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ENTRY, MARKET SHARES, AND OLIGOPOLISTIC PERFORMANCE

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Market shares play a large role in merger policy and for the application of antitrust laws generally. They are used because of the belief that they offer a reasonable measure of market power, or at least they offer a reasonable measure of market power when entry is unlikely. Unfortunately, some controversy exists over both when entry is unlikely and whether market shares are a reasonable measure of market power even when entry is precluded. This controversy arises because of the use of several contradictory models for describing behavior in an oligopoly and could be ended if a consensus ever were to develop on an appropriate oligopoly model.

In particular, some analysts believe that, even with free entry, the knowledge that all operating firms are earning positive profits may be insufficient to induce entry if there are large fixed costs. Bain [5], Sylos-Labini [21], and Modigliani [16] describe the economies of scale in such a market as a "barrier to entry." This result can be derived formally using the Cournot model where one of the firms is a potential entrant, a firm that produces nothing.[2] On the other hand, Stigler [20] does not allow economies of scale as a possible barrier to entry. Producing a formal result consistent with Stigler's view, Grossman has introduced an oligopoly model in a recent article in this journal [14] where he predicts fixed costs need not be a barrier to entry. Specifically, Grossman predicts the zero profit, competitive outcome is the typical outcome for a market with free entry, which exists if some potential entrants have the same costs as some operating firms. This result contradicts a prediction from the Cournot model, where typically some market power is maintained whenever there are only a few operating firms. In addition to the direct implication concerning entry, Grossman's result indicates market shares may not be a good measure of market power, even when firms have differing costs.

Grossman's model is distinguished from the Cournot model by assuming that the appropriate strategy space for each firm is a "supply" function, a quantity choice that depends upon the market price, rather than just a single quantity choice. Grossman justifies this choice of a strategy space by appealing to the effects of contracts which can be made between each firm and its custommers. He assumes contracts are offered with a price protection feature, where each firm commits itself to match the lowest price offered by a rival. Grossman predicts that these markets typically yield the zero profit, perfectly competitive outcome when all firms have the same costs. Providing more controversy, this conclusion completely opposes the intuition of those who argue that this practice may facilitate collusive behavior, like similar practices involved in the Ethyl case before the FTC [22]. These analysts believe that the introduction of price protection guarantees from each seller changes the market outcome to one that is closer to the monopolistic outcome, rather than to the competitive outcome as suggested by Grossman.

In this comment I offer two alternative models which generate Grossman's results, but for different reasons than those suggested by Grossman. The first model is a static Bertrand-type model, where free entry guarantees a perfectly competitive outcome for the long run as well as the short run. The second model is a dynamic Stigler-type model, where free entry may change the predicted outcome from one where a great deal of market power is utilized to a zero profit, perfectly competitive outcome. One implication of these results is that market shares of the operating firms may not be a good measure of market power in markets with free entry.

After this, some market examples are presented with the dynamic model which reveal further that market shares may not be a good measure of market power even when entry is precluded. In addition, these examples reveal that the firms' excess capacities may be important variables for determining whether collusive agreements can occur in equilibrium.

After presenting these models with these results, I examine the market environment considered by Grossman with legal contracts that include price protection clauses. For this environment, we find the dynamic model presented here typically predicts the monopolistic outcome. Grossman's model is then reexamined, and we find the elimination of an erroneous assumption typically changes the predicted outcome--once the equilibrium concept is strengthened--from the competitive outcome to the monopolistic outcome.

1. Another Theory of Oligopoly

Another theory of oligopoly is introduced to industrial organization presumably because of a dissatisfaction with the results of the existing Cournot model. Many economists are dissatisfied. They feel the results predicted for many oligopoly markets by the Cournot model are not consistent with observed facts[3] and do not square with their intuitions, since the predicted outcome leaves unexploited profit opportunities. I believe this should prompt theorists to examine whether all essential structural features of an actual oligopoly market are properly incorporated into the model. As a part of this examination, I argue in this comment that the Cournot game improperly describes the decisionmaking environment for a single time period and that the repeated decisions in the actual dynamic market require an explicitly dynamic model for some market environments.

