The Nature and Scope of Contestability Theory
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THE NATURE AND SCOPE OF CONTESTABILITY THEORY

By MARIUS SCHWARTZ

I. Introduction

TRADITIONAL economic thinking holds that some form of policy intervention may be required to check monopolistic behavior when buyers are numerous and sellers are few due to economies of scale. The proposed remedies, however, regulation, public ownership or antitrust, are acknowledged to suffer significant drawbacks. Contestability theory maintains that the dilemma need not arise, because the threat of new entry may be sufficient to discipline incumbent firms. In the extreme, benchmark case of perfect contestability, threat of entry ensures satisfactory performance regardless of the size distribution of incumbent firms and regardless of any oligopolistic interactions among them. More generally, contestability theory shifts attention away from structural measures of market power (such as concentration ratios) and from the nature of oligopoly interactions towards variables that affect the ease of entry and exit. The theory, therefore, has wide-ranging implications both for policy and for economists' research agenda.

The burgeoning literature has sprung off in different directions. Theoretically, it has been questioned whether perfect contestability is logically possible (Weitzman, 1983; Baumol, Panzar and Willig (BPW hereafter), 1983a), whether the theory is robust (Schwartz and Reynolds, 1983; BPW, 1983a; Schwartz and Reynolds, 1984; Farrell, 1984), and what happens when uncertainty is introduced (Brock, 1983; Appelbaum and Lim, 1985). The empirical plausibility of perfect contestability has been questioned in both the single product (Dixit, 1982; Shepherd, 1984) and multiproduct context (Tye, 1984b). And a growing literature is attempting to test the theory both experimentally (Coursey *et al.*, 1983a, 1983b; Harrison, 1984; Harrison and McKee, 1985) and using market data (Call and Keeler, 1985; Froeb and Geweke, 1984; Morrison and Winston, 1985).

The wide diversity of issues addressed, though interesting, threatens to obscure what points are truly fundamental. Perfect contestability, the commonly discussed case, is advanced by the theory's proponents only as a useful theoretical benchmark. As I see it, the key unsettled issues are what is meant by imperfect contestability and whether many actual markets are imperfectly contestable. These issues are addressed in Sections II and III. Section IV considers the different tack recently taken by contestability

The views expressed here do not purport to represent those of the U.S. Department of Justice. Helpful suggestions were received from Henry McFarland, Ted Keeler, Lois Makowski, Tom McCool, Bob McGuckin, Bob Reynolds, Bert Smiley, Jim Tybout, Greg Werden, Cliff Winston, and especially William Baumol, Tim Brennan and Earl Thompson.

authors, that incumbents' pricing may be constrained not by the threat of hit-and-run entry but by the threat of entry through long-term contracts. Before turning to these issues it is useful to clarify what contestability theory says and place the theory in historical context.

In a contestable environment all firms have access to the same technology. The only entry "barrier," therefore, is the fear of price reactions by the incumbent firms. But this fear is removed if exit from the market is costless, as under perfect contestability, because then an entrant can hit-and-run before incumbents can change price. To prevent costless hit-and-run entry incumbents must set price where average cost intersects market demand, which maximizes welfare subject to a breakeven constraint.

The threat of hit-and-run entry is the linchpin of contestability theory. Note that the operative force is threat of entry not actual entry. This distinction is often overlooked, but the radical implications of contestability hinge on threat of entry. To illustrate, suppose contestability is taken to mean that actual entry will occur fairly rapidly if price is set high. In gauging the market's performance at any point in time, the number and size of existing sellers and the interaction among them will be the only relevant variables—potential entry becomes irrelevant. Moreover, if the market cannot profitably accommodate another entrant, due to scale economies and the nature of the oligopoly interaction, entry will be followed by some firm's exit and another period of high prices. Finally, if both firms are active, productive efficiency is sacrificed when the technology is a natural monopoly. In short, the disciplining effect of potential entrants is weaker, less predictable, and less efficient when actual entry—rather than threat of entry—must be invoked. Perfect contestability therefore is a theory of threatened hit-and-run entry and predicts that, barring errors, an incumbent will deter such entry by setting a low price. These observations should be borne in mind as we evaluate the various attempts to test the theory.

A natural objection if that costless hit-and-run entry is impossible in the scale economy markets on which contestability focuses, since scale economies typically derive from fixed costs whose presence is likely to make exit costly. It is here that contestability proponents offer a valuable insight: fixed costs need not be sunk. A fixed cost reflects the indivisibility of some input; it cannot be reduced by reducing output partially but might be avoided by complete shutdown. To illustrate, the cost of railroad tracks is both fixed and sunk, whereas the cost of a locomotive is fixed but avoidable by moving the equipment elsewhere. The feasibility of hit-and-run entry must therefore be acknowledged, at least as a theoretical possibility.

The basic idea that threat of entry may constrain pricing in concentrated industries has long been recognized. The voluminous "limit pricing" literature dating at least to Bain (1949) makes precisely this point. In this literature, potential entrants are assumed to expect that, should they enter, incumbents will maintain constant either their pre-entry price (Gaskins, 1971) or quantity (Bain, 1956; Modigliani, 1958; Sylos-Labini, 1962). The constant price expectation was generally attributed to fringe entrants as in Gaskins.[1] Where entrants must enter on a large-scale, due to scale economies, the constant price expectation was deemed unreasonable—since it would require a completely offsetting output reduction by incumbents. The alternative "Sylos expectation" was invoked—that the incumbent would maintain output constant. Both types of models fell, somewhat misleadingly, under the heading of "limit pricing." The common prediction is that price will be lower and quantity higher that in the absence of threat of entry.

A powerful criticism of this body of thought is that quantity and, especially, price are fairly easy to change. A potential entrant therefore will not learn much about the profitability of entry by observing the pre-entry levels of these variables but should instead look to the oligopoly interaction expected to prevail post entry (Bain, 1949; Needham, 1969; Spence, 1977). Recognizing this, incumbents will ignore the threat of entry and set price as high as the interaction among them permits.[2] This observation led to a change in course of the entry deterrence literature. Pre-entry price was deemphasized and preemptive investments were stressed, since those cannot be undone rapidly should entry occur and thus constitute credible deterrents (Wenders, 1971; Osborne, 1973; Spence, 1977; Friedman, 1979; Dixit, 1979, 1980; Salop, 1979; Eaton and Lipsey, 1980; Schmalensee, 1979; Gilbert and Newberry, 1980). The predictions of this "capital-commitment" literature regarding the effect of threat of entry on price and welfare differ markedly from those of contestability theory. Earlier writers, then, recognized that price might be kept low to deter entry but dismissed this possibility by implicitly assuming that price can be adjusted easily.

