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Stretching firm and brand reputation

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I consider an adverse selection model of product quality. Consumers observe the performance of the firm's products, and product performance is positively related to the firm's (privately observed) quality level. If a firm is to launch a new product, should it use the same name as its base product (reputation stretching), or should it create a new name (and start a new reputation history)? I show that for a given level of past performance (reputation), firms stretch if and only if quality is sufficiently high. Stretching thus signals high quality.

1. Introduction

■ Canon established its reputation as a maker of photographic cameras. In the mid-1970s, it entered into the market for photocopiers, a related but different product, selling its new offering under the same brand name. Was this a good move by Canon? One justification for Canon's strategy is that because creating new brand names is costly, using the same name saves part of the cost of launching a new product (Tauber, 1988).

A different approach—the one I follow in this article—is to look at the firm's decision as an *informational* problem.[1] Continuing with the same example, Canon enjoys a reputation for product quality as a result of its good track record in selling cameras. Since what it takes to produce a good camera is similar to what it takes to produce a good photocopier, consumers should expect the quality of a Canon photocopier to be approximately at the level of Canon cameras. In this context, by adding a photocopier to its product portfolio, Canon *uses its reputation* to profit from the sale of the new product. Naturally, if the photocopier turns out to be of poor quality (or perceived as such), then the reputation of the Canon brand suffers. In other words, Canon risks *squandering its reputation.*

My purpose in this article is to analyze these tradeoffs in a framework of optimal firm strategy and rational consumer behavior. I develop a simple adverse selection model, derive its equilibrium, and characterize the main informational effects involved

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[1] As the *Economist* (1994) argues, ‘‘brands are created because buyers crave information. They see a huge range of products that look the same and seem to perform similar. Brands offer a route through the confusion.’’

in the decision of stretching a reputation.[2] In the model, each firm is characterized by an exogenously given quality level, which is the firm's private information and applies to any product it supplies. Consumers observe the performance of the firm's products, which is related to the firm's quality level. In this context, reputation is the consumers' posterior on the firm's quality level given the firm's performance history.

I consider three effects in the decision to stretch a reputation. First, a firm's reputation from its base product influences the consumers' willingness to pay for a new product sold under the same name (and for additional sales of the base product); I call this the *direct reputation effect.* Second, the performance of the new product, if sold under the same name, influences the consumers' willingness to pay for future sales of the base product; I call this the *feedback reputation effect.* Finally, insofar as the decision to stretch is related to the firm's quality, the simple fact that a firm uses the same name to launch a second product influences the consumers' willingness to pay for the new product (and for additional sales of the base product); I call this the *signalling effect.*

The feedback reputation effect implies that higher-quality firms are more confident that stretching will consolidate their reputation. As a result, for a given reputation level, the firms that stretch their reputation are the firms of higher quality level. The direct reputation effect is of ambiguous sign. If the new product is very profitable compared to the base product, then firms will ''exploit'' their reputation, so for a given level of quality, stretching takes place if and only if reputation is sufficiently high. If, however, the new product is of marginal importance with respect to the base product, then firms will only stretch if reputation is sufficiently low, in an attempt to ''build'' their reputation; by contrast, when reputation is high, firms prefer to ''protect'' their reputation.

In addition to these basic results, I derive empirical implications of the model's assumptions and results. Some correspond to existing empirical work, some to possible statistical tests that relate reputation, performance, and the decision to stretch. Finally, I consider a number of possible extensions of the model, including the endogenous decision of whether to launch a new product and the choice of which product to stretch to.

The economic analysis (and the economics literature) on reputation stretching can be divided according to the nature of the branding effects it is based upon. Brand names can be vehicles of reputation in two ways: they may incorporate information about the firm's actions or information about firm characteristics.[3] When the firm's actions are not observable (moral hazard), reputation corresponds to an implicit contract between seller and buyers whereby the former supplies high-quality experience goods and the latter pay a high price—until the seller cheats on buyers and reputation breaks down. The seminal economics articles on this approach are Telser (1980), Klein and Leffler (1981), and Shapiro (1983). Kreps (1990) put forward the idea of the firm's name (or the firm's brand name) as the carrier of reputation, in the context of moral hazard. Finally, the strategy of brand stretching in this context is explored in Choi (1998).[4]

[2] Throughout most of the article, I assume that reputation is associated to the firm's brand name. Strictly speaking, the model is one of brand stretching. However, the model can also be interpreted as depicting the decision of stretching a firm's reputation. In this case, the decision would be to sell a second product versus creating a new firm to sell the new product. More on this later.

[3] In this article, I only consider brands as vehicles of information. An alternative approach is to assume that brands have an intrinsic value. See Pepall and Richards (2000) for an analysis of brand stretching in this context.

[4] Actually, Choi's (1998) model features both moral hazard and adverse selection. I will return to this work later. Other articles that take the moral-hazard approach to explain brand stretching include Andersson (1998) and Cabral (2000).

An alternative information-based approach to brand effects is that of adverse selection. Suppose that quality is a firm attribute that consumers cannot observe *ex ante*. In this context, reputation corresponds to the consumers' posterior beliefs regarding firm quality. Such beliefs are updated based on the observation of the firm's past performance as well as on other actions by the firm that might signal its private information. The basic framework for the analysis of this type of reputation was laid down in Milgrom and Roberts (1982) and Kreps and Wilson (1982). The idea of names as carriers of reputation (in the context of adverse selection) was explored by Tadelis (1999), who considers a model where names are traded. Finally, the strategy of brand stretching in an adverse selection context was proposed by Wernerfelt (1988).

My approach is one of adverse selection. Specifically, I develop a model that shares some of the features of Tadelis' (1999) basic framework, though I look at a different set of issues: whereas Tadelis examines the equilibrium in the market for names, assuming that each product is sold under a different name, I consider the case when names are not traded but can be used to sell more than one product. The problem I consider is the same as in Wernerfelt (1988), though the approach I take is somewhat different: in Wernerfelt, brand stretching signals quality because stretching is more costly than creating a new name, whereas I assume that brand stretching is cost neutral.

