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Moral hazard as an entry barrier

Joseph Farrell*

In an experience-goods industry, an entrant who could make positive profits by providing a better deal to buyers than do incumbents may cheat buyers by providing goods of low quality to make even greater profits. If buyers foresee this possibility, they will be unwilling to buy from an entrant. As a result, moral hazard in a seller's choice of the quality of an experience good can lead to a barrier to entry. In particular, since hit-and-run entry is likely to lead to low-quality choice, the threat of such entry may not discipline the pricing of incumbents. We also show that the temptation to dishonest entry—the moral-hazard problem—is stronger if buyers are already receiving some consumer surplus. As a result, there is a first-entrant advantage because the first entrant faces less temptation to provide inefficiently low quality than do subsequent entrants, and with rational buyers this works to his advantage. The scale of entry may affect quality incentives, and therefore introductory offers may assure buyers of an entrant's quality, but this cannot happen under a suitable definition of "constant returns."

1. Introduction

■ Ease of entry is crucial for an industry's performance. Entry constrains monopolies and cartels, and guards against poor performance—both inadvertent and exploitative. New industries begin with entry; and, if sellers differ in efficiency, entry results in the replacement of less efficient early participants with more efficient late arrivals. Modern industrial organization theory[1] stresses the importance of entry conditions and potential competition, in contrast to the earlier emphasis on "actual competition."

One problem that faces a potential entrant is to persuade buyers that his product is of high quality. In markets for experience goods[2] buyers will know the quality of products they have previously bought, but they will not know the quality of the goods produced by entrants. As a result, buyers' fear or suspicion about the quality of an entrant's goods can make entry difficult and thus enable incumbents to sustain excess profits or inefficiency without inducing entry. Schmalensee (1982) has examined this problem, but in his model buyers are irrational (or at least incorrect) in their fears about the quality of an entrant's good. In this article we show how rational buyers may also distrust an entrant and thus create an entry barrier and a first-mover advantage.

* GTE Laboratories Incorporated and University of California, Berkeley.

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[1] See especially Baumol, Panzar, and Willing (1982), who argue that even in "natural monopoly" industries the threat of entry may oblige a monopolist to price at average cost.

[2] Nelson (1970) introduced this term for goods whose quality is unobservable before purchase, though observable after a buyer has used the good.

A barrier to entry is an obstacle to efficient contracting between buyers and a potential entrant.[3] If an industry is providing less consumer surplus than is possible, an entrant can make positive profits by offering buyers a slightly better deal than they are getting from incumbent firms. In some cases, however, an entrant's profits would be higher still if he "cheated" by providing goods of low quality. In such a case, buyers with rational expectations would not be willing to buy from an entrant and entry will not occur.[4] This is our entry barrier.[5]

We can interpret this entry barrier in two ways. First, it may be strategically constructed by an incumbent to deter entry. Alternatively, it may represent an inherent difficulty in entering experience-good industries. We focus primarily on the first interpretation; however, when we discuss the first-entrant advantage, we evidently need the second.

We show that the entry barrier is more severe if the incumbent is already providing some consumer surplus (and is more severe the greater is that consumer surplus). As a corollary, there is a first-entrant advantage, since the first entrant competes only with the alternative of not buying. Thus, *reputation can be a barrier to entry,* in the sense of Fisher, McGowan, and Greenwood (1983, pp. 168–169), who point out that the presence of reputation effects in a market is a barrier to entry only if incumbent firms did not themselves face the same problems as do new entrants. It is also a barrier to entry in von Weizsäcker's (1980) sense, since the private incentives to entry may be unfavorable, even when entry would be socially beneficial.

We also consider the role of introductory offers in assuring buyers about the entrant's product quality. In particular, we ask whether an entrant can commit himself to produce high-quality goods by sacrificing enough first-period profit that he could not make positive profits by providing low-quality goods. If so, introductory offers and costly advertising[6] might (at least partly) overcome this entry barrier. But such sacrifices of first-period profits are sunk costs, and do not themselves affect quality incentives. If introductory offers affect the entrant's first-period sales, however, we show that in some circumstances that can affect quality incentives and thus the possibility of entry.

