambda > \underline{\lambda}$; that is, if the probability that the rival's intrinsic quality is of type L is sufficiently high—in which case the realized second-period profit of firm i is likely high. In the example of Figure 6, the threshold is $\underline{\lambda} = 0.26$.

In summary, we find that a forward-looking principal can improve the performance of the firm by distorting first-period decisions in the presence of (some) uncertainty about the type of the rival firm. These distortions have a profit impact in the second period because the manager is self-serving. In combination, Lemmata 3 and 4 produce to the following result.

Proposition 2 (Profit Comparison). *Suppose that principals are forward-looking and managers are self-serving. Then, there is an interior range of uncertainty $(\underline{\lambda}, \bar{\lambda})$ such that, in equilibrium, the overall expected profit of firm i is higher than in the benchmark case of rational actors if $\lambda \in (\underline{\lambda}, \bar{\lambda})$.*

Finally, note that there is potential for signaling when principals are forward looking (Cho and Kreps 1987; Spence 1973). Specifically, principals communicate profit expectations that influence the managers' behavior. The analysis underlying Proposition 2 has focused on a separating equilibrium, whereby myopic and forward-looking principals make different price and quality improvement decisions contingent on their firm type. It is straightforward to show that there are no incentives to deviate from this solution. Therefore, we can rule out pooling equilibria and semi-separating equilibria as viable alternatives.

5 Conclusion

A robust finding in social psychology is that people perceive themselves readily as the origin of good effects and reluctantly as the origin of ill effects. The objective of this research is to document and study an analogous self-serving tendency affecting the way managers explain and react to market outcomes.

The initial stimulus for our work comes from a simple observation about *causal attributions*: managers tend to distort their understanding of success and failure in a market, systematically crediting quality for positive events but blaming price for negative events. Yet, this observation also implicates certain antecedent *beliefs* and consequent *responses*. First, the literature on causal attributions suggests that one's choice of causes is driven by three properties: locus, control, and stability. To the extent that a potential cause scores higher on these dimensions than its alternatives, it then stands a better chance to be selected to explain attractive outcomes and discarded to explain unattractive outcomes. We argue that this is the case for quality relative to price. Second, a manager's tendency to be self-serving should produce partial responses: success prompts an increase in quality and failure prompts a reduction in price, overlooking the possibility that simultaneously adjusting the remaining decision variable (price and quality, respectively) is a superior strategy.

The empirical evidence for these three elements of our theory comes from an experiment, two surveys, and a marketing simulation. The experiment provides a complete picture of the theory in the sense that we measured beliefs, causal attributions, and responses in the same setting. Specifically, we show that senior executives believe quality is more internal, more controllable, and more stable than price; we show that quality (price) is the preferred explanation for a positive (negative) market outcome; and we show that higher quality (lower price) is the preferred response to a positive (negative) market outcome. The surveys replicate the result for causal attributions using all three indicators of firm performance considered in our model—sales volume, markup, and profit—and asking managers to reflect on their own experiences rather than react to a hypothetical scenario. The Markstrat data provide a similar replication, but in the context of responses to market outcomes. Perhaps more important, we were able to find support for our theory in a rich competitive environment where decisions are made by groups with the aid of substantial market intelligence.

On the basis of the empirical results we developed a multi-period model of oligopolistic competition that allows managers to be self-serving. Two notable features of our model are the inclusion of principals who have varying degrees of foresightedness and the use

of different approaches to incorporate self-serving behavior. Our analysis shows that self-serving managers who are led by myopic principals necessarily make suboptimal price and quality adjustments relative to the benchmark case of rational actors. Yet, the analysis also shows that forward-looking principals can exploit the self-serving nature of their managers to alter competition and improve profits. This result is conditional on the principals' beliefs about the type of rival they face in the market.

At a more general level, it is worth noting that economists often argue that market forces ultimately crowd out all types of psychological shortcomings—even positive illusions (Kaplan and Ruffle 2004). However, many psychologists take the opposite stance that the personal benefits associated with self-serving behavior—lower anxiety, greater confidence, etc.—promote levels of well-being and effectiveness that can prolong the behavior reported in this paper (Taylor and Brown 1988).

Moreover, questioning whether a particular psychological phenomenon is of consequence in the marketplace seems natural when the presumption is that the bias is self-defeating. But, as shown here, there are reasonable conditions under which self-serving behavior is advantageous to the firm. Given this, it is perhaps more appropriate to consider for future research what factors may perpetuate the effect.