The article is structured as follows. In Sections 2 and 3, I present the basic model and derive its Bayesian equilibria. In Sections 4 and 5, I discuss the equilibrium stretching strategy and analyze the particular case when utility is linear and both quality and performance are normally distributed. The empirical implications of the model are discussed in Section 6. Section 7 suggests a number of extensions of the basic framework. All proofs are in the Appendix.

2. Model

■ I consider an economy with overlapping generations of firms. In each period, a fixed measure of new firms is born. Each firm is endowed with a basic product and lives for three periods (ages 0, 1, 2). The firm sells $1 - \delta$ units of the basic product at ages 0 and 2.[5] A countable (i.e., measure zero) set of firms is endowed with a second product at age 1, of which it sells δ units ($\delta \in [0, 1]$).[6] The firm's main decision is whether to sell its second product under the same name as the first one or under a different name. Each firm is endowed with quality q, which only the firm can observe. The firm's second product (if it exists) is of the same quality as the first one, a fact that is common knowledge to firm and consumers.[7] Notice that payoffs are paramaterized by the value of δ, which measures the relative importance of the new product with respect to the base product. If δ is close to one, then most profits are coming from the new product; if δ is close to zero, then most profits come from the base product.

A product's performance in period t, $r_t \in [\underline{r}, \overline{r}]$, is related to its quality, $q \in [\underline{q}, \overline{q}]$, according to the cdf $F(r \mid q)$ (density f). Conditional on quality, product performance is i.i.d. across periods. Moreover, product performance is public information.[8] Consumers derive utility $u(r)$ from the product's performance, where $u(r)$ is strictly increasing

[5] I could also assume sales of the base product at age 1, but this would unnecessarily make the model more cumbersome.

[6] The assumption that only a countable set of firms develop a second product greatly simplifies the analysis. However, my qualitative results would still hold if I assumed a small, strictly positive probability of new product development. See Section 7.

[7] The same qualitative results go through if the correlation between quality levels is positive and sufficiently high.

[8] The model can be interpreted either as one where firms sell one unit per period or, alternatively, a continuum of units that perform equally (e.g., a production batch).

in r. It follows that $v(q) = \int_{\underline{r}}^{\overline{r}} u(r)\, dF(r \mid q)$ is the consumers' willingness to pay for a product of quality q. Consumers do not directly observe q, however. They hold a (correct) prior $G(q)$ (density g) and, based on information Ω, they form posterior beliefs $H(q \mid \Omega)$ (density h). It follows that at each information set Ω, consumers are willing to pay up to $w(\Omega) = \int_{\underline{q}}^{\overline{q}} v(q)\, dH(q \mid \Omega)$.

The consumers' information set includes past product performance and the observation that the firm has stretched its reputation, if that is the case. I assume that consumers do not observe the ownership of each brand. Consumers therefore cannot distinguish between a new product launched by a new firm and a new product launched by an old firm.[9] Specifically, $\Omega = \emptyset$ for a new product; $\Omega = \{r_0, s\}$ for a firm that stretches and at the time it does so; $\Omega = \{r_0, s, r_1\}$ at the beginning of a firm's third year, in case it stretches; and $\Omega = \{r_0\}$ at the beginning of the firm's third year, in case it does not stretch.[10]

As mentioned above, the firm's strategy consists of whether or not to stretch given that it is endowed with a new product. This decision is based on the firm's quality level q (which is the firm's private information) as well as on the first-period product performance r_0 (which is public information). Formally, I denote by $x(q, r_0)$ the probability that the firm stretches its name to the new product.[11]

Finally, I assume the market is short on the sellers' side and that consumers bid for each firm's output. It follows that each unit is sold for $w(\Omega)$, the consumers' willingness to pay.[12] $w(\Omega)$ is also firm profit per unit in each period, since I assume production costs to be zero.

The timing of the model, from the point of view of a firm that is endowed with two products, is summarized in Table 1.[13] The model's notation is summarized in Table 2.

I make the following assumption regarding the function $F(r \mid q)$:

Assumption 1. $f(r \mid q) > 0$ for all q, r. The family of densities $\{f(\cdot \mid q)\}$ has the strict monotone likelihood ratio property (SMLRP), that is, if $q'' > q'$, then $[f(r \mid q'')]/[f(r \mid q')]$ is strictly increasing in r.

This assumption implies that higher-q firms produce better products. In other words, it implies that $v(q)$ is increasing, that is, consumers would be willing to pay more for a higher-q firm product. Moreover, the assumption implies that higher performance is ''good news'' regarding the firm's quality (Milgrom, 1981). That is, the higher r_0, the better the posterior distribution of q, in the sense of first-order stochastic dominance. Finally, notice that in the first period, r_0 is a sufficient indicator for the firm's reputation level. For this reason, I will below refer to r_0 as the firm's reputation level.

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[9] Later I relax this assumption, as well as the assumption of perfect correlation of product quality.

[10] Strictly speaking, Ω should explicitly include the information that the firm did not stretch. However, given my assumption that the measure of firms that develop a second product is zero, the information that the firm does not stretch is irrelevant.

[11] As we will see, in equilibrium $x(q, r_0)$ is either zero or one, but pure strategies are a derived, not assumed, result.

[12] The assumption that consumers bid for each firm's output allows me to set aside the question of signalling through prices and instead focus on the firm's decision of naming its second product.

[13] For a firm not endowed with a second product, the items under $a = 1$ do not apply and the analysis is trivial, as such firm has no decisions to make.

TABLE 1 Timing

$a = 0$	Firm is born and endowed with quality q. Consumers buy one unit and observe performance r_0, drawn from $F(r_0 \mid q)$.
$a = 1$	Firm sells second product under the same name with probability $x(q, r_0)$. Consumers buy one unit of second product and observe performance r_1, drawn from $F(r_1 \mid q)$.
$a = 2$	Consumers buy one unit of first product.