The article is organized as follows. In Section 2 we describe a two-period model of the

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[3] See Grossman (1981) and von Weizsäcker (1980). Grossman discusses contracts in which buyers agree to abandon the incumbent, even though the latter might try to respond with price reductions. Von Weizsäcker points out that a coalition of buyers and entrant is immune to predatory price responses, since any losses inflicted on the entrant are at least compensated by gains to the buyers.

[4] The game-theoretic essence of the model can be seen qualitatively as follows. Suppose that each of two players, E and B, has a choice of two moves. E can choose L or H (low or high quality). B can choose Y or N (buy or do not buy). Payoffs are as follows:

		B: Y	N
E:	L	(2, −1)	(0, 0)
	H	(1, 1)	(0, 0).

The outcome (H, Y), which gives both players positive payoffs, is not an equilibrium, because E will choose to defect to L. In equilibrium each player gets zero. If E could commit himself to H before B chose his move, he would do so and each would get 1.

[5] We assume that sellers cannot sign binding contracts that guarantee a particular quality. Quality is often very difficult to specify precisely enough to permit a contract to be enforced, let alone to permit the very cheap enforceability that is required in the case of ordinary consumer goods. The quality problem may also cause reluctance to sign contracts that specify a price and bind buyers to buy from the entrant. Obviously, no buyer will want to sign such a contract without adequate quality assurances; but such assurances may be hard to provide for the reasons just mentioned. Of course, there are many other reasons for reluctance to sign such contracts.

[6] For models in which the sacrifice of profits guarantees honesty or high quality, see, for instance, Kihlstrom and Riordan (1984), Klein and Leffler (1981), Milgrom and Roberts (1986), Nelson (1970, 1974, 1978), Rogerson (1983), and Shapiro (1983).

incentives facing an entrant whose choice of product quality cannot be observed before purchase. In Section 3 we show how this can create an entry barrier. In particular, hit-and-run entry is especially likely to lead to low product quality: we might say that "hit-and-run" means "fly-by-night." Therefore, moral hazard problems particularly hinder entry where hit-and-run would otherwise be a good strategy for an entrant: in particular, in those natural monopoly markets in which there are no sunk costs and an incumbent's competitive response to entry is not immediate. This barrier does not depend on the existence of even small sunk costs.[7] In Section 4 we discuss the first-entrant advantage created by the fact that the moral-hazard problem becomes more severe, the more consumer surplus the incumbent provides. In Section 5 we consider whether a judicious choice of the scale of entry, which might be achieved by introductory offers, can help an entrant to persuade rational buyers that his product quality will be high. If costs are proportional to output, and if second-period sales are proportional to first-period sales, the outcome is independent of the scale of entry. Otherwise, such a strategy may be useful. Small-scale entry seems more likely to indicate high quality than does large-scale entry, however, so this does not explain introductory offers.

2. A model

■ We consider a two-period model of entry into an experience-goods market where there is already an incumbent firm. In the first period entry is possible. The entrant chooses his product quality when he enters, and cannot change it afterwards.[8] During the first period, this quality is unobservable to buyers. If buyers purchase from the entrant in the first period, then at the end of that period they learn the entrant's product quality. In the second period, then, both the entrant's and the incumbent's[9] product quality are known, at least to the entrant's first-period customers. But if no buyers purchase from the entrant in the first period, they cannot purchase from him in the second period either.[10]

The timing is as follows. First, the incumbent chooses a level of surplus u^* to offer to buyers. Then the entrant chooses whether to enter, and if so, what quality to provide. Buyers then choose (still in the first period) whether to purchase from the incumbent (whose quality they know) or from the entrant (whose quality they do not observe). In the second period, if they bought from the entrant in the first period, they know both quality levels; there is then some form of full-information competition. In particular, the incumbent may be able to change his price and hence his surplus offer.

We assume that there are only two possible quality levels, high (H) and low (L)[11] and that H is the socially efficient quality. We say that a seller who supplies high quality is

[7] See Farrell (1986) or Schwartz and Reynolds (1984) for discussions of the role of small sunk costs as barriers to entry.

