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Monopoly versus Competition under Uncertainty

Elie Appelbaum

Chin Lim

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MONOPOLY VERSUS COMPETITION UNDER UNCERTAINTY

by

Elie Appelbaum and Chin Lim

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I.   Introduction

A very well-known result, one which is incorporated into every intermediate microeconomics text is that, given similar demand and cost conditions, a competitive industry will produce a higher output (at a lower price) than a monopolist. Moreover, the existence of monopoly involves a deviation from marginal cost pricing and, therefore, leads to a welfare loss to society.

This result is, of course, not surprising since the point of reference is the "first best" world of competition with no imperfections.

In this paper, we compare monopoly and competition considering that the world is characterized by uncertainty and imperfect information and is, thus, imperfect. Given that such an imperfection exists and cannot be removed, we demonstrate that the traditional results may be reversed.

In particular, we show that given an exogenous demand uncertainty[1] which cannot be removed (diversified away), there exists several effects, all working to reduce the costs of uncertainty of the monopolist relative to those of the competitive industry. Thus even when production costs are similar, the "full costs"--production costs and costs of uncertainty--of a monopolist are generally lower than those of a competitive industry.

From a welfare point of view, it follows that, with uncertainty, monopoly is less undesirable than without uncertainty. Furthermore, within the environment of uncertainty, monopoly may turn out to be even more desirable than competition since competition under these conditions may in fact be further away from the unattainable first best position.

Our results raise questions as to the validity of the so-called Galbraith-Caves hypothesis[2] that monopolists take out some of their rents in the form of risk avoidance, or alternatively, that risk avoidance increases with market power. A corollary of our analysis is that the Galbraith-Caves hypothesis

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is in general not true[3] and it is in fact possible for a monopolist to exhibit less risk avoidance than a competitive firm.

Finally, we show that our results have some interesting implications with respect to the measurement of the degree of monopoly power.

In Section II we present the competitive industry model with demand uncertainty. In Section III we consider the monopoly's problem. Section IV provides a comparison of the two models and in Section V we consider the implications of our results.

II. The Competitive Industry

Consider a competitive industry facing a random market demand function

$$(1) \qquad p = p(q, \epsilon), \qquad \frac{\partial p}{\partial q} < 0, \quad \frac{\partial p}{\partial \epsilon} > 0$$

where p is price; ϵ is a random variable with probability density, $d\Psi(\epsilon)$;

$$(2) \qquad q = \sum_{i=1}^{N} q_i$$

is the aggregate industry output and q_i (i=1,...,N) is the output of the ith firm in the industry. We assume all firms to be identical in that they have an identical increasing concave utility function, $U(\cdot)$, a cost function, $C(\cdot)$, and a profit function $\pi(q_i) = p(q,\epsilon) \cdot q_i - C(q_i)$. These assumptions imply $q = Nq_i$.

As a simplification, we assume that the probability density function, $d\Psi(\epsilon)$, is sufficiently concentrated and compact so that we can approximate the expected utility function as[4]

$$(3) \qquad E[U(\pi)] = U(\bar{\pi} - \frac{1}{2} R(\bar{\pi}) q_i^2 \sigma^2)$$

where $\bar{\pi} \equiv E[\pi]$ is the firm's expected profit (E is an expectations operator); $R(\cdot) = \frac{-U''(\cdot)}{U'(\cdot)}$ is the Arrow-Pratt measure of absolute risk aversion which following Arrow (1965) is assumed to be decreasing in its argument so that $R'(\ ) < 0$; σ^2 is the variance of the price level; and $\frac{1}{2} R(\bar{\pi}) q_i^2 \sigma^2$ is the risk premium. As can be seen from (1), the absence of any further restrictions implies the variance of p is in general not constant but some function of q.

We, therefore, write $\sigma^2 = \sigma^2(q;s^2)$ with $\frac{\partial\sigma^2}{\partial s^2} > 0$, where s^2 is the __true variance__ of the distribution of ϵ.