3. Equilibria

■ In this section I derive the set of equilibria in the model, as well as the main features of each equilibrium. The equilibrium concept I will use is that of Bayesian equilibrium:

Definition 1. A Bayesian equilibrium (BE) is a pair $\langle x(q, r_0), H(q \mid \Omega)\rangle$ such that (i) $x(q, r_0)$ is optimal given $H(q \mid \Omega)$; and (ii) $H(q \mid \Omega)$ is Bayesian consistent given $x(q, r_0)$.

To determine the firm's optimal strategy, I need to compute the expected value from launching the new product under the same name as the first product, $S(q, r_0)$, and compare it to the payoff from using a new name, $N(r_0)$. The difference between the former and the latter is the marginal payoff from stretching, $M(q, r_0)$. We then have

$$
\begin{aligned}
M(q, r_0) &\equiv S(q, r_0) - N(r_0) \\
S(q, r_0) &= \delta w(r_0, s) + (1 - \delta) \int_{\underline{r}}^{\overline{r}} w(r_0, s, r_1)\, dF(r_1 \mid q) \qquad (1) \\
N(r_0) &= \delta w(\varnothing) + (1 - \delta) w(r_0),
\end{aligned}
$$

where, as an abuse of notation, $w(r_0, s)$ denotes $w(\Omega)$ where $\Omega = \{r_0, s\}$, and so forth. In words, $N(r_0)$ is the profit from selling a new product under a new name, $\delta w(\varnothing)$, plus the profit from selling the base product for the second time, $(1 - \delta) w(r_0)$.

TABLE 2 Notation

q	Firm quality
r_t	Product performance in period t
s	Event of stretching
δ	Relative size of new product (with respect to base product)
$u(r)$	Consumer utility given performance
$v(q)$	Consumer indirect expected utility given quality
$w(H)$	Consumer willingness to pay given belief H about quality
$x(q, r)$	Probability of stretching
Ω	Consumer's information set
$F(r \mid q)$	Probability distribution of performance given quality (density f)
$G(q)$	Prior distribution of quality (density g)
$H(q \mid \Omega)$	Posterior distribution of quality (density h)

$S(q, r_0)$ is the profit from selling the second product under the base product's name, $\delta w(r_0, s)$, plus the expected profit from selling the base product for the second time, $(1 - \delta) \int_{\underline{r}}^{\overline{r}} w(r_0, s, r_1)\, dF(r_1 | q)$.

To obtain a BE, I impose that $H(q | \Omega)$ be consistent with Bayes' theorem. This implies that

$$\begin{aligned} h(q | \varnothing) &= g(q) \\ h(q | r_0) &= \frac{g(q) f(r_0 | q)}{\displaystyle\int_{\underline{q}}^{\overline{q}} f(r_0 | \tilde{q})\, dG(\tilde{q})} \\ h(q | r_0, s) &= \frac{g(q) f(r_0 | q) x(q, r_0)}{\displaystyle\int_{\underline{q}}^{\overline{q}} f(r_0 | \tilde{q}) x(\tilde{q}, r_0)\, dG(\tilde{q})} \\ h(q | r_0, s, r_1) &= \frac{g(q) f(r_0 | q) f(r_1 | q) x(q, r_0)}{\displaystyle\int_{\underline{q}}^{\overline{q}} f(r_0 | \tilde{q}) f(r_1 | \tilde{q}) x(\tilde{q}, r_0)\, dG(\tilde{q})}. \end{aligned} \tag{2}$$

To understand these expressions, note that although I focus on a particular firm, the model assumes overlapping generations of continuums of firms, some of which (a measure zero) are endowed with a second product. So, for example, if consumers observe a product with no history, they assume this is a new product, hence $h(q | \varnothing) = g(q)$. In fact, a new product could also be launched by an old firm, but this is a measure zero event.[14]

The first results in this section are the following. First, I show that there exists a pooling equilibrium whereby firms never stretch. Then I show there exists a unique semiseparating equilibrium (in the sense that no complete pooling takes place for any value of r_0).

Proposition 1 (pooling equilibrium). There exists a pooling equilibrium whereby no firm ever sells a second product under the same name: $x(q, r_0) = 0, \forall q, r_0$.

Proposition 1 is a common result in signalling games. When there are zero-probability events, Bayesian equilibria are consistent with any kind of beliefs. If we make those beliefs sufficiently unfavorable to the first player, then we can support a pooling equilibrium. In the present case, stretching is a zero-probability event. We can therefore associate such an event with the belief that the firm is of the lowest quality, thus making ‘‘no stretching’’ an equilibrium.

Next I consider an equilibrium where there is some separation.

Proposition 2 (semiseparating equilibrium). There exists a unique equilibrium such that for all r_0, the probability of stretching is strictly positive. In this equilibrium, a firm stretches with probability one if and only if $q > q^*(r_0)$, and does not stretch otherwise. The probability of stretching is therefore increasing in q.

The thrust of the proof of Proposition 2 is to show that the marginal payoff from stretching, $M(q, r_0)$, is increasing in q. The implication is that in equilibrium it is the firms with higher q that stretch. The reason for this result is that the only part of the

[14] See Section 7 for a discussion of how to relax this assumption.

payoff function that depends on q is expected future sales at age 2 in case of stretching; Assumption 1 implies such payoff is increasing in q.