[8] Something like this assumption, which von Weizsäcker calls extrapolability, is essential if quality in one period is to indicate quality in another. This is plausible when most of the costs of high quality are incurred at the beginning, so that there is little incentive to reduce quality later, while reputations are hard to repair, so that there is no incentive to increase quality later.

[9] For definiteness, we assume that there is just one incumbent firm. Nothing important would change, however, if there were several; and much of our analysis applies even if there is no incumbent at all (i.e., we are considering a first entrant).

[10] This is intended to capture the idea that if buyers are (rationally) suspicious about the entrant's product quality, then entry cannot succeed. Formally, if buyers do not purchase in the first period, then they do not learn about the product quality. If all buyers waited before purchasing, we would just relabel the point at which the game begins.

[11] In Farrell (1984) we allowed quality to be continuously variable, and showed that only two quality levels are reasonable choices for the entrant. Thus, the discrete high/low quality choice problem considered here also arises in such a model.

"honest." For simplicity, we assume that the low quality L is poor enough that no buyer would knowingly buy it, however low the price.[12] This implies that if an entrant chooses low quality, his optimal strategy at the end of the first period is to leave the market: his second-period profits are then zero. Entry occurs, of course, only if buyers expect an entrant to provide high-quality goods.

If the entrant chooses high quality, he may derive a flow of profits[13] $\Pi_2(x)$ in the second period, where x is his first-period sales level. The value of $\Pi_2(x)$ may also depend on the shape of cost curves, the nature of competition in the market, whether the incumbent responds aggressively, the speed of diffusion of product quality information among buyers, and so on. We consider various cases below.

If buyers believe that the entrant has chosen high quality, what demand curve does he face? We could assume that he takes the entire market demand if his price is below that of the incumbent. This would make it difficult, however, to analyze the effects of the scale of entry, as we wish to do. Accordingly, we suppose that, given the incumbent's price, product quality, and responses, if any, within the first period, the entrant can sell an amount x at a corresponding price $p(x)$,[14] if he can persuade buyers that his quality is high.

We now introduce some notation. Let w_1 be the factor by which we multiply a profit flow over the length of the first period to get its present value at date zero; w_2 is the corresponding factor for period two. We write f for w_2/w_1, the value of the future (the second period) relative to the present. For example, if the first period lasts from time 0 to time T, and there is a constant interest rate r, then a flow of profits equal to y during the first period and to z afterwards is worth

$$\int_0^T y \exp(-rt)dt + \int_T^\infty z \exp(-rt)dt = (1-\exp(-rT))y/r + \exp(-rT)z/r. \tag{1}$$

Hence, $w_1 = (1 - \exp(-rT))/r$, $w_2 = \exp(-rT)/r$, and $f = 1/(\exp(rT) - 1)$. As $rT \to 0$, $f \to \infty$, and *vice versa*.

We write $c(x, q)$ for the cost of producing output x at quality q, and $\Delta c(x)$ for $\Delta c(x, H) - c(x, L)$, which we assume is strictly positive. Where necessary, we write $v(H)$ for a buyer's value for a high-quality good; we assume that the corresponding value $v(L)$ for a low-quality good is negative.

A key parameter is the speed of diffusion of product quality information among buyers. If all buyers learn the entrant's quality in the second period although only a few purchased from him in the first period, we say that information transmission is rapid. Factors affecting this include the length of the first period, the importance of the purchase to buyers, and the perceived correlation between different buyers' values of a particular type of good.

3. Quality incentives and entry barriers

■ We consider the quality incentives facing an entrant with first-period sales of x (we say he enters "at scale x"). If those incentives would lead him to choose low quality, then entry

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[12] We make this assumption for simplicity to rule out the strategy of entering despite buyers' pessimistic expectations about quality. It is possible to show that when buyers have rational expectations, this strategy is never optimal for a seller. For details, see Farrell (1984).

[13] Future profits may depend on x for various reasons, e.g., because information is slow to diffuse among buyers, or because buyers are reluctant to switch among brands. On the latter, see Klemperer (1985).

If the flow of profits is not constant within the second period, then we define $\Pi_2(x)$ so that the present discounted value of second-period profits is the same as that of a steady flow equal to $\Pi_2(x)$.