Even if capital too can be adjusted easily in some absolute sense, threat of entry need not constrain price. What matters is the relative cost of adjusting capital versus price. Section II shows that no matter how easy it is to exit the market, rapid price responses can always render threat of entry irrelevant to incumbents' pricing. Whether they do is an empirical question addressed in Section III, where I consider how the question should be addressed, evaluate some studies that use market data, and criticize the

[1] Implicitly, a fringe firm is viewed as being so small (due to sharply increasing marginal costs) that a large established firm finds it unprofitable to observe and react to its actions. Any one fringe firm therefore is correct in ignoring its own effect on price. However, it should not ignore the collective effect of the entire group of fringe firms. Thus, in Gaskins' model the incumbent selects a price path designed to optimize the rate of fringe entry and along this path price either rises or falls monotonically, yet each entrant takes current price as a proxy for future price. Any fringe firm's price expectation, therefore, is not consistent with the actual price solution.

[2] Recently, models of asymmetric information have been developed where incumbents reduce price in order to portray their costs or market demand as lower and lead entrants to underestimate the profitability of entry (e.g., Milgrom and Roberts, 1982; Saloner, 1982; Matthews and Mirman, 1983). These signalling models have their own shortcomings (Engers and Schwartz, 1984) but, in any event, the bulk of the limit-pricing literature as well as contestability do not feature asymmetric information.

experimental approach. Section IV scrutinizes the effectiveness of threat of entry through long-term contracts (rather than hit-and-run). I conclude in Section V that contestability theory has only limited scope.

II. Ease of entry and exit and the role of rapid price responses

A. *Exit-lag approach*

Consider an incumbent firm and a potential entrant that can produce a homogeneous good with identical cost functions $C = cq + F$ where q is output, c is the constant marginal cost and F is a positive fixed cost incurred at entry (depreciation is ignored for simplicity). Demand is stationary and known. The incumbent sets a price p at time $-E$ and there is an entry lag of length E. If entry occurs at time 0, the incumbent cannot respond by changing price until time T. During this price-response lag the entrant can capture the entire market by matching (or just undercutting) p. After time T the incumbent can change price, hence the entrant faces a duopoly interaction if he stays in the market. We are interested in how threat of entry affects p.

Let $\pi(p)$ denote a firm's operating profit stream, the difference between revenue and variable cost, if it serves the entire market at price p. Assuming an infinite horizon, the "competitive price" p^c is the steady-state price which yields a monopolist zero net profit, $\pi(p^c) = rF$ where r is the competitive interest rate. The monopoly price is denoted p^m.

The incumbent can pursue one of two strategies: exploit the entry lag E and accept entry, or deter entry. If he accepts entry, obviously he sets $p = p^m$ from $-E$ to 0 and loses all sales from 0 to T. If he deters entry, he sets p forever at the entry-deterring level p^*. Which strategy is more profitable depends on the value of p^*, which in turn depends on how easy it is to exit the market.

Schwartz and Reynolds (1983) represented the exit process by assuming that the entrant can leave the market after time $X > 0$ and recover the entire fixed cost F but if he leaves before time X he recovers nothing. The exit lag X is analogous to the Marshallian "short run," the period over which fixed costs cannot be recovered. A shorter exit lag means that exit from the market is easier, making it easier to hit-and-run.

Let π^d denote the entrant's duopoly profit stream if both firms stay in the market beyond time T. Two conditions are necessary (though not sufficient) to make the incumbent choose to deter entry: (1) $\pi^d < rF$ and (2) $T < X$. This is because for any $p > p^c$, hit-and-stay entry is profitable if $\pi^d \geqslant rF$ while hit-and-run entry is profitable if $T \geqslant X$. Thus, if (1) or (2) fails the incumbent must set $p \leqslant p^c$ to deter entry, but instead he would certainly choose p^m and exploit any positive entry lag.

Given $\pi^d < rF$, the entrant's dominant strategy is to exit the market at time X under out assumption that at time X he can fully recoup F. (The model in II.B allows for sunk cost and thus admits the possibility of hit-and-stay being more profitable strategy than hit-and-run.) The entrant's present value as a function of the incumbent's price p, $V(p)$, can be expressed as a weighted sum of net profit streams during the hit period, 0 to T, and the duopoly period, T to X:

$$V(p) = [\pi(p) - rF] \int_0^T e^{-rt} \, dt + [\pi^d - rF] \int_T^X e^{-rt} \, dt$$

Assuming purely for convenience that entry requires strictly positive present value, entry is deterred by setting p to yield $V(p) \leqslant 0$.

How high can p be set while maintaining $V(p) \leqslant 0$? This depends on the price-response lag T. To dramatize how swift price responses can negate a short exit lag, Schwartz and Reynolds (1983) considered the case of instantaneous reaction, $T = 0$. Then $V(p) \leqslant 0$ for any p, hence the incumbent will set $p = p^m$ and deter entry. But this result, that monopoly pricing is consistent with deterring entry, obviously does not hinge on $T = 0$, i.e., on price response being instantaneous. Since $\pi^d < rF$ and $\pi(p^m)$ is bounded, $V(p) \leqslant 0$ provided the weight on $\pi(p^m) - rF$ is sufficiently small. Thus, for any $X > 0$ there exists a $T < X$ that enables p to be raised all the way to p^m while deterring entry. More generally, for suitable combinations (T,X) in the range $0 < T < X$ the entry deterring price is anywhere in the range $(p^c, p^m]$.