Propositions 1 and 2 show that there exist two different equilibria. However, there actually exists a continuum of equilibria. In fact, for each value of r_0 I can select as equilibrium strategies and beliefs either those in Proposition 1 or those in Proposition 2. This leads to a continuum of possible combinations between the two. In the remainder of the article I shall focus on the semiseparating equilibrium of Proposition 2, the only equilibrium where stretching takes place with positive probability for all values of r_0. This is the only universally divine equilibrium.[15] To be more rigorous, the equilibrium of Proposition 2 is the only universally divine equilibrium in a discretized version of the game where there is a finite number of types (which, however, can be arbitrarily large). The reason is that for any consumer belief, the payoff from stretching is increasing in q (see the proof of Proposition 2). It follows that at each round of the iterated elimination process, the D2 criterion eliminates the lowest surviving type. This in turn eliminates any equilibrium where all types pool at "no stretching."

Proposition 2 provides an answer to the following question: Given a value of r_0, how does the optimal strategy depend on the value of q? Consumers do not observe q, only the performance levels r_0 and r_1. By Assumption 1, higher-quality firms expect higher values of r_1; higher values of r_1 increase the consumers' willingness to pay. It follows that the payoff from stretching is increasing in q. This effect, which I call the feed-back reputation effect, provides an answer to the question above: for a given r_0, it is the firms with higher q that stretch.

The complementary question, in terms of characterizing the optimal firm strategy, is the following: Given a value of q, for what realizations of r_0 should a firm stretch? This is a more complicated question: higher levels of r_0 imply that the firm can get more from selling a new product with the same name as its base product; but it also means that the firm has more to lose from squandering its reputation. In other words, the direct reputation effect may cut both ways. My next result states that if the new product is relatively profitable, then firms stretch when their reputation is high.

Proposition 3 (reputation exploiting). For each r_0, there exists a $\overline{\delta}$ such that if $\delta > \overline{\delta}$, then $q^*(r_0)$ is decreasing.

If δ is close to one, then $q^*(r_0)$ is decreasing. If $q^*(r_0)$ is decreasing, then for a given value of q, firms stretch if and only if r_0 is greater than the inverse of $q^*(r_0)$. This is fairly intuitive: a high value of δ effectively implies that the firm is only concerned with the sales of its new product. The direct reputation effect then implies that higher reputation leads to higher benefits from stretching. In other words, the optimal strategy is one of reputation exploiting: use your brand name if and only if it has value.

4. The linear-normal case

■ To get a better idea of the nature of the equilibrium, I now consider the particular case when utility $u(r)$ is linear and both q and r_t are normally distributed. With no further loss of generality, I assume that the *ex ante* expected value of q is zero. Formally,

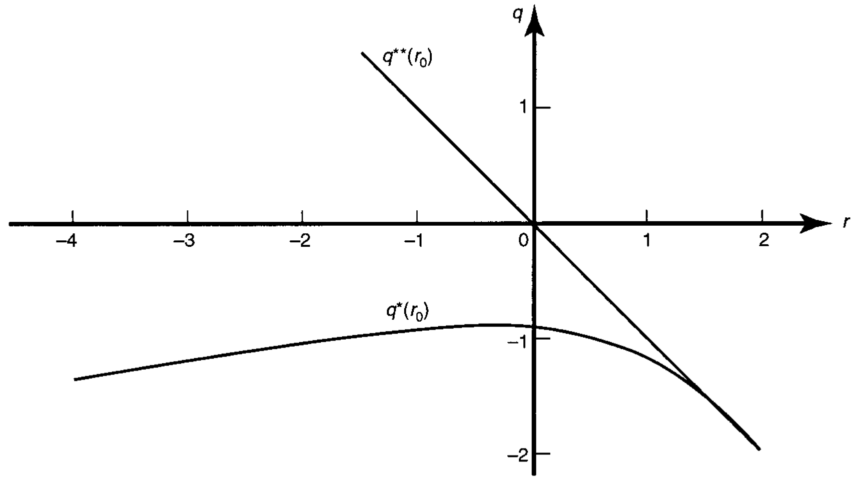
Assumption 2. $u(r)$ is linear.

Assumption 3. (i) $F(r \mid q) = N(q, \sigma_r)$; (ii) $G(q) = N(0, \sigma_q)$.

[15] It is also the only equilibrium that survives the Fudenberg and Tirole (1991) version of D1, though it is generally not the unique divine equilibrium.

FIGURE 1

EQUILIBRIUM WHEN *F* AND *G* ARE NORMAL ($\sigma_q = \sigma_t = 1$)



Linearity of the utility function implies that consumers only care about expected performance. Normality of the prior and the performance distributions allows for a simple solution to the updating problem.[16]

Figure 1 illustrates the equilibrium of Proposition 2 in the linear-normal example and for the parameter values $\sigma_q = \sigma_r = 1$, $\delta = ½$.[17] As shown in the proof of Proposition 2, the equilibrium strategy consists of a critical value $q^*(r_0)$ above which the firm stretches. Figure 1 depicts the equilibrium value $q^*(r_0)$ in the (r_0, q) map. To get a better grasp of the effects at work, the figure also depicts the critical value, $q^{**}(r_0)$, corresponding to the case when consumers do *not* include s in their updating of $h(q)$, so that

$$h(q) = \frac{g(q)f(r_0|q)}{\int_{\underline{q}}^{\overline{q}} f(r_0|\tilde{q})\, dG(\tilde{q})} \quad \text{and not} \quad h(q) = \frac{g(q)f(r_0|q)x(q, r_0)}{\int_{\underline{q}}^{\overline{q}} f(r_0|\tilde{q})x(\tilde{q}, r_0)\, dG(\tilde{q})},$$

as is the case in a Bayesian equilibrium; that is, the value $q^{**}(r_0)$ corresponds to the case when consumers rationally process the information on performance (r_0) but not the information provided by the firm's choice of whether or not to stretch (s).

The first thing to notice from Figure 1 is that $q^{**}(r_0)$ is decreasing. Specifically, if $\delta = ½$, then $q^{**}(r_0) = -r_0$. To understand this fact, note that (i) profit at age 1 in the case of stretching is equal to profit at age 2 in the case of no stretching (in both cases, consumers observe r_0); (ii) profit at age 1 in the case of no stretching is zero (the profit of a new product launched under a new name); (iii) it follows that stretching is optimal if and only if profit at age 2 in the case of stretching is positive; (iv) since, by assumption, consumers do not process the information from the observation of s, age 2 profit is proportional to $r_0 + r_1$; and (v) the firm's expected value of $r_0 + r_1$ is $r_0 + q$.