My argument that the Cournot game improperly describes the decisionmaking environment for a single time period is fully presented in another paper [1]. Basically, the argument derives from a reexamination of the criticisms originally leveled by Bertrand [6] and Edgeworth [9] that the choices made by firms concerning the prices they charge for their goods are not properly incorporated into the model. In that paper some oligopoly models are presented which employ only standard economic assumptions, except that the structures of specific economic institutions are incorporated. It is assumed that oligopolists act as if they operate in a static world, that all traders have complete information, and that buyer behavior can be described by a demand function while behavior in the input markets can be summarized by a cost function. Three different institutions are examined. The first is a market in which the sellers post prices and goods are produced prior to sale, the second is a market in which sellers post prices and goods are made-to-order, and the third is a market in which firms produce the goods and sell them in an auction. The analysis in that paper demonstrates that with homogeneous goods, no pure strategy equilibria exist under the first institution (Edgeworth's outcome),[4] all equilibria yield a competitive outcome under the second institution (Bertrand's outcome), and all equilibria are Cournot equilibria under the third institution. When the institutional choice is endogenous in a market with homogeneous goods, the third institution is never used in equilibrium. With differentiated products, the Edgeworth outcome is obtained when either posted price institution is used. In particular, these results imply that no Cournot outcome is ever observed (unless it is also a competitive outcome) within those environments for which it was supposed to be applied.

A basic conclusion derived from that analysis is that both price and quantity need to be incorporated as choice variables for many typical markets which satisfy standard assumptions. The seemingly benign assumption that once all quantities are chosen only market clearing prices are chosen--an assumption that is at the heart of the Cournot model--is shown to have a strong effect on the predicted outcome. Dropping this assumption changes the prediction from the Cournot outcome to either the competitive outcome or an outcome using strictly mixed strategies, where typically the expected prices and expected quantities are much closer to those in the competitive than the Cournot outcome. This difference derives from the different structures given to the games which are used to describe an oligopolistic decisionmaking environment for a single time period.

The first alternative model we consider is the static Bertrand-type model presented in [1], which uses the second institution where sellers post prices and goods are made-to-order. In this model a perfectly competitive outcome is predicted, largely for the reasons given by Bertrand. There is an incentive to cut price for any price above the competitive level and an incentive to raise price for any price below the competitive level. Right at the competitive price, however, there is no incentive to lower price, no incentive to change quantity at the same price, and no incentive to raise price if other firms can instantly fill the amount that was demanded by the firm now raising its price. When goods are made-to-order, they can instantly fill this demand, since without penalty they can offer quantities to the market that greatly exceed the quantities they actually sell. This could not be done if goods were produced prior to sale because the firms would be penalized for offering more to the market than could be sold.

With this model consider a market where all firms have the same costs, and there is a potential entrant in equilibrium. In this market all firms must be earning zero profits in equilibrium. Otherwise, the potential entrant can actually enter by cutting prices slightly below those of a profitable firm and otherwise mimic its behavior, giving the potential entrant positive profits. Thus, we find:

For any oligopoly market where sellers post prices and goods are made-to-order, and where all sellers have identical costs, any static equilibrium that has a potential entrant and uses only pure strategies must yield a zero profit, perfectly competitive outcome.

Adding free entry to this market changes the static equilibrium conditions, so that the outcome must be perfectly competitive for the long run as well as the short run. It is important to remember that this result concerns a static equilibrium, or an equilibrium where behavior is independent among different time periods. This restriction to a static equilibrium concept is reasonable for some markets, say when the cost of monitoring rivals' actions is high, but for other markets an explicit dynamic model is necessary.