B. *Sunk-cost approach*

Instead of assuming a positive exit lag, BPW (1983a) propose an alternative representation of imperfect contestability. In their approach exit can take place anytime but a fraction $s \in [0,1]$ of the fixed cost F is lost if exit occurs. Holding c and F constant and letting s approach 0 means that scale economies remain unchanged but the fixed cost that gives rise to them becomes less sunk. This makes exit easier hence the market more contestable. BPW argue that, for any positive price response lag, the entry-deterring price decreases monotonically as s decreases. Neither representation of the exit process, exit lag or sunk cost, is clearly superior; the degree of sunk cost generally increases with exit speed and both variables, sunk cost and exit speed, can influence a potential entrant's profit. It is useful to show, therefore, that nothing substantial hinges on how the ease of exit is modelled.

If the entrant leaves the market at time T, when the incumbent can change price, he recovers $(1 - s)F$. If he stays, there follows a duopoly interaction. Any duopoly interaction is allowed, including temporary shutdown by either firm. This duopoly phase is summarized by an operating profit stream to the entrant whose time-T present value is commonly known

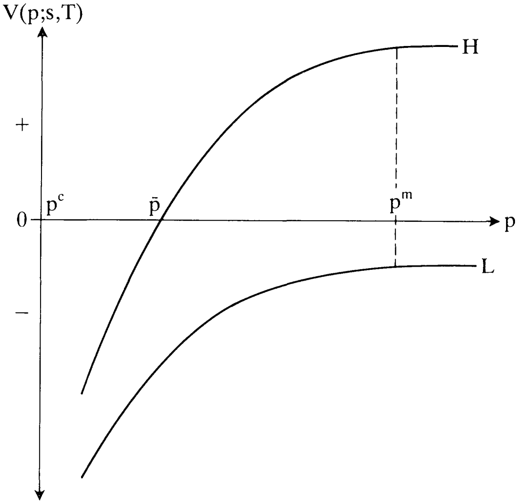

FIG. 1

and denoted $V^d \geqslant 0$. Since the entrant can choose hit-and-run or hit-and-stay, his present value at time 0 is

$$w_1\pi(p) + w_2 \max[(1-s)F, V^d] - F, \qquad w_1 = \frac{1-e^{-rT}}{r}, \qquad w_2 = e^{-rT}. \quad (1)$$

Hit-and-run entry (weakly) dominates hit-and-stay if $V^d \leqslant (1-s)F$. In cases where entry deterrence is chosen, $V^d < F$. Therefore, the above inequality is strict for $s = 0$ and must hold for some $s \in (0,1]$. Assume initially that $V^d = 0$, so hit-and-run entry dominates for all values of s. Later I consider $V^d \in (0,F]$ and allow hit-and-stay to be the more profitable entry strategy.

1. *Hit-and-run entry*[3]

From equation (1), under hit-and-run the entrant stands to earn

$$V(p, s, T) = w_1\pi(p) + w_2(1-s)F - F, \qquad w_1 = \frac{1-e^{1rT}}{r}, \qquad w_2 = e^{-rT} \quad (2)$$

where F has been suppressed as an argument because it is constant throughout and T affects V through w_1 and w_2: $T = 0$ implies $w_1 = 0$, $w_2 = 1$ while $T = \infty$ implies $w_1 = 1/r$, $w_2 = 0$, and for $T \in (0, \infty)$ we have $\partial w_1/\partial T > 0$, $\partial w_2/\partial T < 0$. The incumbent wishing to prevent hit-and-run entry chooses the p closest to p^m subject to $V(p) \leqslant 0$. Let p^* denote this value of p. There are two cases, illustrated by the two curves in Fig. 1. The curves

[3] This section draws on Schwartz and Reynolds (1984).

reflect different values of s and T. Both curves reach their maximum at p^m and remain at this level for $p > p^m$, because the entrant will never charge more than p^m. For curve L, $V(p^m) < 0$ so the incumbent ignores threat of hit-and-run entry and $p^* = p^m$. For curve H the entry threat is binding so $p^* = \bar{p}$, the price which yields $V(p) = 0$. Consider this case first.

Substituting $V(p) = 0$ in (2) and rearranging gives

$$\bar{p} = p \colon \pi(p) = rF\left(1 + \frac{s}{e^{rT} - 1}\right). \tag{3}$$

Under perfect contestability, $T > 0$ and $s = 0$. From (3), $\bar{p}$ is then given by $\pi(p) = rF$, i.e. $\bar{p} = p^c$, the zero-profit price. (In Fig. 1, the profit curve would pass through the origin.) Under imperfect contestability exit is costly, $s > 0$; thus, for $T \in (0, \infty)$ $\bar{p} > p^c$ and

$$\frac{\partial \bar{p}}{\partial s} = \frac{rF}{(e^{rT} - 1)\pi'(p)} > 0 \tag{4}$$

since $\pi'(p) > 0$ for $p < p^m$. In terms of Fig. 1, a reduction in s would shift curve H down, hence shift $\bar{p}$ to the right. The monotonic relationship between $\bar{p}$ and s underlies BPW's (1983a) argument that contestability theory is "robust."

In a technical sense, this robustness claim is correct. Provided price response is not instantaneous, $T > 0$, there is *some* neighborhood of $s = 0$ in which the entry-deterring price rises continuously and monotonically above p^c as s increases. However, this neighbourhood can be *arbitrarily small* and for values of s outside this neighborhood price is unconstrained by threat of entry. To see this, recall that the incumbent's price is

$$p^* = \begin{cases} \bar{p} & \text{if} \quad V(p^m) > 0 \quad \text{(entry threat binding)} \\ p^m & \text{if} \quad V(p^m) \leq 0 \quad \text{(entry threat not binding).} \end{cases} \tag{5}$$

$V(p^m)$ depends on s and T. Let $\bar{s}$ be the fraction of sunk cost that, given T, makes hit-and-run entry just unprofitable when the incumbent charges the monopoly price

$$\bar{s} = s \colon V(s; p^m, T) = 0.$$

Since $\partial V / \partial s > 0$, for $s < \bar{s} V(p^m) > 0$ and for $s \geq \bar{s}$ $V(p^m) \leq 0$. Thus, using (5),

$$p^* = \begin{cases} \bar{p} & \text{if} \quad s < \bar{s} \\ p^m & \text{if} \quad s \geq \bar{s}. \end{cases} \tag{6}$$