For example, it is clear that self-serving behavior requires a mismatch between what the market outcome is and what managers expect it to be (Campbell and Sedikides 1999). At the same time, expectations are shaped by experiences and intentions that are for the most part positive (Taylor 1991). This reflection not only predicts a certain psychological robustness to self-serving behavior, but it also suggests that perceived failure in the market may be more prevalent than perceived success, which in our theory carries consequences for the attributions and responses that managers are willing to consider.

The manager's own disposition probably also plays a role. In particular, to the extent that managers hold a positive view of their strengths, skills, and abilities (Tetlock and Levi 1982), it is likely that a stronger and more permanent asymmetry in the causal attributions and responses that involve price and quality is observed. The two surveys cited in the Introduction point in this direction, as seniority in an organization and self-perceptions are typically associated.

Finally, it seems reasonable to expect that self-serving behavior be moderated by a manager's appreciation of the bias. The problem is that the literature clearly demonstrates that people struggle to see their limitations. The very tendency to be self-serving can lead managers to think that they are not self-serving (Pronin, Lin, and Ross 2002). In addition, motivated reasoning skews the search for information (Kunda 1990) and the standards of

proof (Gilovich 1991) in favor of hypotheses that reinforce past behaviors, which again dilutes one's ability to detect personal flaws. Our model addresses this problem with the inclusion of principals. We show that firms need principals that are farsighted to take advantage of self-serving behavior. Future research could explore other mechanisms and institutions that play a similar exploitative role.

Appendix

We report the results for the case $\omega = 1$, $\tau = 1$, and that $\beta = \frac{1}{2}$. The proofs for the general case are available from the authors upon request.

A.1 Rational Actors

We solve for equilibrium using backward induction. We first analyze the second period and follow with the first period.

Second Period. The optimal prices and quality improvements follow from the necessary and sufficient first-order conditions of profit maximization. Standard analysis yields:

$$\hat{p}_{A2}^{kl} = 1 + \frac{q^k - q^l}{2} \quad \text{and} \quad \hat{p}_{B2}^{kl} = 1 - \frac{q^k - q^l}{2}, \quad (\text{A.1})$$

and

$$\hat{Q}_{A2}^{kl} = \frac{1}{2} \left(1 + \frac{q^k - q^l}{2} \right) \quad \text{and} \quad \hat{Q}_{B2}^{kl} = \frac{1}{2} \left(1 - \frac{q^k - q^l}{2} \right). \quad (\text{A.2})$$

Substituting the optimal prices and quality improvements p_{i2}^{kl} and Q_{i2}^{kl} back into the profit function in (4) yields the equilibrium profits:

$$\hat{\pi}_{A2}^{kl} = \frac{3(2 + (q^k - q^l))^2}{32} \quad \text{and} \quad \hat{\pi}_{B2}^{kl} = \frac{3(2 - (q^k - q^l))^2}{32}. \quad (\text{A.3})$$

□

First Period. The optimal prices and quality improvements follow from the necessary and sufficient first-order conditions of profit maximization. Firm i 's optimal price is:

$$\hat{p}_{i1}^k = \begin{cases} 1 - \frac{2\lambda(q^H - q^L)}{3} & \text{if } k = L \\ 1 + \frac{2(1 - \lambda)(q^H - q^L)}{3} & \text{if } k = H. \end{cases} \quad (\text{A.4})$$

Firm i 's optimal quality improvement is:

$$\hat{Q}_{i1}^k = \begin{cases} \frac{1}{2} - \frac{\lambda(q^H - q^L)}{3} & \text{if } k = L \\ \frac{1}{2} + \frac{(1 - \lambda)(q^H - q^L)}{3} & \text{if } k = H. \end{cases} \quad (\text{A.5})$$

Substituting optimal prices and quality improvements \hat{p}_{i1}^k and \hat{Q}_{i1}^k back into the profit function in (5) yields the optimized overall expected profit:

$$\hat{\pi}_{i1}^k = \begin{cases} \frac{3}{4} - \frac{\lambda(q^H - q^L)(84 - (9 + 16\lambda)(q^H - q^L))}{96} & \text{if } k = L \\ \frac{3}{4} + \frac{(1 - \lambda)(q^H - q^L)(84 + (25 - 16\lambda)(q^H - q^L))}{96} & \text{if } k = H. \end{cases} \quad (\text{A.6})$$

□

Note that in equilibrium, a higher quality improvement (and thus higher quality) goes along with a higher price as $\hat{p}_{i1}^k = 2\hat{Q}_{i1}^k$ and $\hat{p}_{i2}^k = 2\hat{Q}_{i2}^k$.