In the short-run equilibrium, the number of firms, say N, is given, and the equilibrium firm size, q_i, is derived simply by maximizing expected utility (3). In the long run, however, where there is free entry, the number of firms and the size of each firm are endogenously determined as a solution to the competitive industry's long-run equilibrium conditions. Firstly, free entry leads to zero expected utility, $E[U(\pi)] = 0$, which after using (3) and the assumption that $U(0) = 0$ implies

$$(4) \qquad \Delta^o \equiv \bar{\pi} - \frac{1}{2} R(\bar{\pi})q_i^2 \sigma^2 = 0 \qquad\qquad \text{all i.}$$

This simply states that in the long-run equilibrium, the expected profit of each firm must be equal to the risk premium. Secondly, in equilibrium the output, q_i, of each firm is optimally chosen to maximize expected utility (3), which yields, after some manipulations, the first-order necessary conditions

$$(5) \qquad \Delta \equiv E(p) - C'(q_i) - \frac{R(\bar{\pi})q_i\sigma^2}{1 - \frac{1}{2}R'(\bar{\pi})q_i^2\sigma^2} = 0 \qquad \text{all i}$$

Note that in this derivation, it is assumed $\partial q/\partial q_i = 0$ so that the price distribution (here represented by $E[p]$ and σ^2) is unaffected by a competitive firm's choice of q_i.

If we define the firm's __marginal risk premium__ as

$$(6) \qquad \alpha(q_i,q) = \frac{R(\bar{\pi})q_i\sigma^2}{1 - \frac{1}{2}R'(\bar{\pi})q_i^2\sigma^2}$$

then condition (5) can be simplified as

$$(7) \qquad E(p) = C'(q_i) + \alpha(q_i,q)$$

which says that the competitive firm maximizes its expected utility of profits by equating the expected price with what can be called "full" or "effective" marginal costs which is the sum of the marginal costs of production, $C'(q_i)$,

and the marginal cost of uncertainty, given by the marginal risk premium, $\alpha(q_i, q)$.

The second-order condition requires that

(8) $\qquad \dfrac{\partial \Delta}{\partial q_i} < 0 \qquad$ all i.

The system of equations (1), (4) and (5) determines the number of firms in the industry, the size of each firm, total output and price. Let this solution be given by N, q_i, $q_c = Nq_i$ and $p(q_c, \epsilon)$, respectively. Corresponding to the equilibrium values of the endogenous variables we get the competitive firm's marginal risk premium

(9) $\qquad \alpha_c(q_c) \equiv \alpha(q_i, q_c) = \dfrac{R(\bar{\pi}_c) q_i^2 \sigma_c^2}{1 - \frac{1}{2} R(\bar{\pi}_c) q_i^2 \sigma_c^2}$

where $\sigma_c^2 \equiv \sigma^2(q_c; s^2)$ is the variance of the equilibrium price facing the competitive industry and $\bar{\pi}_c \equiv E[p(q_c, \epsilon)q_i - C(q_i)]$ is the competitive firm's expected profits.

III. Monopoly

In order that the comparison between monopoly and competitive equilibrium be meaningful, it is necessary that the monopolist's cost function be appropriately defined. In the certainty model, the prediction that monopoly output is always less than that of competitive equilibrium stems from the crucial assumption that the marginal cost curve of the monopolist is identically the horizontal summation of the marginal cost curves of the competitive firms in equilibrium (or the aggregate supply of the cometitive industry). In what follows, a similar definition is used, thus allowing us to concentrate on the effects of uncertainty, rather than other effects such as the economies of scale in production.

Recall that in the preceding section an individual firm's cost function was defined as $C(q_i)$ for all i. Since all firms are assumed identical, so that the aggregate output $q_c = Nq_i$, the total cost of the competitive industry producing the aggregate output q_c (and with each firm producing q_i) can be written as

(10) $C_c(q_c) = NC(q_i)$

Differentiating the above with respect to q_i yields

(11) $C_c'(q_c) = C'(q_i)$

where $C'(q_i)$ is the marginal cost of an individual firm whereas $C_c'(q_c)$ is the "horizontal summation" of the firms' marginal costs. Note also that (11) implies $C_c''(q_c) = \frac{1}{N} C''(q_i)$ which says that the slope of the industry's marginal cost (or the "horizontal summation" of individual marginal costs) is 1/N of the slope of each individual firm's marginal cost schedule. Using $C_c(\cdot)$ as the appropriate monopoly cost function, we shall now proceed to analyze the monopoly problem.