Figure 2 shows two $p^*(s)$ curves, OAC and OBC. Each has some range, $s > \bar{s}$, over which equilibrium price declines as s decreases and the market becomes more contestable. But the range for OAC, $s < \bar{s}_1$, is very small, so a small deviation from $s = 0$ is sufficient to make the threat of entry irrelevant and yield the monopoly price. It is in this sense, a low value of $\bar{s}$

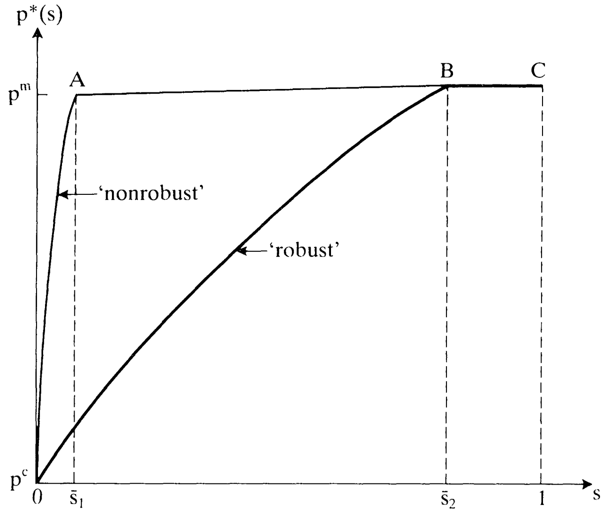

FIG. 2

rather than the shape of the p^* function from 0 to $\bar{s}$ (contrast Shepherd, 1984), that I view contestability theory as nonrobust. After briefly showing that a low $\bar{s}$ also makes hit-and-stay entry unprofitable, I provide some numerical examples showing that in practice $\bar{s}$ is likely to be low.

2. *Hit-and-stay entry*

From (1), the entrant's present value under hit-and-stay entry is

$$Y(p) = w_1\pi(p) + w_2V^d - F.$$

So far I assumed $V^d = 0$ so that hit-and-run always dominated hit-and-stay. Assume now $V^d \in [0, F)$ so that $V^d = (1-s)F$ for some $s^* \in (0, 1]$. If $s^* \geqslant \bar{s}$, hit-and-stay entry can be ignored because it is unprofitable even if the incumbent charges p^m: $Y(p^m) = V(p^m, s^*) \leqslant V(p^m, \bar{s}) = 0$, the inequality because V decreases in s. Thus, if $s^* \geqslant \bar{s}$ the preceding hit-and-run analysis continues to apply, with $p^* = \bar{p}(s)$ for $s < \bar{s}$ and $p^* = p^m$ for $s \geqslant \bar{s}$.

If $s^* < \bar{s}$ the above inequality is reversed and hit-and-stay entry both is profitable at p^m and dominates hit-and-run for values $s > s^*$. For values $s \leqslant s^*$ hit-and-run dominates. To deter both entry strategies the incumbent therefore sets: $p^* = \bar{p}(s)$, as before, if $s < s^*$; but if $s \geqslant s^*$ he now sets a lower price, $p^* = \bar{p}(s^*)$.

The possibility of hit-and-stay entry, therefore, modifies the conclusions reached for hit-and-run entry only if $s^* < \bar{s}$. Recall, however, that the value $s^* = 1 - V^d/F$ is independent of the price response lag T, while $\bar{s} \to 0$ as $T \to 0$. Therefore, for sufficiently small T, $s^* \geqslant \bar{s}$ and hit-and-stay entry, like hit-and-run, is unprofitable even at the monopoly price.

TABLE 1
Values of $\bar{s}$

	$T=0.1$ *year*				$T=0.5$ *year*		
		r/*year*				r/*year*	
r^m/r	0.1	0.2	0.3	r^m/r	0.1	0.2	0.3
1.5	0.005	0.01	0.15	1.5	0.026	0.053	0.081
2	0.01	0.02	0.03	2	0.051	0.105	0.162
3	0.02	0.04	0.061	3	0.103	0.21	0.324

3. *Examples*

The question now becomes: is the empirically expected value of $\bar{s}$ "low" or "high"? If for most reasonable parameter values $\bar{s}$ is low, most markets are likely to have values of s exceeding this threshold level and their prices will thus be unaffected by the threat of entry. Substituting p^m in (2), equating to 0 and rearranging gives

$$\bar{s} = \left(\frac{\pi(p^m)}{rF} - 1\right)(e^{rT} - 1). \tag{7}$$

In the scale-economy markets on which contestability focuses, rF is large relative to $\pi(p^m)$, which makes $\bar{s}$ relatively small. More importantly, rapid price responses can make $\bar{s}$ arbitrarily small: $s \to 0$ as $T \to 0$.[4]

To get a crude feel for just how small $\bar{s}$ is likely to be, interpret $\pi(p^m)/F$ as (approximately) the monopoly rate of return, r^m, and r as the competitive rate. Substituting in (7) gives $\bar{s} = (r^m/r - 1)$ $(e^{rT} - 1)$. Table 1 shows that $\bar{s}$ is low for most sensible parameter values. For example, if the monopoly rate of return is twice the competitive rate, the latter is twenty percent per annum, and the incumbent must wait over one month before lowering his price ($T = 0.1$), the incumbent can charge the monopoly price if as little as two percent of fixed costs are sunk.[5] As a whole, these examples suggest that contestability theory has very restricted applicability. The experience of the airline industry discussed in Section III reinforces this impression.

C. *Synthesis: rapid price responses and noncontestability*

The preceding two sections showed that, regardless of how easy exit is, in the class of cases where entry deterrence might be attempted, $V^d < F$, there

[4] In particular $s = 0$ if $T = 0$. From (6) this implies that if $T = 0$ then $p^* = p^m$ for any $s > 0$, which shows that in this model, as in the earlier Exit Lag model, instantaneous price responses enable the incumbent to ignore entry threats and set the monopoly price.