[14] The precise form of this demand curve is irrelevant to our results. What counts is the comparison between the cost savings from cutting quality and the second-period profits that can be earned by an honest entrant.

at scale x is impossible, because rational buyers will not buy from the entrant. A scale of entry x is feasible, therefore, if and only if $q = H$ is an optimal quality choice for an entrant with first-period sales x. If no feasible x is profitable, and if some values of x would be profitable (with $q = H$) absent this moral-hazard constraint, then moral hazard has created an entry barrier.

□ **Incentives to honesty.** Given a first-period sales level of x, and a first-period price p, the entrant's discounted profits are:

$$w_1(px - c(x, H)) + w_2\Pi_2(x) \quad \text{if} \quad q = H; \tag{2}$$

$$w_1(px - c(x, L)) \quad \text{if} \quad q = L. \tag{3}$$

From (2) and (3), we see that an entrant who enters at scale x will choose $q = H$ if and only if[15]

$$f\Pi_2(x) \geq \Delta c(x). \tag{4}$$

Therefore, an entrant can profitably enter if and only if there exists an x such that (4) holds and also such that the profits from entry are positive:

$$w_1(p(x)x - c(x, H)) + w_2\Pi_2(x) > 0. \tag{5}$$

By contrast, if the entrant could publicly commit himself to high quality in some other way, for example by contract, then he could profitably enter by finding any x such that (5) holds.

This entry barrier can take two forms. First, (4) may fail for all positive x: the entrant may be unable, whatever his choice of x, to convince buyers that he will provide high quality. This is certainly the case if $\Pi_2(x) = 0$ for all x—in particular, if hit-and-run entry is an optimal entry strategy, as we now discuss. The second form of entry barrier occurs when (4) holds for some positive x, but entry at those levels of x is simply unprofitable; we discuss this case below.

□ **Moral hazard in hit-and-run entry.** Suppose that the optimal strategy for an honest entrant is "hit-and-run." For example, suppose that the incumbent will react very vigorously at or before the end of period one. Then $\Pi_2(x) = 0$, so that (4) can never hold. In this case entry is blocked by buyers' rational pessimism about the entrant's product quality. This entry barrier exists even though the incumbent cannot react instantly, and even though there is no sunk cost of entry.[16]

Proposition 1. If an entrant expects no second-period profits, then honest entry is never his best strategy. As a result, entry is blocked.

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[15] We are skirting a subtle game-theoretic issue here. The entrant can be regarded as "simultaneously" choosing both x and q. We have to ask how buyers (who observe x but not q, and care about q) infer q from x. But, given the entrant's beliefs about buyers' rules of inference, there will (generally) be only one optimal (x, q) choice for him. That means that rationality is already contradicted if a buyer observes a choice of x not consistent with the optimal (x, q). It is not clear how buyers "ought" to infer q from x; we assume that they assume that q will be optimal, given x.

[16] A similar phenomenon may be observed in the contestability model (Baumol, Panzar, and Willing, 1982) if there are consumer switching costs (Klemperer, 1985). If entry can only be hit-and-run, because of delayed competitive response by the incumbent, and if buyers suffer a cost of switching custom from incumbent to entrant and back, then entry may be blocked even if there are no sunk costs of entry, so that the market appears perfectly contestable. This latter barrier is limited, however, by the size of the switching cost, amortized over the time until the entrant is driven out, so that if the response lag is not excessively short, the problem may be unimportant. The barrier discussed in the text is limited by the difference in consumer value between high and low quality, which is likely to be more significant.

Intuitively, in this case an entrant cannot collect the benefits of producing high quality: his quality is unobservable in the first period, and in the second period he is no longer in the market. Since he bears the costs but does not collect the benefits of producing high quality, he will not do so.

The second type of moral-hazard entry barrier depends on scale effects, and on interaction between the honesty constraint (4) and the profitability condition (5).

□ **Scale effects and moral hazard.** Although some scales of entry, x, satisfy (4) and some satisfy (5), none may satisfy both simultaneously. A leading case is the following. Suppose that, because of economies of scale, (5) holds only for large x, but for some reason[17] (4) holds only for small x. Then the entrant can either enter (a) in such a way that he will get buyers but lose money (small x), or (b) in such a way that he will attract no buyers, since honest choice of quality would produce lower profits than would a dishonest choice. Profitable entry is thus impossible.