A.2 Myopic Principals

We solve for equilibrium using backward induction. We first analyze the second period and follow with the first period.

Second Period. There are four market structures: Structure LL , structure LH , structure HL , and structure HH . We consider each of them in turn.

(i) Market structure LL . The managers respectively solve:

$$\max_{Q_{A2}} \pi_{A2}^{LL}(\bar{p}_{A1}^L, \bar{p}_{B1}^L, Q_{A2}, Q_{B2}) \quad \text{and} \quad \max_{Q_{B2}} \pi_{A2}^{LL}(\bar{p}_{A1}^L, \bar{p}_{B1}^L, Q_{A2}, Q_{B2}).$$

Firm i 's optimal quality improvement is:

$$\bar{Q}_{i2}^{LL} = \frac{1}{2} - \frac{\lambda(q^H - q^L)}{3}.$$

By substitution, firm i 's optimized profit is:

$$\bar{\pi}_{i2}^{LL} = \frac{(3 - 2\lambda(q^H - q^L))(9 + 2\lambda(q^H - q^L))}{72}. \quad (\text{A.7})$$

(ii) Market structure LH . The managers respectively solve:

$$\max_{p_{A2}} \pi_{A2}^{LH}(p_{A2}, \bar{p}_{B1}^H, \bar{Q}_{A1}^L, Q_{B2}) \quad \text{and} \quad \max_{Q_{B2}} \pi_{B2}^{LH}(p_{A2}, \bar{p}_{B1}^H, \bar{Q}_{A1}^L, Q_{B2}).$$

The firms' optimal adjustments are:

$$\bar{p}_{A2}^{LH} = 1 - \frac{(1+\lambda)(q^H - q^L)}{3} \quad \text{and} \quad \bar{Q}_{B2}^{LH} = \frac{1}{2} + \frac{(1-\lambda)(q^H - q^L)}{3}.$$

By substitution, the firms' optimized profits are:

$$\bar{\pi}_{A2}^{LH} = \frac{(3 - 2(q^H - q^L))(9 - 2(1 + 2\lambda)(q^H - q^L))}{72} \quad (\text{A.8})$$

$$\bar{\pi}_{B2}^{LH} = \frac{(3 + 2(1 - \lambda)(q^H - q^L))(9 + 2(1 + 3\lambda)(q^H - q^L))}{72}. \quad (\text{A.9})$$

(iii) Market structure HL . The managers respectively solve:

$$\max_{Q_{A2}} \pi_{A2}^{HL}(\bar{p}_{A1}^H, p_{B2}, Q_{A2}, \bar{Q}_{B1}^L) \quad \text{and} \quad \max_{p_{B2}} \pi_{B2}^{HL}(\bar{p}_{A1}^H, p_{B2}, Q_{A2}, \bar{Q}_{B1}^L).$$

The firms' optimal adjustments are:

$$\bar{Q}_{A2}^{HL} = \frac{1}{2} + \frac{(1-\lambda)(q^H - q^L)}{3} \quad \text{and} \quad \bar{p}_{B2}^{HL} = 1 - \frac{(1+\lambda)(q^H - q^L)}{3}.$$

By substitution, the firms' optimized profits are:

$$\bar{\pi}_{A2}^{HL} = \frac{(3 + 2(1 - \lambda)(q^H - q^L))(9 + 2(1 + 3\lambda)(q^H - q^L))}{72}$$

$$\bar{\pi}_{B2}^{HL} = \frac{(3 - 2(q^H - q^L))(9 - 2(1 + 2\lambda)(q^H - q^L))}{72}.$$

(iv) Market structure HH . The managers respectively solve:

$$\max_{p_{A2}} \pi_{A2}^{HH}(p_{A2}, p_{B2}, \bar{Q}_{A2}^H, \bar{Q}_{B1}^H) \quad \text{and} \quad \max_{p_{B2}} \pi_{B2}^{HH}(p_{A2}, p_{B2}, \bar{Q}_{A2}^H, \bar{Q}_{B1}^H).$$