[5] For small rT, $e^{rT} - 1$· approximately equals rT. Therefore, $\bar{s}$ approximately equals $(r^m - r)T$. This approximation provides some indication how large $r^m - r$ must be or how long T must be to make $\bar{s}$ large enough for contestability theory to have significant applicability.

always exists a price response rapid enough to make the entry-deterring price p^* equal the monopoly price p^m. This is true whether the entrant contemplates hit-and-run or hit-and-stay. Intuitively, a rapid price response reduces the hit period and thus its contribution to present value.[6]

If the actual price response is not rapid enough to yield $p^* = p^m$, the incumbent must compare the profitabiltity of two strategies: set $p^* < p^m$ forever and deter entry or accept entry and set p^m during the entry lag phase. Setting p^m obviously becomes more attractive the longer is the entry lag. It also becomes more attractive the swifter is the incumbent's price response, because a swift response shortens the period over which his price is undercut and his sales driven to zero.[7]

To clarify the discussion of empirical evidence I adopt the following terminology: "perfect contestability" exists when threat of entry keeps a monopolist's price at p^c, imperfect contestability when $p \in (p^c, p^m)$, and "noncontestability" when threat of entry has no effect, $p = p^m$. Rapid price responses have been shown to cause noncontestability through the two

[6] Anderson (1984) uses a similar quick-response argument in a different context. He emphasizes the role of quick price responses in sustaining cooperative equilibria in repeated games where the payoff matrix has a prisoner's dilemma structure. He notes that as long as there is some cost of changing one's play between periods there always exists a period short enough—a quick enough price response—that makes deviation from the cooperative solution unprofitable.

[7] Ironically, if the entry-deterring price is p^c, because the entrant can costlessly hit-and-run, there always exists a swift price response that leads the incumbent to choose p^m and accept entry rather than choose p^c and deter. Since setting p^c forever yields zero profit, the incumbent would certainly set p^m until entry occurred if he could then exit instantaneously and costlessly. Therefore, a necessary condition for choosing p^c over p^m is that the incumbent cannot exit costlessly—so that if entry occurred he would remain stuck in the market with negative profit (zero revenue and an interest expense on the fixed cost). But this negative profit phase goes to zero as the price response lag goes to zero, making it more profitable to ignore threat of entry and set the monopoly price when the alternative is to set p^c forever.

The preceding discussion raises a paradox. If exit is frictionless to all firms—as under perfect contestability—the threat of hit-and-run entry will never constrain price, because the incumbent will price monopolistically to exploit any entry lag. The familiar perfectly contestable result, $p = p^c$, therefore requires that the incumbent (but not the entrant!) face both an exit lag and a price response lag. But then an equilibrium with positive output may not exist! Consider the exit-lag model and assume that entry cannot be deterred at p^c because duopoly profit $\pi^d > rF$. Assume also that the incumbent's exit lag exceeds his price response lag T. Deterring entry certainly would yield negative profit. The best alternative, setting p^m during the entry lag period and accepting entry, makes present values

$$\text{incumbent:} \quad w_0[\pi(p^m) - rF] + w_1[0 - rF] + w_2[\pi^d - rF]$$

$$\text{entrant:} \quad w_1[\pi(p^m) - rF] + w_2[\pi^d - rF] > 0.$$

where

$$w_0 = \int_{-E}^{0} e^{-rt}\, dt, \qquad w_1 = \int_{0}^{T} e^{-rt}\, dt, \qquad w_2 = \int_{T}^{\infty} e^{-rt}\, dt$$

For E sufficiently short and $\pi^d - rF$ sufficiently small, the incumbent's present value is negative. Anticipating this, no firm would enter the market in the first place for fear of becoming the incumbent. This implausible outcome arises because the entrant can undercut the incumbent's initial price and capture over half the market before the incument can react. The plausibility of such a hit period is discussed further in Section IV.

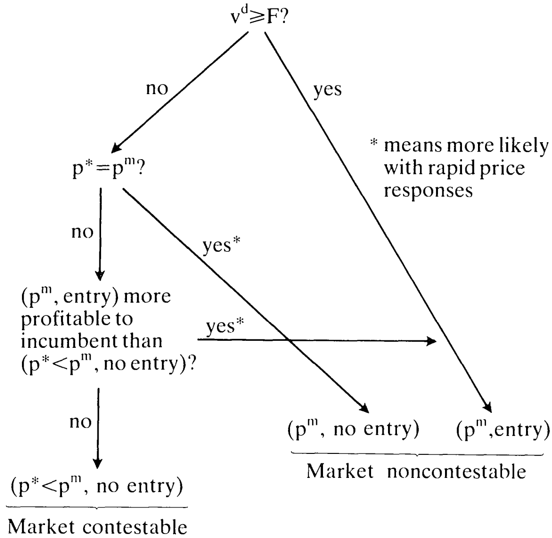

FIG. 3

channels shown in Fig. 3. First, they make the hit period short thereby reducing the potential hit profit, possibly to where entry can be deterred with $p^* = p^m$. Second, they reduce the incumbent's vulnerability if he sets p^m and accepts entry, making this strategy more attractive relative to deterring entry through $p^* < p^m$.

III. Empirical appraisal

A. *Testing for contestability*

To deal with the empirically-prevalent case of an initial oligopoly rather than monopoly, we must examine incumbents' joint profit-maximizing price rather than the actual price charged. For a monopolist the two prices coincide, but in oligopolies competition may keep actual price below the joint-maximizing level. Therefore threat of entry may constrain oligopolists' joint-maximizing price even if it does not constrain their current price. In such a case the market can nevertheless be viewed as imperfectly contestable because the entry threat constraint could become binding in future, if incumbents attempt to raise price.

Let p^m be the joint-maximizing price absent threat of entry, p^j the actual joint-maximizing price and p^c the zero-profit price. Perfect contestability implies $p = p^c = p^j < p^m$. This is empirically refuted for oligopolies by a positive correlation between profitability or price-cost measures and market concentration. The absence of such a correlation, however, does not prove perfect contestability. Interactions among existing producers may be sufficiently competitive across a range of concentration levels to yield competitive performance even if threat of entry were ignored.[8] That is, oligopolies can exhibit $p = p^c$ even if $p^j = p^m$.

Imperfect contestability is much more difficult to refute. If $p^c < p^j < p^m$, actual price p can vary between p^c and p^j according to the number of incumbents and competition among them, yielding a positive correrlation between profitability and concentration. This correlation need not refute imperfect contestability because we could still have $p^j < p^m$ in all the sample markets. Similarly, imperfect contestability is not refuted if oligopoly prices and profits are unaffected by variations in the number and costs of potential entrants (if these were possible to observe). Such variations could affect p^j, and the absence of correlation could mean merely that $p < p^j$ in all markets. If a correlation is present, however, imperfect contestability is supported. Ironically, while perfect contestability seems impossible to prove, imperfect contestability seems impossible to thoroughly disprove.