□ **Competitive reaction after entrant's quality known.** Next, we discuss the case in which the incumbent cannot respond (in particular, cannot change the level of consumer surplus he offers to buyers) until strictly after the entrant's quality becomes known. Then an honest entrant can make positive profits in the second period: $\Pi_2(x) > 0$. These profits are a decreasing function of the level of consumer surplus, u^*, originally supplied by the incumbent.

There is a critical level of expected second-period profit Π_2 (given by (4)) required to make buyers believe that the entrant's quality will be high. Therefore, if the incumbent provides "enough" consumer surplus, entry will be impossible. In a simple case we can derive an explicit formula for the height of this entry barrier: the extent to which the entry-preventing level u^{**} of u^* falls short of the maximum attainable social surplus.

Assume that all buyers value the good equally and that each buys one unit per unit of time and values it at $v(H)$ if $q = H$.[18] There is a unit mass of buyers. The incumbent provides a flow of surplus that we write as u^*, perhaps because he provides high-quality goods at a price $v(H) - u^*$. We write $s(x)$ for the second-period sales of an honest entrant who sold x in the first period; two extreme assumptions[19] would be $s(x) = x$ (individual buyers learn quality, but their information is not passed on) and $s(x) = 1$ for all $x > 0$ (all buyers learn the entrant's quality, although only some buyers tried it in the first period). Each of the $s(x)$ buyers in the second period is willing to pay up to $v(H) - u^*$ for the entrant's product, until the incumbent responds: this is the price at which a fully informed buyer is indifferent between the two suppliers.

The present value (at time zero) of an honest entrant's profit in the second period is

$$w_2' s(x)(v(H) - [c(s(x), H)/s(x)] - u^*), \tag{6}$$

where w_2' is the value at time zero of a unit of cash flow, lasting from the beginning of the second period until competition from imitators or incumbents reduces profits to zero.[20] Define $f' = w_2'/w_1$.

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[17] This would be true if $\Pi_2(x)$ is relatively independent of x (information diffuses rapidly among buyers), but $\Delta c(x)$ increases significantly with x (*marginal* cost increases with quality).

[18] And at a negative value if $q = L$.

[19] Suppose, for example, that each first-period buyer passes on his information to n other randomly selected contacts. Then if first-period sales are x, the probability that a given (potential) buyer knows the entrant's quality is $s(x)$, where $1 - s(x) = (1 - x)^{n+1}$. When $n = 0$, we get $s(x) = x$; as $n \to \infty$, we get $s(x) = 1$ for all $x > 0$.

[20] If buyers learn the entrant's product quality at time T, and the incumbent responds at time $T' > T$ so vigorously that the entrant's profits become zero, then $w_2' = (1 - e^{-r(T'-T)})e^{-rT}/r$ and

$$f' = w_2'/w_1 = (1 - e^{-r(T'-T)})/(e^{rT} - 1).$$

The entrant's temptation to reduce quality is

$$w_1 \Delta c(x). \tag{7}$$

From (6) and (7) we see that the entrant will set $q = H$, provided that

$$f'[s(x)/x](v(H) - c(s(x), H)/s(x) - u^*) \geq \Delta c(x)/x. \tag{8}$$

In particular, *if average costs are constant (given q) and if s(x) is proportional to x, then x will not affect the quality choice.* In other cases, x may affect quality incentives, and perhaps could be used to influence buyers' expectations of quality: see Section 4 below. For now, we focus on the proportional case. Writing s for the constant [21] $s(x)/x$, and $c(q)$ for $c(x, q)/x$, we denote the condition for $q = H$ as

$$f's(v(H) - c(H) - u^*) \geq c(H) - c(L). \tag{9}$$

We ask for the level of u^* such that entry will be impossible, i.e., such that any entrant will be expected to be dishonest. The critical entry-preventing level, which we call u^{**}, is[22]

$$u^{**} = v(H) - c(H) - (1/f's)(c(H) - c(L)). \tag{10}$$

Since the available social surplus is $v(H) - c(H)$, this implies the following proposition.