Consider a monopolist which has the same utility function $U(\cdot)$; which faces the same demand curve given by (1); and whose cost function $C_c(\cdot)$ is defined in (10). Let q_m be the monopoly equilibrium output, then it must satisfy the first-order condition

(12) $\Delta^m \equiv \left\{ E[p(q_m, \epsilon)] + E[\delta(q_m, \epsilon)] \right\} - \left\{ C_c'(q_m) + \alpha_m(q_m) \right\} = 0$

where

(13) $\delta \equiv \frac{\partial p}{\partial q_m} q_m < 0$

and

(14) $\alpha_m(q_m) \equiv \dfrac{R(\bar{\pi}_m) q_m [\sigma_m^2 + \frac{q_m}{2} \frac{\partial \sigma_m^2}{\partial q_m}]}{1 - \frac{1}{2} R'(\bar{\pi}_m) q_m^2 \sigma_m^2}$

is the monopolist's marginal risk premium; $\sigma_m^2 \equiv \sigma^2(q_m; s^2)$ and $\dfrac{\partial \sigma_m^2}{\partial q_m}$ are the

variance and the marginal variance of price faced by the monopolist; and

$\bar{\pi}_m \equiv E[p(q_m, \epsilon)q_m - C_c(q_m)]$ is the monopolist's expected profit in equilibrium. Furthermore, the second order condition requires

(15) $\dfrac{\partial \Lambda^m}{\partial q_m} < 0$

Condition (12) states that the monopoly optimum is one that equates the expected marginal revenue $\{E[p] + E[\delta]\}$ with the "effective" marginal costs which consist of the marginal production cost, C_c', plus the marginal cost of uncertainty or marginal risk premium given by α_m. Notice, however, that α_m, in contrast with α_c, contains an additional term $\partial \sigma_m^2 / \partial q_m$. This term is zero for the case of the competitive firm since the output of the competitive firm, by definition, cannot affect the price or the variance of the industry price. In the case of a monopolist, however, $\partial \sigma_m^2 / \partial q_m$ is in general not zero and could take on a positive or negative value depending on the stochastic nature of the demand function.

IV. Monopoly Versus Competition

The comparison between monopoly and competition is now conveniently facilitated by rewriting the monopoly equilibrium condition (12) as

(16) $E[p(q_m, \epsilon)] = -E[\delta(q_m, \epsilon)] + C_c'(q_m) + \alpha_m(q_m)$

and the competitive firm's equilibrium condition (5) as (after using (6), (9) and (11)):

(17) $E[p(q_c, \epsilon)] = C_c'(q_c) + \alpha_c(q_c)$

The question that confronts us is whether or not it is possible for the monopoly equilibrium output q_m to exceed the competitive equilibrium output q_c. In addressing this question, observe that the monopoly equilibrium condition (16) holds only for equilibrium output q_m. For any other output $q_m^o \neq q_m$ (where q_m^o is any arbitrary value in the neighbourhood of q_m), the second-order condition (15) implies.

$$E[p(q_m^o, \epsilon)] \gtrless - E[\delta(q_m^o, \epsilon)] + C_c'(q_m^o) + \alpha_m(q_m^o) \quad \text{iff} \quad q_m^o \lessgtr q_m$$

Now if we let $q_c = q_m^o$, then

$$E[p(q_c, \epsilon)] \gtrless - E[\delta(q_c, \epsilon)] + C_c'(q_c) + \alpha_m(q_c) \quad \text{iff} \quad q_c \lessgtr q_m$$

and using (17),

$$\alpha_c(q_c) \gtrless - E[\delta(q_c, \epsilon)] + \alpha_m(q_c) \quad \text{iff} \quad q_c \lessgtr q_m$$

In what follows, our motive is to present sufficient conditions such that

$$(18) \quad \alpha_c(q_c) - \alpha_m(q_c) + E[\delta(q_c, \epsilon)] > 0 \Rightarrow q_c < q_m.$$