Firm i 's optimal price is:

$$\bar{p}_{i2}^{HH} = 1.$$

By substitution, firm i 's optimized profit is:

$$\bar{\pi}_{i2}^{HH} = \frac{(9 + 2(1 - \lambda)(q^H - q^L))(3 - 2(1 - \lambda)(q^H - q^L))}{72}. \quad (\text{A.10})$$

□

First Period. The optimal first-period decisions are given by (A.4) and (A.5). Substituting the corresponding prices and quality improvements back into the profit function

$$\begin{aligned}\pi_{i1}^k &= (1 - \lambda)[(p_{i1}^k - c_i)D_{i1}^{kL}(\mathbf{p}_1, \mathbf{Q}_1) - \beta(Q_{i1}^k)^2] \\ &\quad + \lambda[(p_{i1}^k - c_i)D_{i1}^{kH}(\mathbf{p}_1, \mathbf{Q}_1) - \beta(Q_{i1}^k)^2]\end{aligned}$$

given in (6) yields firm i 's optimized expected first-period profit:

$$\bar{\pi}_{i1}^k = \begin{cases} \frac{(3 - 2\lambda)(q^H - q^L)^2}{24} & \text{if } k = L \\ \frac{(3 + 2(1 - \lambda)(q^H - q^L))^2}{24} & \text{if } k = H. \end{cases} \quad (\text{A.11})$$

The overall expected profit is given by $\bar{\Pi}_{i1}^k \equiv \bar{\pi}_{i1}^k + (1 - \lambda)\bar{\pi}_{i2}^k + \lambda\bar{\pi}_{i2}^k$. Specifically, we obtain:

$$\bar{\Pi}_{i1}^k = \begin{cases} \frac{3}{4} - \frac{\lambda\Delta^q(18 - (1 + \lambda(4 + \lambda))\Delta^q)}{18} & \text{if } k = L \\ \frac{3}{4} + \frac{(1 - \lambda)\Delta^q(3(5 - \lambda) + 2(2 - \lambda(1 + \lambda))\Delta^q)}{18} & \text{if } k = H, \end{cases} \quad (\text{A.12})$$

where $\Delta^q \equiv q^H - q^L$. □

Proof of Lemma 1. The realized first-period profit of firm i , denoted by π_{i1}^{kl} , follows from substituting the corresponding first-period decisions given in (A.4) and (A.5) into the profit function

$$\pi_{i1}^{kl} = (p_{i1} - c_i)D_{i1}^{kl}(\mathbf{p}_1, \mathbf{Q}_1) - \beta(Q_{i1})^2.$$

The manager's evaluation of the market outcome is based on the comparison of realized profit and expected profit. If firm A faces a competitor of type L , comparing the realized first-period profit to the expected profit in (A.11) yields

$$\bar{\pi}_{A1}^{kL} - \bar{\pi}_{A1}^k = \begin{cases} \frac{\lambda(q^H - q^L)(3 - 2\lambda)(q^H - q^L)}{9} & \text{if } k = L \\ \frac{\lambda(q^H - q^L)(3 + 2(1 - \lambda)(q^H - q^L))}{9} & \text{if } k = H. \end{cases}$$

This profit difference is positive as we assume that $q^H - q^L < \frac{3}{2}$ (which ensures that both firms have positive sales). If firm A faces a competitor of type H instead, it follows that $\bar{\pi}_{A1}^{kH} - \bar{\pi}_{A1}^k < 0$ for $k \in \{L, H\}$. Similarly, it is straightforward to show that $\bar{\pi}_{B1}^{Ll} - \bar{\pi}_{B1}^l > 0$ and that $\bar{\pi}_{B1}^{Hl} - \bar{\pi}_{B1}^l < 0$ for $l \in \{L, H\}$. □

Proof of Lemma 2. From the manager's utility function in (7), we know that the non-monetary costs accrue if $p_{i2}^{kl} \geq \hat{p}_{i1}^k$ or $Q_{i2}^{kl} \leq \hat{Q}_{i1}^k$. We first compare the optimal prices and quality improvements chosen by rational managers in (A.1) and (A.2) to the ones chosen by myopic principals in (A.4) and (A.5). There are four market structures: Structure *LL*, structure *LH*, structure *HL*, and structure *HH*. We consider each of them in turn.