[16] Straightforward computation shows that Assumption 3 is consistent with Assumption 1.

[17] Details of the computation are available upon request. Some of the details are included in the proof of Proposition 4 below.

$q > q^{**}(r_0)$ cannot be an equilibrium, however. If that were the case and a firm with low r_0 were to stretch, then consumers should expect such a firm to be of very high quality ($q > -r_0$ in the case when $\delta = ½$); accordingly, consumers would be willing to pay a high price for the firm's output. As a result, a firm of quality lower than q^{**} (but not much lower) would have a big incentive to stretch, in effect "free riding" on the high-quality firms' stretching strategy. This is the essence of the signalling effect: the mere fact that a firm stretches improves the consumers' assessment of quality.

If we factor in the signalling effect, then we get an equilibrium threshold $q^*(r_0)$ that falls below $q^{**}(r_0)$: the signalling effect increases the likelihood of stretching. As the level of reputation increases, $q^*(r_0) - q^{**}(r_0)$ tends to zero. The intuition is that as the level of reputation increases, the probability of stretching goes to one, and consequently the signalling effect becomes less and less important.

At the equilibrium threshold $q^*(r_0)$ and for a given r_0, it is the firms with higher q that stretch (Proposition 2). What about the stretching strategy for a given q? Proposition 3 suggests that if δ is high enough, then it is the firms with highest r_0 that stretch. Figure 1 shows that this is not a general result. In fact, for $\delta = ½$ and for low values of r_0, $q^*(r_0)$ is *increasing.* More generally, $q^*(r_0)$ is increasing if δ is small enough:

Proposition 4 (reputation building). For each r_0, there exists a $\underline{\delta}$ such that if $\delta < \underline{\delta}$, then $q^*(r_0)$ is increasing.

The idea of Proposition 4 is that if future sales of the base product are sufficiently profitable with respect to the stretched product, then firms should stretch if and only if their reputation is very low. Even an average-quality firm expects that its reputation will improve starting from a low reputation level: things can only get better. In the short run, stretching implies a lower payoff than starting a new name; but in the long run, such a strategy pays off.[18] That is, in contrast with the large-δ case, the firm's strategy for low δ is one of reputation building. To put it differently: If δ is low, then the firm stretches only if its quality is very high, that is, the firm follows a strategy of reputation protection.[19]

Figure 2 illustrates Propositions 3 and 4: it depicts the equilibrium threshold $q^*(r_0)$ for three different values of δ: 0, ½, and 1. As suggested by Proposition 3, $\delta = 1$ implies that $q^*(r_0)$ is decreasing: for a given q, firms stretch if and only if r_0 is greater than the inverse of $q^*(r_0)$. As suggested by Proposition 4, $\delta = 0$ implies that $q^*(r_0)$ is increasing: for a given q, firms stretch if and only if r_0 is lower than the inverse of $q^*(r_0)$. For intermediate values of δ, the optimal strategy may be more complicated. For example, if $\delta = ½$ and q is one standard deviation below average, then the optimal strategy is to stretch if r_0 is very low or very high.

5. Discussion

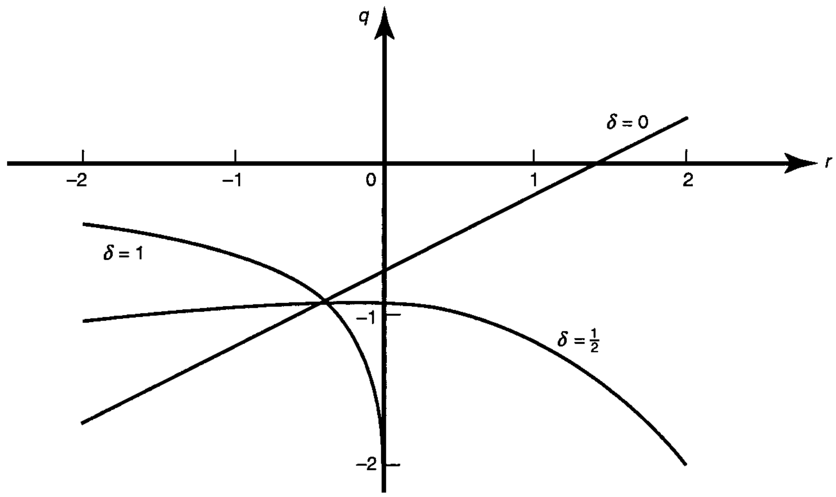
■ As suggested in the previous sections, there are essentially three effects at work in the decision of stretching a reputation. The feedback reputation effect implies that higher-quality firms are more confident that stretching will consolidate their reputation. As a result, for a given reputation level, firms with higher quality decide to stretch (Proposition 2).

[18] An implicit assumption of my analysis is that firms cannot change the name of their existing product. In fact, all I need to assume is that consumers are able to identify the product even if the firm changes its name.

[19] Dranove and Tan (1990) show that information spillovers may lead an incumbent to be overconservative in its decision to enter a new market: by doing so, the incumbent's true ability (e.g., quality) may be revealed and induce entry into the base market.

FIGURE 2

EQUILIBRIUM THRESHOLD $q^*(r_0)$ AS A FUNCTION OF δ, THE RELATIVE WEIGHT OF THE STRETCHED PRODUCT ($\sigma_q = \sigma_t = 1$)



The direct reputation effect implies that firms with higher reputation are able to sell for a higher price than firms with lower reputation. If the new product is relatively profitable compared to the base product, then firms will ''exploit'' their reputation, so that for a given level of quality, stretching takes place if and only if reputation is sufficiently high (Proposition 3). If the new product is of marginal importance, however, then firms will stretch only if reputation is sufficiently low, in an attempt to ''build'' their reputation; by contrast, when reputation is high, firms prefer to ''protect'' their reputation (Proposition 4). Finally, because it is the firms of higher quality that stretch in equilibrium, the mere fact that a firm stretches signals that its quality is relatively high.