Since $E[\delta] < 0$, it is obvious that condition (18) can never be satisfied when there is no uncertainty or when there is risk neutrality. The reason is in both of these cases, $\alpha_c = \alpha_m = 0$ so that a monopolist, by the standard prediction, will always produce a lower output. However, in the presence of uncertainty and risk aversion, it is possible that a monopolist may produce a higher output level compared to that of competitive equilibrium. To demonstrate this, i.e., condition (18), what is required is that the marginal risk premium (or avoidance) or the monopolist (α_m) to be sufficiently smaller than that (α_c) of a competitive firm--a requirement which obviously contradicts the Galbraith-Caves hypothesis that the monopolist should exhibit a greater risk avoidance. In what follows, it will be shown how several factors may contribute toward assuring $(\alpha_c - \alpha_m) >> 0$; thus making it possible that monopoly output may in fact exceed that of competitive equilibrium.

To begin with, observe that using the definitions of α_c and α_m in (9) and (14) respectively, the term

$$(19) \quad \alpha_c(q_c) - \alpha_m(q_c) = \frac{R(\bar{\pi}_c(q_i))q_i}{1 - \frac{1}{2}R'(\bar{\pi}_c(q_i))q_i^2 \sigma_c^2} \sigma_{cc}^2 - \frac{R(\bar{\pi}_m(q_c))q_c}{1 - \frac{1}{2}R'(\bar{\pi}_m(q_c))q_c^2 \sigma_{cm}^2} \left\{ \sigma_{cm}^2 + \frac{q_c}{2}\frac{\partial \sigma_{cm}^2}{\partial q_c} \right\}$$

where we now introduce a new definition:

$$\sigma_{cc}^2 \equiv \sigma^2(q_c, s_c^2) \quad \text{and} \quad \sigma_{cm}^2 = \sigma^2(q_c, s_m^2) .$$

The reason for this is the <u>true variance</u> of ϵ is in general unknown and needs to be estimated. As will be revealed shortly, the <u>estimated variance</u> s_m^2 of the monopolist will in general differ from the competitive firm's estimated variance s_c^2. Before we evaluate expression (19), it is convenient to consider a few further simplifications. Firstly,

$$\bar{\pi}_m(q_c) = E[p(q_c, \epsilon)]q_c - C_c(q_c)$$

$$= N\{E[p(q_c, \epsilon) \cdot q_i - C(q_i)\}$$

$$= N \bar{\pi}_c(q_i)$$

i.e., the expected profit of a monopolist at the output q_c is N times that of a competitive firm. Thus, because of the decreasing absolute risk aversion assumption,

$$(20) \quad R(\bar{\pi}_m(q_c)) = \theta R(\bar{\pi}_c(q_i)) \quad \text{where} \quad 0 < \theta \equiv \frac{R(N\bar{\pi}_c(q_i))}{R(\bar{\pi}_c(q_i))} < 1$$

i.e., the absolute risk aversion factor of the monopolist is a fraction of that of a competitive firm. Secondly, defining

$$\eta_c \equiv - R'(\bar{\pi}_c) \bar{\pi}_c/R(\bar{\pi}_c) > 0$$

to be the (absolute) value of the elasticity of absolute risk aversion of the competitive firm, and recalling the competitive equilibrium condition (4), it follows that

$$(21) \quad \eta_c = - \frac{1}{2} R'(\bar{\pi}_c)q_i^2 \sigma_c^2$$

Thirdly, we assume

$$(22) \quad R'(\bar{\pi}_c) = R'(\bar{\pi}_m) = \text{constant}$$

which implies $R'' = 0$. This assumption is not at all restrictive since R'' involves the fourth derivative of the utility function on which neither economic theory nor intuition has much to say.[5]

Substituting (20), (21) and (22) into (19), and after some manipulations, we have

$$(23) \quad \alpha_c(q_c) - \alpha_m(q_c) = \lambda[\sigma^2_{cm}\{(N\eta_c - 1)(N - 1) + (1 + \eta_c)(1 - \theta)N\}$$
$$+ \{\sigma^2_{cc} - \sigma^2_{cm}\} - (1 + \eta_c)\theta N\{\frac{q_c}{2} \frac{\partial\sigma^2_{cm}}{\partial q_c}\}]$$

where $\lambda \equiv R(\bar{\pi}_c)q_i/(1 + \eta_c)(1 + \eta_c N^2 \sigma^2_{cm}/\sigma^2_{cc}) > 0$. In observing (23), it is readily recognized that there are at least three effects, represented by the three terms within the parenthesis [ ], which work toward assuring $\alpha_c - \alpha_m > > 0$.