Now consider our second alternative model, which is an explicit dynamic model of this same environment. With this model we find, in addition to the changes in the predictions caused by the changes in the game for a single time period, changes result from considering the effect of making decisions repeatedly within an oligopolistic market. Consider the following dynamic model which has the structure of a supergame, a structure where the game for a single time period is repeated infinitely. Say an oligopolistic market can be described for each time period by the following game: the players are the n selling firms, each firm i has a set of feasible strategies denoted by S_i, and the payoff for any firm i is given by $\pi_i(s)$, where the selection of strategies $s \in X_{i=1}^{n} S_i$. The supergame consists of this component game repeated in each time period t = 1,2, ... For the supergame the players are the same n firms, their strategies consist of a choice for each time period which may depend upon any information received by that time period, and each firm i has a payoff described by the discounted sum $\Sigma_{t=1}^{\infty} \delta^{t-1} \pi_i(s^t)$, where δ is a time discount factor and s^t is the selection of strategies actually used at time t. For simplicity, assume that each firm is informed of the actions taken by all firms (T+1) periods after they occur and not before, so that any change in behavior is concealed from rivals for exactly T periods.

Now consider the use of the following dynamic strategy by each firm i:

Choose s_i in period t if $s \equiv (s_1, \ldots, s_n)$ has been played in each period before (t-T), or

choose d_i in period t if s has not been played in each period before (t-T).

If all firms choose such a dynamic strategy, the selection of strategies s is played in each time period since no deviation ever occurs, and the alternate selection d is never played. The selection d only has an effect if some firm deviates from this dynamic strategy, and given this, provides a large influence on the incentive for deviating. In effect, a selection of dynamic strategies is described where the firms have made an agreement, explicit or tacit, to play the selection s, and the agreement is enforced by the threat of using the strategies in the deterrent selection d. Each firm monitors the actions of its rivals, but with a lag of (T+1) time periods. If a violation of the agreement is observed, penalties are imposed with the retaliatory responses described in the deterrent d.

Now we wish to determine which agreements can occur in a Nash equilibrium where all firms use these dynamic strategies. To determine when some firm has an incentive to change its dynamic strategy unilaterally, we examine the best response each firm has against all other firms using the given dynamic strategies.[5]

Assume first that the deterrent d is a Nash equilibrium from the one-shot component game.[6] Given this, if firm i deviates from its strategy, once a violation has been detected all other firms are playing their strategies from d forever, so that within any best response firm i must do the same. Also, with the same discount factor between any two consecutive periods, if firm i is to deviate from its strategy its best response requires it to deviate in the first period. This means the best response for firm i must be to play the best response to s from the component game, denoted by s_i^*, for the first T periods, and play d_i thereafter. Thus, in an equilibrium we must find for any firm i

$$\sum_{t=1}^{\infty} \delta^{t-1}\pi_i(s) \geq \sum_{t=1}^{T} \delta^{t-1}\pi_i(s/s_i^*) + \sum_{t=T+1}^{\infty} \delta^{t-1}\pi_i(d),$$

where the slash (/) indicates a substitution has been made (i.e. $s/s_i^* \equiv (s_1, \ldots, s_{i-1}, s_i^*, s_{i+1}, \ldots, s_n)$). The equilibrium condition for firm i can be rewritten as

$$\sum_{t=1}^{T} \delta^{t-1}(\pi_i(s/s_i^*) - \pi_i(s)) \leq \sum_{t=T+1}^{\infty} \delta^{t-1}(\pi_i(s) - \pi_i(d)).$$

This means in any equilibrium each firm finds that for any devition the discounted current gain, or that gain realized before detection and retaliation, must be less than or equal to the discounted future losses, or those losses realized after detection and retaliation.

This model has many of the same elements described verbally by Stigler's "Theory of Oligopoly" [19]. The most prominent feature of this model which distinguishes it from other oligopoly models is the imperfect monitoring of the actions of each firm's rivals. The effect of this monitoring is incorporated into the model with a time lag associated with obtaining information on rivals' actions and reacting to it. There is no prior assumption either that no firms ever attempt to use any threats of future retaliation to alter rivals' behavior, as in the Cournot model, or that such threats are carried out instantaneously and are always effective, which allows monopoly outcome, as described by Chamberlin [7] or as in Grossman's reaction function model [14].[7] This model does include both extremes as special cases. This model has been analyzed previously in the literature, but as an oligopoly model the Cournot game has always been used as the component game.[8] In this comment we will consider this model, but with the static Bertrand-type game described in [1] as the component game.