□ **Comparison with alternative theories of brand stretching.** An alterative signalling model of reputation stretching is given by Wernerfelt (1988). He assumes that umbrella branding (an alternative term for brand stretching) is more costly than creating a new brand. This extra cost allows for a separating equilibrium where a firm umbrella brands if and only if it is a good type (high quality). This is one of many Bayesian equilibria, but Wernerfelt shows it to be the only equilibrium that survives the Cho-Kreps intuitive criterion. My model differs from Wernerfelt in several respects. In particular, his result depends on a positive cost of umbrella branding. By contrast, I assume that brand stretching is cost neutral, that is, the cost of launching a new product is the same regardless of the name the firm chooses for its new product. Another important difference is that my result depends (crucially) on a positive correlation of qualities across a firm's product offerings, whereas Wernerfelt's does not (see Wernerfelt, 1986).

Choi's (1998) theory of brand extension (still another term for the same practice) features both adverse selection and moral hazard. He considers the case when the seller offers a series of products under the same brand name. Each new product is launched at a price that signals its quality. If consumers expect the product to be of high quality, as is the case with brand-extended products, then the price distortion necessary to signal quality is lower. If consumers later find out that the product is of low quality, then the firm's reputation breaks down and future high-quality launches will need to be signalled with a large price distortion. Although Choi's model features adverse selection and signalling, the strategy of brand extension is supported by a moral-hazard equilibrium in the tradition of the Klein and Leffler (1981) and Shapiro (1983) models.

6. Empirical evidence and empirical implications

■ Empirical evidence seems to support the model's prediction that bad news in one product leads consumers to revise their expectations about the quality of other products sold under the same name. For example, Jarrell and Peltzman (1985) find that a dangerous drug recall by the Food and Drug Administration lowers the manufacturer's stock price by more than can be attributed to the lost profits from the recalled drug. Sullivan (1990) shows that the 1986 sudden-acceleration incident with the Audi 5000 shrunk the demand for the Audi 5000 and the Audi Quattro as well. Erdem (1998) estimates positive (if small in magnitude) cross-category effects between two oral hygiene products, toothpaste and toothbrushes.

Proposition 2 also has implications for reputation, stretching, and performance. First, the average performance of firms that stretch is greater than the average performance of firms that do not. This is so because the probability of stretching is increasing in quality, while performance is also increasing in quality. The empirical evidence is consistent with a positive correlation between stretching and performance (see Court, Leiter, and Loch, 1999). However, it is important to notice that this is a case of correlation, not causality: it is not the case that by stretching firms perform better; rather, firms that stretch end up doing better. Too often one hears the argument that firms should stretch because it improves their performance. My results show that this is true for high-quality firms, but not generally.

Another implication is that if the stretched product is relatively profitable (high δ), then the likelihood of stretching is increasing in reputation. This is not an obvious result. In fact, the probability of stretching conditional on r_0, $P(s|r_0)$, is given by

$$P(s|r_0) = \frac{\displaystyle\int_{q^*(r_0)}^{\overline{q}} f(r_0|q)\, dG(q)}{\displaystyle\int_{\underline{q}}^{\overline{q}} f(r_0|\tilde{q})\, dG(\tilde{q})}. \tag{3}$$

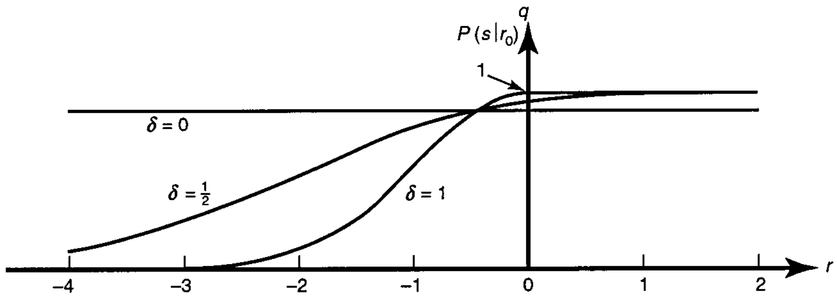
$P(s_0|r)$ is increasing in r_0 (by Assumption 1) and decreasing in $q^*(r_0)$. If $q^*(r_0)$ is decreasing, as is the case when δ is high enough (Proposition 3), then $P(s|r_0)$ is unambiguously increasing in r_0. However, if $q^*(r_0)$ is increasing, as is the case when δ is small, then it is conceivable that $P(s|r_0)$ is decreasing in r_0. As it turns out, in the linear-normal example, $P(s|r_0)$ is increasing for all values of δ, but less so for lower values of δ. Specifically,

$$P(s|r_0) = 1 - \Phi\left(\frac{q^*(r_0) - \dfrac{\sigma_q^2}{\sigma_q^2 + \sigma_r^2} r_0}{\sqrt{\dfrac{\sigma_q^2 \sigma_r}{\sigma_q^2 + \sigma_r^2}}}\right),$$

where Φ is the standardized-normal cdf. This is illustrated by Figure 3, which plots

FIGURE 3

PROBABILITY OF STRETCHING CONDITIONAL ON REPUTATION, FOR DIFFERENT VALUES OF δ ($\sigma_q = \sigma_t = 1$)



$P(s|r_0)$ for three values of δ. The figure suggests that a regression with $P(s|r_0)$ as a dependent variable would show a positive coefficient in the $r_0 \cdot \delta$ interaction term.