The <u>first effect</u> is a direct result of decreasing absolute risk aversion or the economies of scale in the monopolist's risk avoidance which is represented by the term $\sigma^2_{cm}\{(N\eta_c - 1)(N - 1) + (1 + \eta_c)(1 - \theta)N\}$ in (23). This term is in general positive for the following reasons. First $(1 + \eta_c)(1 - \theta)N > 0$ because from (20), $1 > \theta > 0$. Second, $(N\eta_c - 1)(N - 1) > 0$ since for large N, $\eta_c > \frac{1}{N} \to 0$. Thus compared to a firm within a competitive industry, a monopolist, because of decreasing absolute risk aversion assumption, has a lower risk attitude and is therefore able to absorb more risk. In other words, it attaches a lower cost to uncertainty as compared to a competitive firm.

The <u>second effect</u> that may contribute toward making $\alpha_c > \alpha_m$ is given by the second term in (23), $\{\sigma^2_{cc} - \sigma^2_{cm}\}$. This term is always non-negative and it should in general take on a positive sign for the following reason. The price variance $\sigma^2 \equiv \sigma^2(q,s^2)$ in general depends not

only on q but also s^2 which is the __true variance__ of the distribution of the random variable ϵ. Since neither the monopolist nor the competitive firm knows the true parameters of ϵ, parameters such as the variance s^2 need to be estimated. For the competitive firm, its estimate of s^2, defined by s_c^2, is based on information only of past prices which are independent of its own individual output levels. However, the monopolist, in its estimate of s^2 (defined by s_m^2) can exploit an added information given by the relationship between its past output levels and prices. In other words, the monopolist has an informational advantage in that its estimate s_m^2 is "partly explained" by its own actions (i.e., its past output levels) whereas the competitive firm's estimate s_c^2 is totally "unexplained" by its own past actions or output levels. Hence in general, $s_m^2 \leq s_c^2$. Furthermore, given the assumption that $\partial\sigma^2/\partial s^2 > 0$, it follows that for the same output level q_c, $\sigma_{cc}^2 \equiv \sigma_c^2(q_c, s_c^2) \geq \sigma^2(q_c, s_m^2) \equiv \sigma_{cm}^2$.

It can, of course, be argued that such informational advantage cannot persist since information can generally be acquired even by a competitive firm. This argument, however, does not nullify our conclusion that $\sigma_{cm}^2 \leq \sigma_{cc}^2$ because acquiring information is costly; and at least in our example where the crucial information is the relationship between output levels and prices, the information acquisition cost of a competitive firm is at least as high as that of a monopolist.

It should be noted that our above argument is related to the general idea that centralization of activities will in general reduce informational cost. In a decentralized system of many decision makers, each faces not only exogenous uncertainty from outside the industry (e.g., exogenous random shifts in demand), but also uncertainty from within the industry (e.g., the output levels of other firms which in

aggregate affect the market demand distribution). On the other hand, a single decision maker or in general, a centralized system, can avoid the latter type of uncertainty--hence reducing its overall cost of uncertainty.

The <u>third effect</u> that affects $\alpha_c - \alpha_m > 0$ lies in the term $\partial \sigma^2_{cm}/\partial q_c$ in (23). Note that $\sigma^2_{cm} \equiv \sigma^2(q_c, s^2_m)$ and $\sigma^2_{cc} \equiv \sigma^2(q_c, s^2_c)$. Abstracting from the differential estimate of variance of ϵ between the monopolist (i.e., estimate s^2_m) and the competitive firm (i.e., estimate s^2_c), there still remains a fundamental difference between them regarding their information about the random demand conditions. To a competitive firm, $\partial q_c/\partial q_i$ is by definition equal to zero so that $\partial \sigma^2_{cc}/\partial q_i = 0$. This simply says that its output level is perceived to have a negligible impact on the price distribution. This is nothing but the uncertainty analogue of the certainty model in which a competitive firm's output is assumed not to affect the market price. To a monopolist, however, its output level affects not only the expected market price but also the price variance. What then is the sign of $\partial \sigma^2_{cm}/\partial q_c$? Clearly the answer depends on the functional form of the demand function and on the way the random variable ϵ enters the function.