2. Some Markets with Free Entry

Before examining the effect of free entry I give the following well-established, basic results: each Nash equilibrium from the component game is an equilibrium agreement, and all equilibrium agreements yield payoffs that are no worse for each firm than those achieved in some Nash equilibrium from the component game.[9] These results establish the existence of an equilibrium for the supergame once the component game has been shown to have one, and an initial characterization is made of the set of equilibrium outcomes. These results also indicate the problem of multiple equilibria may be common with this model.

Directly from the equilibrium conditions, we find that for any firm in an agreement equilibrium either both the current gain and the future loss are positive, or both the current gain and the future loss are zero.[10] In addition, for any market where zero production yields a cost of zero, each firm must realize a non-negative profit in any Nash equilibrium from the component game. Now, for a market with free entry, the results above imply that in any agreement equilibrium any potential entrant must earn a profit of zero from the agreement, from the deterrent, and from its best response to the agreement; i.e., $\pi_i(s)=0$, $\pi_i(d)=0$, and $\pi_i(s/s_i^*)=0$ for this potential entrant.

Now consider a market where sellers post prices and goods are made-to-order. For this market, Bertrand-type results are predicted, as any equilibrium outcome which uses pure strategies from the one-shot game must be a perfectly competitive outcome.[11] In addition, since both prices and quantities offered to the market are chosen by the firms, price cutting strategies can be considered. When examining the effect of price cutting strategies one finds that all firms with identical costs must be earning identical profits in any equilibrium from the one-shot game.[12] Given these observations, we infer:

<u>For any oligopoly market where sellers post prices and goods are made-to-order, and where all sellers have identical costs, any equilibrium agreement that has a potential entrant and uses only</u>

pure strategies must yield a zero profit, perfectly competitive outcome.

This result follows regardless of the size of T. If monitoring of rivals' actions is instantaneous, impossible, or somewhere in between, there is no effective deterrent to stop the potential entrant from cheating on any agreement yielding positive profits. In this market the potential entrant always has an incentive to cheat on any agreement yielding positive profits, since its current gain from cheating must be positive and no future loss is possible In this situation, the potential entrant can always take its money and run. Also, to satisfy the equilibrium conditions the predicted outcome must be a Nash equilibrium from the component game, which here is a perfectly competitive outcome. One might also note that the previous model presented in this paper, the static Bertrand-type model, is a special case of this model when monitoring of rivals' actions is impossible, so that the earlier result is a special case of this one.

Thus, this model predicts that for these markets with free entry no market power can be exercised, regardless of the number of operating firms. Since this result includes markets with large fixed costs, we find economies of scale need not be a barrier to entry. This also implies that the number and market shares of the operating firms are irrelevant for predicting the outcome in such a market with free entry.

3. Some Markets without Free Entry

Now consider some markets without free entry. Say that there are n operating firms and entry is effectively precluded, possibly because of high sunk costs. Say that each firm i has a constant marginal cost of c for any quantity up to a physical production capacity of k_i units. Sav that market demand is given by D(p), and $\Sigma_{i=1}^{n} k_i > D(c)$. For this market assume that firms post prices and determine both the quantities to offer to the market and the quantities to actually produce, and that all goods are made-to-order.