(i) Market structure *LL*. The differences in prices and quality improvements are:

$$\hat{p}_{i2}^{LL} - \hat{p}_{i1}^L = \frac{2\lambda(q^H - q^L)}{3} \quad \text{and} \quad \hat{Q}_{i2}^{LL} - \hat{Q}_{i1}^L = \frac{\lambda(q^H - q^L)}{3},$$

which are positive for all λ .

(ii) Market structure *LH*. For firm *A*, the differences in prices and quality improvements are:

$$\hat{p}_{A2}^{LH} - \hat{p}_{A1}^L = \frac{(4\lambda - 3)(q^H - q^L)}{6} \quad \text{and} \quad \hat{Q}_{A2}^{LH} - \hat{Q}_{A1}^L = \frac{(4\lambda - 3)(q^H - q^L)}{12}.$$

Thus, firm *A* decreases its price and quality improvement if $\lambda < \frac{3}{4}$ and increases its price and quality improvement if $\lambda > \frac{3}{4}$. For firm *B*, the differences in prices and quality improvements are:

$$\hat{p}_{B2}^{LH} - \hat{p}_{B1}^H = \frac{(4\lambda - 1)(q^H - q^L)}{6} \quad \text{and} \quad \hat{Q}_{B2}^{LH} - \hat{Q}_{B1}^H = \frac{(4\lambda - 1)(q^H - q^L)}{12}.$$

Thus, firm *B* increases its price and quality improvement if $\lambda > \frac{1}{4}$ and decreases its price and quality improvement if $\lambda < \frac{1}{4}$.

(iii) Market structure *HL*. This market structure mirrors structure *LH*. Thus, firm *A* increases its price and quality improvement if $\lambda > \frac{1}{4}$ and decreases its price and quality improvement if $\lambda < \frac{1}{4}$. Firm *B* decreases its price and quality improvement if $\lambda < \frac{3}{4}$ and increases its price and quality improvement if $\lambda > \frac{3}{4}$.

(iv) Market structure *HH*. The differences in prices and quality improvements are:

$$\hat{p}_{i2}^{HH} - \hat{p}_{i1}^H = \frac{2(\lambda - 1)(q^H - q^L)}{3} \quad \text{and} \quad \hat{Q}_{i2}^{HH} - \hat{Q}_{i1}^H = \frac{(\lambda - 1)(q^H - q^L)}{3},$$

which are negative for all λ .

To determine the threshold levels \bar{u}_p and \bar{u}_Q , we compare the profits that arise from self-serving behavior to the profits of a manager who derives utility from profits and non-monetary payoffs. As before, we consider each market structure in turn.

- (i) Market structure *LL*. As the optimal price increases, the manager of firm i gets utility $u_i^{LL}(\lambda) = \hat{\pi}_{i2}^{LL}(\lambda) - u_p$ when adjusting price and quality improvement. Instead, if the manager employs self-serving behavior, the corresponding profit is $\bar{\pi}_{i2}^{LL}(\lambda)$ as given in (A.7). Thus, manager i sticks to self-serving behavior if

$$u_p > \hat{\pi}_{i2}^{LL}(\lambda) - \bar{\pi}_{i2}^{LL}(\lambda).$$

- (ii) Market structure *LH*. There are three cases; which of these cases emerges depends on the value of λ . The profits that arise from self-serving behavior are given in (A.8) and (A.9). All conditions give the bounds on u_p and u_Q such that the managers stick to self-serving behavior.

- Suppose that $\lambda \leq \frac{1}{4}$. As both managers decrease price and quality improvement, we have:

$$\begin{aligned} u_Q &> \hat{\pi}_{A2}^{LH}(\lambda) - \bar{\pi}_{A2}^{LH}(\lambda) \\ u_Q &> \hat{\pi}_{B2}^{LH}(\lambda) - \bar{\pi}_{B2}^{LH}(\lambda). \end{aligned}$$

- Suppose that $\frac{1}{4} < \lambda < \frac{3}{4}$. As the manager of firm A decreases quality improvement and the manager of firm B increases price, we have:

$$\begin{aligned} u_Q &> \hat{\pi}_{A2}^{LH}(\lambda) - \bar{\pi}_{A2}^{LH}(\lambda) \\ u_p &> \hat{\pi}_{B2}^{LH}(\lambda) - \bar{\pi}_{B2}^{LH}(\lambda). \end{aligned}$$

- Suppose that $\lambda \geq \frac{3}{4}$. As the manager of firm A increases price and the manager of firm B decreases quality improvement, we have:

$$\begin{aligned} u_p &> \hat{\pi}_{A2}^{LH}(\lambda) - \bar{\pi}_{A2}^{LH}(\lambda) \\ u_p &> \hat{\pi}_{B2}^{LH}(\lambda) - \bar{\pi}_{B2}^{LH}(\lambda). \end{aligned}$$

- (iii) Market structure *HL*. This market structure mirrors structure *LH*. The proof is thus omitted.