It is readily verified that there exists a large class of frequently used random demand functions that will guarantee $\partial \sigma^2_{cm}/\partial q_c < 0$ which in turn would contribute further toward making $\alpha_c > \alpha_m$. For example, consider the class of functions where the random variable enters the demand function in a multiplicative fashion: $p = p(q) \cdot g(\epsilon)$ where $p' < 0$. In this case, $\partial \sigma^2/\partial q \equiv \partial var(p)/\partial q = 2pp' \, var(g(\epsilon)) < 0$. Even for the more general forms such as the translog demand function: $\log p = a + b \log q + c \log \epsilon + d \log \epsilon q$ (with $b + d < 0$ to ensure $p' < 0$),

we have $\partial\sigma^2/\partial q \equiv \partial \text{ var }(p)/\partial q = 2(b+d)a^2 q^{2(b+d)-1} \text{var}[e^{(c+d)}] < 0$.

Similarly, it can be easily verified that for many other demand functions which are quadratic or convex in ϵ, we also get $\partial \text{ var }(p)/\partial q < 0$.

In summary, we have shown that in an environment of demand uncertainty, there exists at least three effects that will cause $\alpha_c >> \alpha_m$. More importantly, all these effects occur under a very general set of conditions. The first effect--the economies of scale in risk avoidance--is always operative given the assumption of decreasing absolute risk aversion. This assumption is in fact the most plausible form of restriction that can be placed on the utility function (see Arrow (1964)). The second effect--arising from the monopolist's informational superiority in the prediction of $s_m^2(\leq s_c^2)$--is also always operative since at the minimum the absence of any predictive superiority only suggests that the true parameter s^2 of the distribution of ϵ is common to both the monopolist and the competitive firm (i.e., $s^2 = s_m^2 = s_c^2$). The third effect is again related to the monopolist's informational superiority in the sense that he knows his output level affects the demand distribution: e.g., the expected price and the price variance. For a large class of frequently used demand functions for which $\partial \text{ var }(p)/\partial q < 0$ he can exploit this situation by producing more since a higher output level lowers the price variance and hence reduces the risk it needs to absorb.

Furthermore to the extent that $\alpha_c - \alpha_m >> 0$ is sufficiently large as to more than offset $E[\delta](<0)$ as in (18), then monopoly output will exceed that of a competitive industry, thus reversing the conventional presumption that monopoly always incur a welfare loss relative to the competitive industry.

V.   Conclusions and Implications

One of the most accepted results in economic theory is that, given the same cost conditions and in a certainty environment, a monopolist will always produce less than a competitive industry--with the consequence that monopoly always causes a welfare loss to society . In an environment of uncertainty, another standard result (see Sandmo (1971), Leland (1972)) exists which suggests that increasing uncertainty would lead a firm (whether a monopolist or competitive firm) to reduce its output because of risk aversion or avoidance. Furthermore, there is a presumption, as exemplified by the Galbraith-Caves hypothesis (Galbraith (1967), Caves (1970)), that a firm with greater market power (e.g., monopolist) would exhibit greater risk avoidance. This of course would lead one to conclude that increasing uncertainty would cause a monopolist to reduce its output much more than a competitive firm; thus accentuating the welfare loss argument associated with monopoly.

This paper has shown that while it is true that increasing uncertainty reduces the monopolist's and the competitive industry's output (this result being assured by $\alpha_m > 0$, $\alpha_c > 0$), it is however not true in general that the monopolist would react to increasing uncertainty by shrinking its output level by more than a competitive industry. On the contrary, it was shown that under a very general and plausible set of conditions, a monopolist will exhibit a smaller risk avoidance as compared to a competitive firm--i.e., $\alpha_c > \alpha_m$--with the consequence that increasing uncertainty would lead a monopolist to reduce its output level by less than a competitive industry. This result implies that in an environment of uncertainty, the welfare loss associated with monopoly is in fact reduced rela- to competition. Furthermore, it is not inconceivable that the welfare loss

associated with monopoly might turn out to be smaller than the one associated with competition. Such would be the case if $\alpha_c - \alpha_m \gg 0$ is sufficiently large to offset the negative $E[\delta]$ monopoly effect as in (18).