If we were to construct the set of all equilibrium outcomes, we would have to consider all price-quantity combinations that could be chosen by each firm. Nevertheless, for ease of exposition we formally consider only a subset of all the possible choices, as we eliminate some possibilities which are dominated by or yield an equivalent outcome to some equilibria. In particular, consider outcomes where all firms earn positive profits, each firm charges a price of p no greater than the monopoly price, and any (n-1) firms offer a quantity to the market sufficient to meet the amount demanded at that price. Say that under the agreement firm i sells the quantity $m_iD(p)$, where m_i is the market share for firm i. With these restrictions, each firm's best response against the agreement is to undercut the others' price by an infinitesimal amount, so that its demand is the total market demand. Given this we find

$$\pi_i(s) = m_i D(p)(p-c),$$

$$\pi_i(s/s_i^*) = (\min\{k_i, D(p)\})(p-c), \text{ and}$$

$$\pi_i(d) = 0.$$

This market then has an equilibrium condition for any firm i which can be rewritten as

$$\frac{\min\{k_i,\ D(p)\} - m_i D(p)}{\min\{k_i,\ D(p)\}} \leq \delta^T,$$

or equivalently, the pair of inequalities

$$1 - \frac{m_i D(p)}{k_i} \leq \delta^T \text{ if } k_i \leq D(p), \text{ and}$$

$$1 - m_i \leq \delta^T \qquad \text{if } k_i \geq D(p).$$

These equilibrium conditions can be interpreted rather simply. The quantity actually produced by i is $m_i D(p)$ and its total physical capacity is k_i, so that $1 - \frac{m_i D(p)}{k_i}$ is its excess capacity, expressed as a percentage of its total capacity. When its physical capacity exceeds the quantity demanded, its usable capacity is only the amount demanded. In this case, $1-m_i$ is the excess of its usable capacity, expressed as a percentage of its usable capacity. Thus, for each firm the excess capacity, ~~ex~~ expressed as a percentage of the total usable capacity, must be less than or equal to a number determined by the discount rate and the length of the concealment period.

The following observations can be made with this example. Market shares have no direct effect on whether market power can be exercised by the firms in this market, even though entry is precluded. The number of operating firms has no direct effect on whether market power can be exercised by the firms in this market. Their only effect is indirect, and are only felt by way of their effect on the excess capacity of each firm. In a more general version of this model they may also have an indirect effect by way of the detection time or the accuracy of the information actually received. Also, we observe that only the largest excess capacity among the firms is important, since if the equilibrium condition is satisfied for this firm it is satisfied for all. Thus, even when market shares may be important, such as when each firm's capacity exceeds demand, only the smallest market share is important. Certainly, any four-firm or eight-firm concentration ratio is useless.

As a by-product, this example gives a prominent role to an economic variable not included in most models--each firm's excess capacity. Since the market described in this example has several special structural features, it would be interesting to determine if excess capacity plays a central role in a more general setting. Consider again the supergame where the component game is left in its general form. The equilibrium condition previously developed for each firm i can be rewritten as

$$\frac{\pi_i(s/s_i^*) - \pi_i(s)}{\pi_i(s/s_i^*) - \pi_i(d)} = 1 - \frac{\pi_i(s) - \pi_i(d)}{\pi_i(s/s_i^*) - \pi_i(d)} < \delta^{T.13}$$

The left-hand side of this inequality may be interpreted as the excess capacity of profit, where profits are measured against those achieved as a "competitor." Say we interpret "competition" as being achieved when no firm uses any threats to change the behavior of rivals and the Nash equilibrium from the component game is played. For each firm i, where profits are measured against those achieved as a "competitor," $\pi_i(s/s_i^*) - \pi_i(d)$ is the total capacity of profit with the agreement s, $\pi_i(s) - \pi_i(d)$ is the profit actually taken, and $\pi_i(s/s_i^*) - \pi_i(s)$ is the unused or excess capacity of profit with the agreement s. With this interpretation the left hand side of the inequality is then the excess capacity of profit, expressed as a percentage of the total capacity of profit. Thus, in an agreement equilibrium we must find that for each firm the excess capacity of profit with the agreement is less than or equal to a number determined by the discount rate and the length of the concealment period. For the example considered previously, the assumed structural features forced the excess capacity in physical terms to equal the excess capacity of profit for each firm.

4. Markets with Contracts Offering Price Protection

Now we wish to consider a market environment where all sales are made under legal contracts which include a price protection clause. This price protection clause commits each seller to match the lowest price offered by a rival, subject to a quantity constraint for the entire market which depends upon the market price. This contract binds the buyer to purchasing from the existing seller first, and the buyer must exhaust the quantity offered by this seller before purchasing from another. We assume there are no costs to the buyers to utilize this clause if some rival does offer a lower price.