Proposition 2. The incumbent(s) can extract excess profits, or sustain inefficiency, to the extent of $(1/f's)(c(H) - c(L))$.

This entry barrier decreases with the relative importance of the part of the future in which the entrant's quality is known and profits can be earned, f', and with the rate of transmission of information among buyers, s. It increases with the cost difference $(c(H) - c(L))$, which represents the attractiveness of "cheating."[23]

4. First-entrant advantage

■ Fisher, McGowan, and Greenwood (1983), in their analysis of barriers to entry, point out that, where reputation is important (as it generally is in experience-good markets), firms with established reputations may well command a price advantage over entrants. To them, however, this is not an entry barrier, because the established firms themselves had to build their reputations.

In the present model, however, we see from (9) that if u^* is small, then it is relatively easy to persuade buyers that quality will be high. Moreover, a first entrant who can choose the level of surplus that he offers to buyers can prevent subsequent entry and thus make w_2, and hence f, large. This gives him an added advantage in overcoming the moral-hazard problem.

The more surplus is available in the *status quo* (whether buying from the incumbent or not buying in this market at all), the harder is entry. This means that the first entry into an industry is easier than subsequent entry: the first entrant is competing only with "not buying," while later entrants are competing with the first entrant's offering. This gives the

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Thus, f' becomes small as $T \to \infty$ and as $(T' - T) \to 0$.

If competition will reduce profits, but not to zero, then we define w_2' as the number such that the present value of the second-period profits is as given in (6).

[21] Since $s(x) \leq 1$, we cannot literally have such a constant relationship if $s > 1$. If we think, however, of entry as occurring (realistically) with a relatively small market share x, then this may be a fair approximation.

[22] We assume that u^{**}, as given in expression (10), is less than $v(H) - c(H)$. If not, then the incumbent can extract the whole surplus $(v(H) - c(H))$ without inducing entry.

[23] In a model with more than two possible qualities, "buyer protection" laws that prohibit low-quality items will lower the entry barrier in the high-quality market. This is so since "cheating" becomes less attractive if the permitted ways to cheat save less on production costs. See Shapiro (1983).

first entrant an advantage, and there is an entry barrier in the sense that later entrants face an obstacle that the first entrant did not.

Intuitively, if the *status quo* consumer surplus is high, then an entrant must also provide high consumer surplus if he is to succeed. Because there is relatively little room for mutually advantageous arrangement between him and the buyers, he will make relatively little profit this way. The extra profit available in the first period by cheating (which does not become small as the incumbent's provision of consumer surplus approaches the optimum) is therefore more attractive than if it were set against the prospect of higher profits later.

5. Scale and introductory offers as quality commitments

■ In this section we ask whether x can be used by an entrant to "reassure" buyers as to his product quality. We begin by recalling from above our negative observation on this.

□ **No commitment possible under constant returns.** If both $c(x, q)$ and $\Pi_2(x)$ are proportional to x, then either (4) holds for all x or it holds for no x: the scale of entry does not affect quality incentives. Since first-period price does not appear in (4), introductory offers can affect (4) only through x, and so introductory offers cannot be quality commitments.

Proposition 3. If costs are proportional to output, and if future profits are proportional to first-period sales, then scale of entry and introductory offers cannot be quality commitments.

Next, we ask how deviations from the "proportionality" assumptions may make scale of entry into an indicator of quality. Either small- or large-scale entry may indicate quality.

□ **Small-scale entry as a quality commitment.** If $\Pi_2(x)$ grows less rapidly with x than does $\Delta c(x)$, then (4) holds for all x less than some critical value x^*. This is the case if second-period profits depend little on the initial scale of entry,[24] while marginal production costs are higher for high quality. In that case the entrant can commit to high quality by entering at a small scale $x \leq x^*$. The cutoff level x^* is defined by $\Delta c(x^*) = f\Pi_2(x^*)$, so it increases with f and with factors that increase Π_2, and decreases with factors that increase Δc.[25] Other things being equal, an entrant can "convincingly" enter at a larger scale if higher quality does not much affect costs, or if competitive response will be slower.