Nevertheless, suggestive evidence against imperfect contestability and for noncontestability is the occurrence of actual entry and a subsequent reduction in price. Such an observation indicates that entry prevention was either unsuccessful—due to mistakes—or was deemed unprofitable and not attempted. If the mistakes hypothesis can be dismissed, the inference is that threat of entry was ignored in setting price for reasons discussed in Section II.

B. *Market evidence*

Airline city-pair routes are often cited as a prime illustration of a contestable market (e.g., Bailey and Baumol, 1984). Although the fixed costs of planes are substantial relative to market demand (thus limiting the number of airlines on any route), the intrinsic mobility of airplanes between routes strongly suggests that entry and exit is considerably easier than in most industries. These structural conditions are conducive to contestability. But since deregulation airlines can respond quickly to entrants' price cutting.[9] Such rapid price responses can make the threat of entry irrelevant to incumbents' pricing, rendering the market noncontestable.

The available evidence points to noncontestability. Statistical cross-sections studies show a significant, positive correlation between concentration and profits in airline markets, refuting perfect contestability (see Call

[8] Another explanation for the absence of a correlation is that both monopoly pricing and superior efficiency are present in a given industry (Demsetz, 1973; Froeb an Geweke, 1984). However, this departs from the structural assumption of contestability that costs are identical.

[9] For example, Delta Airlines assigns 147 employees to track rivals' prices and select quick responses—on a typical day, comparing over 5,000 industry pricing changes against Delta's more than 70,000 fares. New fares filed the prior day with Air Tariff Publishing Co. are tracked by a Delta computer. "Secret" price changes that are deliberately withheld from the Air Traffic Publishing system for several days are tracked through local newspapers or calls to other airlines' reservation offices. Once Delta learns of a competitor's pricing move, it can put matching fare into its reservation system within two hours (Wall Street Journal, August 24, 1983).

and Keeler, 1984, which also provides a good discussion of previous studies). Moreover, new entry does occur and established carriers reduce their fares in response to such entry (Call and Keeler, 1984). In other words, prices are not kept low to deter entry. This evidence points against even imperfect contestability. As Bailey and Baumol (1984) concede, airline behavior has resembled that expected from rival oligoplists in standard analysis not from players in a perfectly contestable world.

Bailey and Baumol attempt to reconcile these results with contestability theory by arguing that the latter pertains to behavior in long run equilibrium, a situation the industry may not yet have reached. In particular, they argue that established carriers found it unprofitable to keep prices low and deter entry because (i) entrants may have enjoyed lower costs and (ii) entrants may have been unable to enter on a large scale. For these reasons, the more profitable strategy may have been to keep prices high initially and reduce them only gradually as entry occurred. Call and Keeler (p. 45) provide a powerful rebuttal: "Given that most *trunk* carriers (my emphasis) have roughly the same costs, and that their capacity is seemingly adequate for rapid entry into new routes, if the contestability hypothesis were correct, the entry of trunk carriers on to new routes would not affect trunk fares. Our statistical evidence goes against that hypothesis."

Morrison and Winston (1985) argue that while airline markets are not perfectly contestable they may be imperfectly contestable. Their testing methodology, conceptually correct, is to include as an explanatory variable of performance[10] not only the number of actual competitors on a route but also the number of potential competitors. They note that testing perfect contestability does not require this regression approach since it predicts no variation in the dependent, performance variable. Imperfect contestability, however, does allow for variation. They find both coefficients to be statistically significant, with that on actual competitors about four times as large. They interpret this as indicating that the airline industry is not perfectly contestable but is imperfectly contestable.

This evidence is interesting but the conclusion that airlines are even imperfectly contestable is premature. First, there is the unanswered question of why entry does occur (Call and Keeler) if prices are set to deter it. Second, Morrison and Winston find the coefficient on the number of potential entrants statistically insignificant until there are *at least* four potential entrants. One would expect precisely the opposite: the marginal effect of large potential entrants should decline rapidly after the first few. This pattern was in fact found in an experimental test of perfect contestability (Harrison, 1984). Morrison and Winston argue, however, that the measured number of potential entrants may overstate the actual number on

[10] Their performance measure is consumer surplus relative to the theoretical optimum rather than a profitablity measure, both types of measures are related to price so the distinction is not critical for our purposes.

a given route, since the same firms may be contemplating entry into other routes. A definitive interpretation of their results is probably premature.

Overall, the airline experience since deregulation weights against perfect contestability but is inconclusive regarding imperfect contestability. Airlines, however, are cited as structurally among the most conducive to contestability. If pricing behavior is ultimately found to be largely independent of threat of entry in airlines, contestability is unlikely to be a force in most concentrated industries.

A glimpse of evidence supporting this conjecture is found in Froeb and Geweke's (1984) study of the U.S. primary aluminium industry. Examining time series of profits and concentration, they found no feedback from concentration to profits, but significant negative feedback from profits to concentration. They interpet this as supporting contestability—in the sense that market performance is independent of structure and that profits caused by growing demand or falling costs will be only transient and induce entry. Contestability, however, should be interpreted as saying that threat of entry constrains price, not that actual entry will eventually eliminate profit. In fact, Froeb and Geweke's evidence suggests that price is not affected by threat of entry. First, they find that profits attract entry only after a lag of five years or more. This lag approximately equals the estimated time of construction of a new plant. Given such a long entry lag, it seems implausible that incumbents would find it more profitable to practice limit pricing than to set price high and accept entry. The actual occurrence of entry supports the latter hypothesis. Second, since profit is found to be unaffected by the number of actual competitors, it is difficult to believe that price was being held low to deter potential competitors.

Perhaps the most direct test of whether the threat of entry affects price is to consider situations where potential entrants' costs are reduced by an exogenous structural change such as the removal of a tariff or the expiration of a patent. If incumbents' price is not affected by a change unless actual entry occurs, the inference is of noncontestability. Shaw and Shaw (1977) performed precisely such a test for the West European polyester fiber industry following patent expirations and rejected the hypothesis of limit pricing (or contestability), finding that prices fell only after entry occurred.