- (iv) Market structure *HH*. As the optimal quality improvements decrease, the manager of firm i gets utility $u_i^{HH}(\lambda) = \hat{\pi}_{i2}^{HH}(\lambda) - u_Q$ when adjusting price and quality improvement. Instead, if the manager employs self-serving behavior, the corresponding profit is $\bar{\pi}_{i2}^{HH}(\lambda)$ as given in (A.10). Thus, manager i sticks to self-serving behavior if

$$u_Q > \hat{\pi}_{i2}^{HH}(\lambda) - \bar{\pi}_{i2}^{HH}(\lambda).$$

Clearly, the non-monetary costs \bar{u}_p and \bar{u}_Q are functions of λ . Collecting the results, the threshold levels for the case $\frac{1}{4} < \lambda < \frac{3}{4}$ can be derived as:

$$\begin{aligned}\bar{u}_p(\lambda) &= \max \{ \hat{\pi}_{i2}^{LL}(\lambda) - \bar{\pi}_{i2}^{LL}(\lambda), \hat{\pi}_{B2}^{LH}(\lambda) - \bar{\pi}_{B2}^{LH}(\lambda) \} \\ \bar{u}_Q(\lambda) &= \max \{ \hat{\pi}_{A2}^{LH}(\lambda) - \bar{\pi}_{A2}^{LH}(\lambda), \hat{\pi}_{i2}^{HH}(\lambda) - \bar{\pi}_{i2}^{HH}(\lambda) \}.\end{aligned}$$

The threshold levels for the cases $\lambda \leq \frac{1}{4}$ and $\lambda \geq \frac{3}{4}$ can be derived in a similar way. \square

Proof of Proposition 1. Comparing the overall expected profit in (A.12) to the profit in the benchmark case in (A.6) yields:

$$\begin{aligned}\bar{\Pi}_{i1}^k - \hat{\pi}_{i1}^k &= \begin{cases} -\frac{\lambda \Delta^q (36 + \Delta^q (11 - 16\lambda(1 + \lambda)))}{288} & \text{if } k = L \\ -\frac{(1 - \lambda) \Delta^q (4(3 + 12\lambda) + \Delta^q (11 - 16\lambda + 32\lambda^2))}{288} & \text{if } k = H. \end{cases} \quad (\text{A.13})\end{aligned}$$

As $\Delta^q \equiv q^H - q^L < \frac{3}{2}$ and $36 + \Delta^q (11 - 16\lambda(1 + \lambda)) > 0$ for all λ , we have that $\bar{\Pi}_{i1}^L - \hat{\pi}_{i1}^L < 0$ for all λ . Similarly, as $11 - 16\lambda + 32\lambda^2 > 0$ for all λ , we have that $\bar{\Pi}_{i1}^H - \hat{\pi}_{i1}^H < 0$. \square

A.3 Forward-Looking Principals

We solve for equilibrium using backward induction. We first analyze the second period and follow with the first period.

Second Period. There are four market structures: Structure *LL*, structure *LH*, structure *HL*, and structure *HH*. We consider each of them in turn.

(i) Market structure *LL*. The managers respectively solve:

$$\max_{Q_{A2}} \pi_{A2}^{LL}(\tilde{p}_{A1}^L, \tilde{p}_{B1}^L, Q_{A2}, Q_{B2}) \quad \text{and} \quad \max_{Q_{B2}} \pi_{A2}^{LL}(\tilde{p}_{A1}^L, \tilde{p}_{B1}^L, Q_{A2}, Q_{B2}).$$

Firm *i*'s optimal quality improvement is $\tilde{Q}_{i2}^L = \frac{\tilde{p}_{i1}^L}{2}$.