In this market each firm offers a price to each customer, a legal commitment to match the lowest price in the market, and a maximum quantity it is willing to sell to the market for any possible price. We assume the seller is limited to offering only enforceable contracts, those where the firm earns nonnegative profits given any market price.

Upon examining the possible equilibrium agreements in such an environment, we find the effect of the price protection clauses is to enforce any individually rational outcome as a collusive agreement. Since there are no costs to the buyer for utilizing a price protection clause, any lower price from a rival is instantly revealed to the seller. When any firm contemplates a change in its strategy, it knows there is no time in which its change in actions is concealed from its rivals. The price protection clauses require that the length of the concealment period T equals zero. Thus, when all firms use agreement strategies, agreeing upon the selection s and enforcing it with the deterrent d, they find s is an equilibium agreement if and only if for each firm i

$$\sum_{t=1}^{\infty} \delta^{t-1} \pi_i(s) \geq \sum_{t=1}^{\infty} \delta^{t-1} \pi_i(d).$$

As d is a Nash equilibrium from the component game we find this equilibrium condition is satisfied for every firm, by definition, if the selection s is individually rational.

This means that this environment with price protection clauses typically yields multiple equilibria. Given this, we may sharpen the equilibrium concept with the hope that a single outcome is predicted. Say we consider only those Nash equilibria undominated by another Nash equilibria. We do not expect to observe any Nash equilibrium if another exists where all firms are earning a higher profit. If side payments are allowed this means:

<u>In an oligopoly market with price protection guarantees from each seller, all undominated Nash equilibria yield the monopolistic outcome</u>.

This result gives us a predicted outcome which is quite different than the one suggested by Grossman [14] for this same environment. Rather than the monopolistic outcome, Grossman predicts that markets covered with a price protection guarantee from each seller typically yield the zero profit, perfectly competitive outcome. This difference in predictions warrants a reexamination of Grossman's model and his results.

Grossman considers the same environment described above. He assumes further that in an equilibrium any prices offered by a seller must clear the market, so that all that is necessary to describe the equilibrium strategies is a function that gives the quantity each firm actually sells at any given price. Grossman calls this function the firm's "supply" function.

With this, Grossman considers the appropriate strategy space for each firm in this environment is the set of all "supply" functions derived from the use of enforceable contracts. Grossman's first theorem shows that a competitive outcome, if it exists, is always an equilibrium outcome in his model when there is free entry. His second theorem shows that any supply function equilibrium in a market with free entry and satisfying mild assumptions concerning cost and demand, must allow the competitive outcome as an equilibrium outcome. He then argues that firms use only upward sloping supply functions in equilibrium, and as a result, any supply function equilibrium allows only one equilibrium outcome, which must be the competitive outcome.

I have no quarrel with the two theorems, but with the critical argument for eliminating downward sloping supply functions. Downward sloping supply functions are dismissed both because of the belief that the threats expressed by downward sloping supply functions are "unrealistic,"[14] and due to the possibility of multiple equilibria which can occur when downward sloping supply functions are allowed. Both of these reasons are inappropriate. Without this critical argument the impact of Grossman's two theorems is particularly weak.

First, any threats described in an enforceable contract are clearly credible, and therefore "realistic." The courts would order the firm to carry out any actions required by the contract, and the firm would comply to avoid the severe sanctions that would be imposed against it if it violated the terms of the contract. The courts give the firm the alternative of adhering to the terms of the contract and earning nonnegative profits, or having severe sanctions imposed against it that result in negative profits. As noted by Grossman, the threats expressed by a downward sloping supply function would not be credible in this static setting without some outside enforcement mechanism, since they are not self-enforcing.[15] But with the outside enforcement mechanism provided by the courts the threats in such contracts are clearly credible. These contracts, enforced by the courts, give each firm the ability to pre-commit itself to certain actions that would not be credible without this outside enforcement mechanism. Given this, we find that any Nash equilibrium with supply functions, where only enforceable contracts are used between the firms and their customers, must also be a perfect Nash equilibrium.[16]