C. *Experimental evidence*

Several authors have recently presented experimental evidence that they claim generally supports contestability theory. I offer the following observations. First, the evidence offered cannot be interpreted as favorable or unfavorable to contestability theory. Second, and more important, it is doubtful whether the entire experimental approach can contribute anything to appraising the empirical importance of contestability theory.

The work of Coursey, Isaac and Smith (1984, hereafter CIS) and Coursey, Isaac, Luke and Smith (1984, hereafter CILS) is representative of the experimental approach. CIS consider two firms with zero fixed costs and identical declining marginal costs. Each period the firms post prices simultaneously and buyers purchase from the lower-price seller. The results showed that in four of six experiments price declined monotonically to competitive levels. (There is a range of such prices since demand is discrete.) In the other two experiments, price was closer to competitive than to monopoly levels but remained above competitive levels. CIS characterize this as evidence for contestability theory.

CILS perform essentially the same experiment except that they introduce a small sunk cost in the form of a permit to serve the market for five periods. One firm, designated the incumbent, is forced to purchase two permits (through period ten) and the other is allowed to contest the market starting in period six after observing the incumbent's price for five periods. CILS find that in five of their twelve experiments both firms entered and price converged monotonically to or close to competitive levels. In two experiments there was tacit collusion—both firms entered and priced at noncompetitive levels. Four experiments revealed price oscillations, with price falling due to entry and then rising—either due to temporarily successful tacit collusion (both firms staying in the market) or one firm's exit from the market. In only one experiment was there a monopolist that kept price at competitive levels—the behavior predicted by perfect contestability.

Harrison (1984) correctly observes, however, that these experiments and others (e.g., Harrison and McKee, 1985) do not implement the key feature of the contestable market hypothesis: the existence of a price response lag for the incumbent which an entrant can exploit. Recall that both CIS and CILS have firms setting prices simultaneously, so that each does not know the other's current period price when choosing its own. Harrison reruns CIS's experiments but allowing the incumbent's price to be known to entrants before they choose their prices. The results, not surprisingly, are more competitive than in CIS, with prices almost always converging to competitive levels.

What do the above papers really show? CIS and CILS are tests not of contestability but of standard duopoly interactions: how two firms behave when prices are chosen simultaneously and marginal costs are decreasing. Noncooperative game theory predicts that there is no pure strategy equilibrium in this environment, with or without fixed costs. The theoretical expectation is for a mixed strategy equilibrium where each firm randomizes its price. The contradictory results of CIS and CILS are therefore interesting in themselves, but not informative about contestability.

Harrison's experiments basically do constitute a fair test of behavior under perfect contestability:[11] the incumbent faces a price response lag and

[11] The only caveat is that contestability theory is formulated assuming complete information whereas in Harrison's and other studies demand and rivals' costs are not always commonly known.

the entrant can hit-and-run costlessly. The real question, however, is not whether competitive results will emerge under perfectly contestable conditions but how often such conditions are likely to exist and what happens when they do not. In addressing the latter issue, I have assumed along with BPW that (i) the entrant's present value depends on both a hit phase and a duopoly phase and (ii) that the outcome in the latter can be captured in an expected profit term, V^d, that is common knowledge. Given these assumptions, the outcome is deterministic once parameter values are specified. The key issue is empirical: how rapid are price responses and how low are sunk costs. These questions cannot be answered experimentally.

IV. Contestability and long-term contracts

Rapid price responses eliminate the threat of hit-and-run entry. As an alternative constraint on incumbents' pricing, contestability authors have recently emphasized the threat of entry through long-term contracts (BPW, 1983a). The introduction of long-term price contracts converts contestability into Demsetz's (1968) "competition for the market" argument for a relatively *laissez faire* treatment of natural monopolists.

An obvious objection is that long-term price contracts are simply infeasible in many markets. The severe problems of enforcing quality and making the contracts optimally contingent on different future states, familiar from widespread experience with governmental price controls and price regulation, also plague long-term price contracts employed by private agents and help explain the infrequency of such contracts.[12]

Putting aside the above problems, there is a second objection that is both more subtle and more fundamental. When buyers are numerous and cooperation among them is prohibitively costly, free-rider behavior by individual buyers would foil an entrant's attempt to commit a large fraction of buyers to purchase from him at a given price. Since scale economies force the entrant to capture a large fraction of buyers in order to break even, contracting by an entrant would fail under conditions of scale economies and numerous, noncooperating buyers, And, as argued below, it is largely under such conditions that policy concerns with protecting buyers from monopolistic sellers arise in the first place.

First, suppose the entrant's strategy were to give buyers an unconditional price offer of $p^e \in [p^c, p^m]$, where p^c is the price at which the entrant's decreasing average cost intersects market demand and p^m is the incumbent's monopoly price. Since the offer is unconditional, buyers will inform the

[12] The fact that long-term pice contracts suffer from substantially the same problems as price regulation removes much of the bite from Demsetz's proposal (1968) of replacing price regulation of natural monopolies by franchise bidding for the right to serve the market at a fixed price. See, e.g., Williamson (1976).

incumbent of the offer in order to induce a lower counter-offer.[13] The incumbent will respond to the entrant's offer only if it becomes effective, that is, if at least one buyer has signed thereby ensuring entry. At that point the rational response is to undercut p^e to remaining buyers. Since some of his costs are sunk, the incumbent can profitably undercut any $p^e \geqslant p^c$ if only a few buyers have committed to the entrant. And the entrant will not capture more than a few buyers because each buyer will want to be part of the hold-out group that would obtain the lower price from the incumbent. The prospective losses from serving only a few buyers under the assumed scale economies will deter the entrant from ever making an unconditional price offer.

Now suppose the entrant can offer a price contract that is conditional on a minimum number of buyers accepting. If we grant the entrant the ability to make such conditional offers it is only natural to grant the same ability to the incumbent, in which case the rational incumbent again forestalls entry. Purely for simplicity, suppose that there are N identical buyers so we can speak interchangeably of the number $n \leqslant N$ that sign exclusively with the entrant and the quantity this implies. The entrant's offer is: p^e only if $n \geqslant k$ where the critical number specified, k, may be a function of p^e. If n is observable at all times (game theoretically, if buyers act sequentially), the incumbent can easily prevent entry by specifying an integer j, $1 \leqslant j \leqslant k-1$, and committing to undercut p^e if (and only if) $n \geqslant j$.[14] This ensures holdout once n reaches j.