(ii) Market structure *LH*. The managers respectively solve:

$$\max_{p_{A2}} \pi_{A2}^{LH}(p_{A2}, \tilde{p}_{B1}^H, \tilde{Q}_{A1}^L, Q_{B2}) \quad \text{and} \quad \max_{Q_{B2}} \pi_{B2}^{LH}(p_{A2}, \tilde{p}_{B1}^H, \tilde{Q}_{A1}^L, Q_{B2}).$$

The optimal adjustments are:

$$\tilde{p}_{A2}^{LH} = \frac{\tilde{p}_{B1}^H + 2(1 + q^L - q^H + \tilde{Q}_{A1}^L)}{4} \quad \text{and} \quad \tilde{Q}_{B2}^{LH} = \frac{\tilde{p}_{B1}^H}{2}.$$

(iii) Market structure *HL*. The managers respectively solve:

$$\max_{Q_{A2}} \pi_{A2}^{HL}(\tilde{p}_{A1}^H, p_{B2}, Q_{A2}, \tilde{Q}_{B1}^L) \quad \text{and} \quad \max_{p_{B2}} \pi_{B2}^{HL}(\tilde{p}_{A1}^H, p_{B2}, Q_{A2}, \tilde{Q}_{B1}^L).$$

The optimal adjustments are:

$$\tilde{Q}_{A2}^{HL} = \frac{\tilde{p}_{A1}^H}{2} \quad \text{and} \quad \tilde{p}_{B2}^{HL} = \frac{\tilde{p}_{A1}^H + 2(1 + q^L - q^H + \tilde{Q}_{B1}^L)}{4}.$$

(iv) Market structure *HH*. The managers respectively solve:

$$\max_{p_{A2}} \pi_{A2}^{HH}(p_{A2}, p_{B2}, \tilde{Q}_{A2}^H, \tilde{Q}_{B1}^H) \quad \text{and} \quad \max_{p_{B2}} \pi_{B2}^{HH}(p_{A2}, p_{B2}, \tilde{Q}_{A2}^H, \tilde{Q}_{B1}^H).$$

The optimal prices are:

$$\tilde{p}_{A2}^{HH} = \frac{3 + \tilde{Q}_{A1}^H - \tilde{Q}_{B1}^H}{3} \quad \text{and} \quad \tilde{p}_{B2}^{HH} = \frac{3 - \tilde{Q}_{A1}^H + \tilde{Q}_{B1}^H}{3}. \quad \square$$

First Period. The optimal price and quality improvement decisions can be derived in a straightforward way and are given by:

$$\begin{aligned} \tilde{p}_{i1}^L &= \frac{240 + \lambda[47 + 14\Delta^q] - 2\lambda^2[61 - 60\Delta^q] - 3\lambda^3[41 - 4\Delta^q] + 4\lambda^4[25 - 24\Delta^q]}{6(40 + 46\lambda - 25\lambda^2 - 20\lambda^3 + 7\lambda^4)} \\ \tilde{p}_{i1}^H &= \frac{66 + 68\lambda - 41\lambda^2 - 30\lambda^3 + 9\lambda^4 - 12\Delta^q(1 + \lambda)^2(3 - 4\lambda + \lambda^2)}{3(40 + 46\lambda - 25\lambda^2 - 20\lambda^3 + 7\lambda^4)} \\ \tilde{Q}_{i1}^L &= \frac{60 + 6\lambda[12 + 7\Delta^q] - 3\lambda^2[11 - 9\Delta^q] - \lambda^3[35 + 24\Delta^q] + \lambda^4[10 - 3\Delta^q]}{3(40 + 46\lambda - 25\lambda^2 - 20\lambda^3 + 7\lambda^4)} \\ \tilde{Q}_{i1}^H &= \frac{66 + 42\lambda - 37\lambda^2 - 18\lambda^3 + 7\lambda^4 - 12(q^L - q^H)(3 - \lambda - 3\lambda^2 + \lambda^3)}{3(40 + 46\lambda - 25\lambda^2 - 20\lambda^3 + 7\lambda^4)}, \end{aligned}$$

where $\Delta^q \equiv q^H - q^L$. □

Profit Impact. The proofs of Lemmata 3 and 4 are similar to that of Proposition 1. Specifically, the upper bound $\bar{\lambda}$ is defined by the condition $\tilde{\pi}_{i1}^L(\lambda) - \hat{\pi}_{i1}^L(\lambda) = 0$. Likewise, the lower bound $\underline{\lambda}$ is defined by the condition $\tilde{\pi}_{i1}^H(\lambda) - \hat{\pi}_{i1}^H(\lambda) = 0$. Proposition 2 follows immediately from the two Lemmata. □

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