If downward sloping supply functions are allowed multiple equilibria are common. Consider an example of a market where each firm has no fixed cost and the same, constant marginal cost. Assume one firm offers the monopoly price and a "supply" function which equals demand for prices down to the marginal cost and zero below. Assume there is one potential entrant, and it offers some price between the monopoly and competitive price and a "supply" function which indicates it sells nothing at any price (it may, at the same time, be willing to sell a large quantity for some prices). This is a supply function equilibrium, where the market price is the price offered by the potential entrant. If the offered price from the potential entrant is varied, any outcome on the demand curve from the monopoly outcome to the competitive outcome can be obtained in equilibrium. This example can be generalized, and one then finds multiple equilibria are typical, with many equilibrium outcomes which appear to utilize the operating firms' market power.

Even though multiple equilibria are typical with this model when downward sloping "supply" functions are allowed, rejecting them solely because this result is inconvenient is inappropriate. If the model is felt to capture the essential factors which determine behavior and multiple equilibria are obtained, then the structure of the model, with the strategy spaces given, should remain unchanged, and an effort should be made to sharpen the equilibrium concept with the hope that a single outcome is predicted. For example, the subset of Nash equilibria which are undominated by other Nash equilibria may be of interest. For the markets described by the Grossman model, we find the undominated Nash equilibria typically yield outcomes where firms appear to utilize a great deal of market power. In markets with large fixed costs the monopoly outcome is typically predicted. So, even though the competitive outcome is a Nash equilibrium outcome, it is not an important one after the equilibrium concept is strengthened. This severely limits the importance of Grossman's second theorem.

One should not restrict the strategy space solely because either counterintuitive or inconvenient results are predicted. The structure of the ideal model perfectly mirrors the structure of the actual decisionmaking environment, and a simpler structure, say one with strategy sets which eliminate some elements of the ideal strategy sets, should be used only if there is little change in the resulting prediction. Grossman's ad hoc prohibition of downward sloping supply functions changes the prediction for markets with large fixed costs, after the equilibrium concept is strengthened, from the monopoly outcome to the competitive outcome--hardly a nonnegligible change. Believing that a result is counterintuitive, because "most economists would agree that in an industry with free entry, constant marginal costs and no fixed costs, the outcome would be competitive,"[17] is no reason to restrict the strategy sets, when the offending choices are available to an actual decisionmaker. Similarly, Grossman's formulation of a Bertrand equilibrium cannot be rejected solely because no pure strategy equilibria exist, a result which is certainly inconvenient. If we are to reject it, we must reject it on other grounds.

If counterintuitive or inconvenient results are predicted, one must reflect further on whether the model incorporates all essential elements of the actual decisionmaking environment. If upon further reflection the model is felt to miss some essential elements of the actual decisionmaking environment, then one should search for these unincorporated but essential factors. We note that with this approach the strategy spaces used in the model are expanded, not contracted. Given counterintuitive results, there are either some additional elements of the environment which need to be incorporated into the model to yield results consistent with one's intuition, or one's intuition needs to be changed. Using arbitrary restrictions of the decisionmakers' choices within the model, restrictions which are designed to allow only "intuitive" results, is practicing religion, not science.

5. Conclusion

Another theory of oligopoly is presented that predicts the zero profit, perfectly competitive outcome for some markets with free entry. In particular, this result occurs for markets where each firm faces large fixed costs, so that economies of scale need not be a barrier to entry. Also, this result occurs regardless of the number or market shares of the operating firms, indicating that market shares may not be appropriate measures of market power.