Matters might seem trickier when n is observable only *ex post,* because then an individual buyer is uncertain whether j others have signed when making his choice (game theoretically, buyers are acting simultaneously). But suppose the incumbent commits to beat p^e if $n \geqslant j'$, $1 \leqslant j' \leqslant k-2$. Any buyer is better off holding out: if $k-2$ or less have signed, there will be no entry regardless of his choice; if $k-1$ or more have signed, the incumbent's superior offer is triggered.

Finally, it might be argued that the precise value of n is not observable even *ex post.* However, whether entry occurs or not reveals if $n \geqslant k$ or

[13] Implausible as it is for the entrant to temporarily capture the entire spot market before the incumbent can react, it is even more implausible to assume that he can do so in the marketing of long-term contracts. For the incumbent now has a much stronger incentive to observe and react to an entrant's pricing overtures. As Brock (1983) points out, it is ridiculous to argue that numerous individual buyers can react to these pricing overtures before the incumbent seller, whose stake is much higher. The argument in the text, however, works even if the incumbent is sluggish because individual buyers have an incentive to inform him of the entrant's offer.

[14] Making an offer that is obviously contingent on the entrant's actions may arouse antitrust suspicion, but the incumbent can give it a less predatory flavor by phrasing it as "I'll beat an entrant's price to my loyal x customers." Choosing $x = N - j$ produces the desired result.

Note that the incumbent may have to be commited to the counter offer, otherwise buyers may fear withdrawal of the counter offer if the entrant's offer fails. Such fears could prevent them from signing with the incumbent. However, we have assumed that the incumbent, like the entrant, can commit to contracts. Moreover, the commitment required is not harsh since by specifying a low j the incumbent can beat the entrant's price while remaining profitable.

$n < k$. (The latter must be observable at least to somebody otherwise it is meaningless to speak of a conditional contract.) The incumbent will offer to beat (or match) p^e only if $n \geq k$. This leaves a small incentive for any buyer to sign with the entrant, namely, the fear that if precisely $k-1$ others have signed his individual holdout would defeat the entry attempt (and thus also nullify the incumbent's counter offer). The incumbent can overcome this incentive by offering a lump sum, "loyalty bonus" B to his remaining customers if entry does occur.

Suppose the incumbent's offer is: p^m if $n \leq k-1$, (p^e, B) if $n \geq k$. Consider a buyer's decision. Letting m be the number of other buyers ultimately signing with the entrant, a buyer considers three possible states.

1. If $m \leq k-2$, entry fails regardless of his choice.
2. If $m = k-1$, entry succeeds only if he chooses the entrant.
3. If $m \geq k$, entry occurs regardless of his choice.

Let $U(p)$ denote the buyer's consumer surplus from buying the good at price p, and normalize $U(p^m)$ to 0. Let V^M and V^E denote the buyer's expected payoffs from signing with the incumbent and entrant respectively, and L_t the probability the buyer assigns to state t. Then

$$V^M = L_1 \cdot 0 + L_2 \cdot 0 + L_3(B + U(p^e))$$
$$V^E = L_1 \cdot 0 + L_2 \cdot U(p^e) + L_3 U(p^e)$$
$$V^M - V^E = L_3 B - L_2 U(p^e).$$

Since $U(p^e)$ is bounded, for any $L_3 > 0$ there exists a B that will make $V^M - V^E$ positive. Moreover, the requisite B will be "small" since L_2 will be "small": any one of numerous buyers will assign a negligible probability to his being the swing voter.

In short, for any contingent contract the entrant can propose, the incumbent can find a counter that will defeat the entry attempt. Recognizing the sure failure of his offer, a rational entrant would not make it in the first place given any cost of making it. Thus, as pointed out by Thompson (1984), without a mechanism to prevent buyer defection—a mechanism that implies buyer cooperation—there is no equilibrium constrained by competition for the market. Buyers as a group would, of course, prefer an entrant's bid to continue, but individual free riding precludes it. The problem would be absent if there were no economies of scale, because then an entrant's ability to offer a low price would not hinge on numerous buyers going along. Scale economies, however, coupled with noncooperating buyers, create a public good problem with its familiar free-rider incentives.

Scale economies notwithstanding, if buyers' collective purchasing power could be harnessed and offered as a block to the most favorable bidder, concern about seller exploitation of buyers would arise. Indeed, the opposite might be true. Buyers' ability to advance their interests might be excessive—as in monopsony situations. In such cases of "buyer cooperation," signing long-term contracts with entrants would be just one way to protect their interest, a probably inferior way as suggested by its infrequency. Alternatives include bargaining with an incumbent or paying an entrant's sunk cost to ensure the presence of two or more active sellers. But buyer cooperation is infrequently observed, because of the severe informational requirements involved in monitoring and enforcing the behavior of numerous agents. It is in those, rather typical cases of noncooperating buyers and few sellers that concern with monopoly behavior arise.

V. Conclusion

Although proponents of contestability carefully acknowledge the importance of rapid price responses by incumbent firms, this caveat is frequently overlooked. Structural conditions that make entry and exit easy, such as low sunk costs, are incorrectly taken as sufficient to ensure contestability. We have seen that the ability of incumbent firms to change price rapidly in response to entry can offset ease of entry and exit and make markets noncontestable in the sense that pricing behavior becomes unaffected by the threat of entry. Available empirical evidence indicates that this is typically the case.

Nor do long-term contracts salvage contestability. In conclusion, threat of entry is unlikely to be a reliable check on monopolistic behavior in most markets. My own view is that is was a mistake to try and extend contestability beyond the regulatory environment, where regulatory constraints on incumbents' pricing might have provided an explanation for sluggish price responses. The ensuing debate has been of value, forcing a rethinking of conditions implicitly required for competitive outcomes. But given its restricted empirical applicability, contestability theory should not significantly alter either our theoretical thinking about concentrated industries or our policy approach to such industries.

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