7. Extensions

■ The model I have presented is very simple in many respects. For example, I could have considered more than three periods. Also, instead of assigning all of the market power to the seller, I could have assumed some sharing with buyers. However, I believe that the main results are robust and would hold in more general settings as well. In what follows, I specifically consider the robustness of the model with respect to the assumption that the set of firms developing a new product has measure zero. I also consider three possible extensions of my basic framework.

□ **Positive probability of new product development.** I have considered an overlapping-generations model of three-period-lived firms. Firms are endowed with a product in the first period. Some firms are also endowed with a second product in the second period. I have assumed that these firms form a set of measure zero. Suppose, however, that independently of q, a firm is endowed with a second product with probability α. The equations for the posterior distribution of q are now more complicated. Specifically, if consumers observe a new product with a new name, they must consider the possibility that this product is being launched by a new firm or by an old firm that decided to create a new name. We thus have, instead of (2),

$$h(q|\varnothing) = \frac{g(q)[1 + \alpha y(q)]}{\displaystyle\int_{\underline{q}}^{\overline{q}} [1 + \alpha y(\tilde{q})]\, dG(\tilde{q})},$$

where

$$y(q) = \int_{\underline{r}}^{\overline{r}} [1 - x(q, r_0)]\, dF(r_0|q).$$

($y(q)$ is the probability that a firm of quality q does not stretch.)

Likewise, when consumers make a second purchase from a firm that did not stretch, they must consider the possibility that the firm did not develop a second product or, having developed one, decided to sell it under a new name. We thus have, instead of (2),

$$h(q|r_0) = (1-\alpha)\frac{g(q)f(r_0|q)}{\int_{\underline{q}}^{\overline{q}} f(r_0,\tilde{q})\,dG(\tilde{q})} + \alpha\frac{g(q)f(r_0|q)[1-x(q,r_0)]}{\int_{\underline{q}}^{\overline{q}} f(r_0,\tilde{q})[1-x(\tilde{q},r_0)]\,dG(\tilde{q})}.$$

(The expressions for $h(q|r_0, s)$ and $h(q|r_0, s, r_1)$ remain unchanged.) Notice that the above expressions are continuous in α at $\alpha = 0$. Moreover, the proof of Proposition 2 is based on strict monotonicity with respect to q. Consequently, the same result would follow for small values of α, that is, the result is robust to small perturbations in the value of α.

□ **Imperfect correlation.** One interesting question is how the equilibrium strategy depends on the degree of correlation between the quality of the base product and the quality of the second product. I conjecture that the lower the degree of correlation between products, the greater the probability of stretching. The argument runs as follows. Let $\overline{S}(q, r_0)$ be the expected payoff from stretching given that consumers do *not* process the information given by the signal that the firm stretched. (That is, the curve $q^{**}(r_0)$ in Figure 1 corresponds to the condition $\overline{S}(q^{**}(r_0), r_0) = N(r_0)$.) Let q' be the quality of the second product and ρ an indicator of the correlation between q and q'. Suppose that ρ is common knowledge to firm and consumers; that the firm can only observe q' after it decides whether or not to stretch; and that consumers can never observe q or q'. It seems reasonable to assume that $(\partial/\partial\rho)|\overline{S}(q, r_0; \rho) - N(r_0)| > 0$. In words, the greater the correlation between q and q', the more important the r_0 news, both good news and bad news. Recall that in equilibrium and for the marginal type $q^*(r_0)$, the positive signalling effect exactly balances a negative reputation effect. A greater degree of correlation implies that the reputation effect is more negative. To compensate for this, the signalling effect must also be more positive, which implies a greater q^*.[20]

□ **Endogenous choice of correlation.** Does the above conjecture imply that we should observe firms stretching mainly into unrelated product lines? Not necessarily. The above conjecture is for the comparative statics with respect to an exogenous change in ρ. But it probably makes more sense to think of ρ as the result of an endogenous choice by the firm. Also, it seems reasonable to assume that the cost of stretching is increasing in the degree of correlation: if the firm wants to choose a product that is very closely correlated to its current offering, then it has less to choose from. A tantalizing possibility is that there exists a separating equilibrium whereby the higher the quality and/or reputation, the greater the degree of correlation.

□ **Endogenous choice of launching new product.** Along the same lines, one could also endogenize the decision of launching a new product. Suppose that a firm develops a new product, as in the model above, but then decides whether to launch it (under the same name as the first product) or not to launch it at all. Formally, this model is

[20] The exact statement would then be: for a given r_0, the higher ρ is, the higher the threshold $q^*(r_0)$ above which firms stretch.

isomorphic to the model in Section 2. In fact, if $w(\varnothing) = 0$, then we get the same model. The alternative interpretation of the model is interesting because it dispenses with the assumption of unobservability of brand ownership. We would then have a model of firm reputation rather than brand reputation, and a theory of how reputation affects the firm's expansion strategy rather than its product naming strategy.

Appendix

■ The proofs of Propositions 1–4 follow.

Proof of Proposition 1. Since in the proposed equilibrium stretching occurs with probability zero and, for all q and r_0, $f(r_0|q) > 0$, we can assign any posterior belief upon the event of stretching. Let that belief be that $\hat{x}(q, r_0) > 0$ if and only if $q = \underline{q}$. This induces a posterior distribution H that is dominated by both G and $H(q|r_0)$. Since w increases when H increases in the sense of first-order stochastic dominance, the result follows. *Q.E.D.*

Proof of Proposition 2. From (1), we see that the marginal payoff from stretching only depends on r_1 through the second-period payoff in the case of stretching. High values of r_1 shift the posterior distribution of q in the direction of first-order stochastic dominance; that is, high values of r_1 are good news. It follows that the realized marginal payoff from stretching is strictly increasing in r_1. Assumption 1 then implies that $M(q, r_0)$ is strictly increasing in q. In fact, other than through r_1, $M(q, r_0)$ does not depend on q. Finally, the fact that $M(q, r_0)$ is strictly increasing in q implies that the equilibrium strategy must be

$$x(q, r_0) = \begin{cases} 1 & \text{if } q > q^*(r_0) \\ 0 & \text{otherwise.} \end{cases}$$

To show that there exists a unique $q^*(r_0)$, suppose there exist two equilibria identified by the functions $q^*_L(r_0)$ and $q^*_H(r_0)$, where $q^*_L(r_0) < q^*_H(r_0)$. Also, let $M_L(q, r)$ and $M_H(q, r)$ be the marginal benefit from stretching given that consumers hold beliefs corresponding to $q^*_L(r_0)$ and $q^*_H(r_0)$, respectively. Consider the following result, the proof of which is obtained by straightforward differentiation.