□ **Large-scale entry as a quality commitment.** If $\Pi_2(x)$ grows more rapidly with x than does $\Delta c(x)$, however, then large-scale entry will act as a commitment to quality. This case seems less plausible than the opposite case treated above, but it is possible. For example, suppose that large-scale entry will preempt subsequent entry (if quality is high), while small-scale entry will allow more competition later. Then large-scale entry becomes a commitment to quality. This case can also occur if information diffuses slowly and the cost difference between high and low quality is primarily in fixed cost. Then $\Pi_2(x)$ grows more rapidly with x than does $\Delta c(x)$.

□ **Introductory offers.** We have seen how the scale of entry can affect quality incentives, so that scale may be used strategically to assure buyers of quality. How does this relate to introductory offers?

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[24] For example, suppose that information spreads rapidly among buyers. Then $\Pi_2(x)$ is almost independent of x.

[25] We have $dx^*/df(\Delta c' - \Pi_2') = \Pi_2(x^*)$, where primes denote differentiation with respect to x^*, and functions are evaluated at x^*. Using the equation that defines x^*, we see that if Δc increases (proportionally) more rapidly than Π_2 with x^*, then dx^*/df is positive.

If buyers are not all alike, then some will be more and others less ready to buy from an entrant. Thus, a low introductory price will increase the scale of entry. Introductory offers can therefore affect x; and we have seen that x can affect quality choice.

It might be thought that lowering the introductory price until dishonest first-period profits become zero will make buyers believe in honest quality. Lowering the introductory price does make dishonest entry less attractive; but it also makes honest entry less attractive by the same amount, and thus does not affect the incentives for honesty. The fact that first-period price does not appear in (4) shows that a pure sacrifice of first-period profits, for instance by introductory offer, does not change quality incentives.

A pure sacrifice can, however, signal something exogenous that relates to quality. In the model of Milgrom and Roberts (1986), quality is exogenous, and high-quality producers are more profitable than low-quality producers. Hence, a sacrifice of profits (by introductory offer or by costly and otherwise useless advertising) can convince buyers that quality is high. In Farrell (1984), entrants differ in some other unobservable attribute, such as cost structure or discount rate, that will affect the quality decision. In some cases a sacrifice of profit shows "good news" about that attribute and thus makes a choice of high quality more likely. For instance, if variations that make profits higher, such as lower discount rates, also make (4) more likely to hold, then profit sacrifices are desirable signals.

We have seen that introductory offers do not in themselves affect an entrant's quality choice incentives, and our analysis also suggests that any effect that operates through the scale of entry would be adverse (the increase in first-period sales worsens the moral-hazard problem). Therefore, any explanation of introductory offers in terms of assuring rational buyers about the seller's incentives must depend on an incomplete-information argument. Introductory offers may constitute a signal, but they cannot act as a commitment.

6. Conclusions

■ Moral hazard in product quality can create a barrier to entry. Even though an entrant could make positive profits by entering with high-quality products (the socially efficient choice), he may be able to make even higher profits by fly-by-night entry—producing low-quality products and leaving the market once buyers discover the fact. If buyers are aware of this possibility, however, they may refuse to buy from an entrant, and then even entry with high-quality products will be impossible.

An incumbent can strategically exploit this moral-hazard problem faced by entrants—even if he is making excess profits, if he cannot respond instantly to entry, and if there are no sunk costs of entry. The reason is that buyers, quite rationally, are reluctant to buy from a hit-and-run—which means fly-by-night—entrant.

The moral-hazard problem is more severe, and so entry is harder, the higher is the level of consumer surplus offered by the incumbent. As a result, there is a *first-entrant advantage:* the first entrant into an industry faces a less severe moral-hazard problem than do subsequent entrants. In this sense reputation can be an entry barrier.

Introductory offers, considered as pure sacrifices of profit, cannot affect quality incentives, although they may signal something that is related to quality choice. The scale of entry may, however, affect quality incentives. The most plausible case is that in which an entrant must enter at a small scale to convince buyers that his quality will be high. This may conflict with the need to keep costs down (where there are economies of scale) by entering at a large scale. Pricing strategy in the first period of entry may to some extent reflect such a commitment motive.

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