Further examples of markets are given, where entry is precluded, to illustrate the predictions made with this model. In this model, where all firms wish to collude but find it is more effective in some markets than others, predictions range all the way from the monopolistic outcome to the competitive outcome. For these examples, we find the important market variables for determining whether a collusive agreement can exist in equilibrium include the time before rivals' actions can be detected and retaliated against, the discount rate, and each firm's excess capacity. These examples also indicate that market shares may not be a good measure of market power, even when entry is precluded.

The work by Grossman in [14] is reexamined, as his model also predicts the zero profit, competitive outcome for some markets with free entry, but in an environment in which other analysts expect more collusive behavior, not less. The environment considered by Grossman, where sales are made under legal contracts with price protection clauses, is examined with the model presented here. It typically predicts the monopolistic outcome, as the price protection guarantees eliminate any time a firm might have to conceal its actions from its rivals. Grossman's own model is reexamined, and I challenge one assumption, which is critical for interpreting his results as strongly as he has. Without this assumption his model typically predicts multiple equilibrium outcomes, and after the equilibrium concept is strengthened, we find the monopolistic outcome is typically expected.

Upon reaching these conclusions, I should note some major qualifications to these results to indicate work that may follow. It should be remembered that much of these results hinge upon the effect of some short run changes. The profits coming from some relatively abrupt changes in actions play an important role here. A market environment is described here where the quantity produced by a firm changes drastically if it is to cheat on an agreement or retaliate against another. If we attempt to generalize this model, while incorporating adjustment costs may be important, the effect of adding adjustment costs is unclear as both current gains and future losses are reduced. Other market elements which may be important include uncertainty, either exogenous or endogenous; varying costs of obtaining different types of information concerning rivals; and product differentiation. Much more productive work is possible by considering the effect of adding these market elements to the model. Another important qualification stems from restricting the analysis to markets using an economic institution where sellers post prices and goods are made-to-order. More work needs to be done examining behavior within specific economic institutions and considering the effect of endogenous institutional development. Also, for markets with price protection guarantees, if the costs to buyers for using these guarantees are included, the question remains: does such a practice facilitate collusive behavior in actual oligopolistic markets?

Federal Trade Commission

FOOTNOTES

1. I have had helpful discussions on the effect of price protection contracts with Steve Salop and Paul Pautler. All of the views expressed in this paper are the author's and are not necessarily shared by any other individual or the Commission.

2. The Sylos-Labini postulate is, of course, a Cournot behavioral assumption for the potential entrant. See the example described by Grossman [14], p. 1150.

3. See the empirical studies of the Japanese glass market [15], the U.S. paint market [11], and some experimental markets [8].

4. These results are similar to, but more general than, those derived in [14], pp. 1168-1170.

5. For simplicity, the best response is assumed to exist. If not, the argument needs to be rephrased using the supremum concept.

6. This restriction would be implied if there were some positive probability that even when all firms adhere to the agreement some violation is indicated. See [11, 13, 17]. It would also be implied if we were to use the perfect Nash equilibrium concept.

7. Similar results occur with the reaction function models used in [3, 10].

8. As examples, see [11, 13].

9. In particular, all equilibrium agreements are β-individually rational and if the discount is large enough (or the concealment period short enough) all β-individually rational outcomes can be achieved by an equilibrium agreement. See [4]. See [2, 4] for related results when the equilibrium concept is sharpened to yield "cooperative" outcomes.

10. Other possibilities lead to immediate contradictions.

11. See [1] for a detailed derivation and discussion of this.

12. This is not true with the Cournot game, as shown on p. 1151 in [14]. When price cutting strategies are available, each firm can consider duplicating the choices of any other firm except undercut the other firm's prices by an infinitesimal amount. If that other firm has identical costs, a profit at least as great as that achieved by that other firm can be obtained.

13. This is of course assuming $\pi_i(s/s_i^*) \neq \pi_i(d)$.

14. [14], p. 1163.

15. See footnote 12 in [14], p. 1163.

16. See [18] for a discussion of the perfect Nash equilibrium concept, which requires that all nonrealized actions be rational as well as those actions which are actually realized. The perfect Nash equilibrium concept formalizes what some people mean when they allow only "credible" threats.

17. [14], p. 1163.

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