Finally, the results of our model have a further interesting implication regarding the measurement of monopoly power.

Rewrite the monopolist's first order condition (16) as

$$(24) \qquad \bar{p}_m(1 - \xi) = MC_m + \alpha_m$$

where $\bar{p}_m \equiv E[p(q_m, \epsilon)]$ is the expected price, $\xi \equiv -E[\delta]/\bar{p}_m$ is the absolute value of the inverse expected demand elasticity; $MC_m \equiv C_c'(q_m)$ is the marginal cost; and $\alpha_m \equiv \alpha_m(q_m)$ is the monopolist's marginal risk premium. The equilibrium for the competitive industry, given by (17) can be re-written as

$$(25) \qquad \bar{p}_c = MC_c + \alpha_c$$

where $\quad \bar{p}_c = E[p(q_i, \epsilon)]$; $\alpha_c \equiv \alpha_c(q_c)$; and $MC_c \equiv MC_c(q_c)$.

In the case of no uncertainty, i.e., $\alpha_c = \alpha_m = 0$, the standard Lerner measure[6]

$$(26) \qquad L_m^n \equiv (\bar{p}_m - MC_m)/\bar{p}_m = \xi$$

(where $0 < \xi < 1$). This says the degree of deviation from marginal cost pricing--and hence the efficiency loss--is due solely to the standard monopoly element ξ. This is an appropriate measure of inefficiency since for the competitive industry, the Lerner measure (when $\alpha_c = 0$)

$$(27) \qquad L_c^n \equiv (\bar{p}_c - MC_c)/\bar{p}_c = 0$$

identically reduces to zero.

In the case of uncertainty, however, both the competitive industry and the monopoly deviate from marginal cost pricing. For instance, the index of

such a deviation defined for the monopoly case can be inferred from (24) as

$$(28) \qquad L_m^u \equiv (\bar{p}_m - MC_m)/\bar{p}_m = \xi + \alpha_m/\bar{p}_m > 0$$

The deviation here is not only due to the traditional monopoly argument ξ but also due to the risk avoidance term $\alpha_m/\bar{p}_m$. In the case of competition, the deviation measure can be inferred from (25) as

$$(29) \qquad L_c^u \equiv (\bar{p}_c - MC_c)/\bar{p}_c = \alpha_c/\bar{p}_c > 0$$

which does not reduce to zero.

This deviation from marginal cost pricing arises with both forms of market structure. This suggests that one should be careful in the interpretation of such measure. In a certainty model, Lerner's measure of monopoly power ξ precisely measures the degree of inefficiency. In the case of uncertainty, our results suggest that the deviation due to competition L_c^u could plausibly exceed the deviation due to monopoly, L_m^u. In a world where the first-best marginal cost pricing rule is not attainable, the relevant comparison is between the alternative possible second-best outcomes, i.e., $L_c^u - L_m^u$ which can turn out to be either positive or negative.

Footnotes

[1]Although we have restricted ourselves to the case of demand uncertainty, a similar analysis can be applied to cost uncertainty.

[2]See Galbraith (1967) and Caves (1970). See also Edwards and Heggestad (1973) for a formalization and the test of the Galbraith-Caves hypothesis.

[3]A similar result is derived in Appelbaum and Lim (1980) in the context of a general monopolistic competition model.

[4]See Pratt (1964). See also Samuelson (1970) for a defence of local approximations when the probability distribution is compact and concentrated.

[5]It can be shown that relaxing the restriction $R'' = 0$, will only strengthen our results. For example, if we take $u'''' = 0$, it follows that $R'' < 0$, which will further lead to a reduction in the monopolist's risk avoidance α_m relative to α_c.

[6]See Lerner (1934).

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