Lemma A1. Suppose that $\xi(x|\hat{x}) = \psi(x)/\int_{\hat{x}}^{\infty} \psi(\tilde{x})\, d\tilde{x}$ $(x > \hat{x})$, where ξ and ψ are densities and $x \in \mathbb{R}$. Then $\xi(x|x')$ dominates $\xi(x|x'')$, in the sense of first-order stochastic dominance, if and only if $x' > x''$.

This implies that $M_L(q, r) < M_H(q, r)$. But then we have a contradiction:

$$0 = M_L(q^*_L(r_0), r) < M_H(q^*_L(r_0), r) < M_H(q^*_H(r_0), r) = 0,$$

where the last inequality follows from monotonicity of $M(q, r)$ with respect to q, as shown above.

Finally, we only have to show that the probability of stretching is strictly positive, i.e., $q^*(r_0) < \overline{q}$. In fact, in the limit as $q^*(r_0) \to \overline{q}$, both $H(q|r_0, s)$ and $H(q|r_0, s, r_1)$ dominate $H(q|\varnothing)$ and $H(q|r_0)$ (in the sense of first-order stochastic dominance). Since $M(q, r_0)$ is increasing in q and the belief $q^*(r_0)$, it follows that the marginal firm's payoff is positive for sufficiently high $q^*(r_0)$. *Q.E.D.*

Proof of Proposition 3. For δ large enough, the comparison between stretching and not stretching corresponds to the comparison between $w(r_0, s)$ and $w(\varnothing)$, the firm's unit profit at age 1 depending on whether it stretches or does not, respectively. In the limit when $\delta = 1$, we have

$$S(q, r_0) = w(r_0, s) = \frac{\displaystyle\int_{q^*}^{\overline{q}} f(r_0|q)v(q)\, dG(q)}{\displaystyle\int_{q^*}^{\overline{q}} f(r_0|\tilde{q})\, dG(\tilde{q})}$$

$$N(r_0) = w(\varnothing) = \int_{\underline{q}}^{\overline{q}} v(q)\, dG(q).$$

The indifferent type $q^*(r_0)$ is therefore determined by

$$\frac{\int_{q^*}^{\bar{q}} f(r_0|q)v(q)\, dG(q)}{\int_{q^*}^{\bar{q}} f(r_0|\tilde{q})\, dG(\tilde{q})} - \int_{\underline{q}}^{\bar{q}} v(q)\, dG(q) = 0.$$

Assumption 1 implies that $v(q)$ is strictly increasing. Assumption 1 and the fact that $v(q)$ is strictly increasing imply that the left-hand side is strictly increasing in r_0. Lemma A1 and the fact that $v(q)$ is strictly increasing imply that the left-hand side is strictly increasing in q^*. The result then follows from the implicit function theorem and continuity in δ. *Q.E.D.*

Proof of Proposition 4. In the limit when $\delta = 0$, the condition for the indifferent type $q^*(r_0)$ is given by

$$\int_{\underline{r}}^{\bar{r}} w(r, s, r_1)\, dF(r_1|q^*) - w(r_0) = 0.$$

By the same argument as in the proof of Proposition 2, the left-hand side is strictly increasing in q^*. I will now argue that under Assumptions 2 and 3, the left-hand side is deceasing in r_0.

Assumption 3 (normality) implies that the posterior distribution of q given a signal r_0 is normal with mean $\sigma_q^2 r/(\sigma_q^2 + \sigma_r^2)$ and variance $\sigma_q^2\sigma_r^2/\sigma_q^2 + \sigma_r^2)$; the posterior distribution of q given signals r_0, r_1 is normal with mean $\sigma_q^2(r_0 + r_1)/(2\sigma_q^2 + \sigma_r^2)$ and variance $\sigma_q^2\sigma_r^2/(2\sigma_q^2 + \sigma_r^2)$. Assumption 2 (linearity) implies that consumers only care about the expected value of q. Moreover, it is known that if $q \sim N(\mu, \sigma)$, then the expected value of q given that $q > q^*$ is equal to $\mu + \sigma^2 Z[(q^* - \mu)/\sigma]$, where $Z(x) = \phi(x)/[1 - \Phi(x)]$ is the standardized-normal hazard rate (i.e., $\phi(x)$ and $\Phi(x)$ are the standardized normal density and cdf, respectively). Finally, $Z(x)$ is strictly increasing.

Together, these facts imply that the above equation can be rewritten as

$$\frac{\sigma_q^2}{2\sigma_q^2 + \sigma_r^2}(r_0 + q^*) + \frac{\sigma_q^2\sigma_r^2}{2\sigma_q^2 + \sigma_r^2}\int_{-\infty}^{+\infty} Z\left(\frac{q^* - \dfrac{\sigma_q^2}{2\sigma_q^2 + \sigma_r^2}(r_0 + r_1)}{\sqrt{\dfrac{\sigma_q^2\sigma_r^2}{2\sigma_q^2 + \sigma_r^2}}}\right) dF(r_1|q^*) - \frac{\sigma_q^2}{\sigma_q^2 + \sigma_r^2} r_0 = 0.$$

Straightforward computation shows that since $Z(x)$ is strictly increasing, the left-hand side is strictly decreasing in r_0. The result then follows from the implicit function theorem and continuity in δ. *Q.E.D.*

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