

THE ANALYSIS OF INDUSTRY EQUILIBRIUM:  
A THEORETICAL PERSPECTIVE

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ABSTRACT

The paper criticises the conjectural variation model for saying little about the determinants of industry equilibrium. It therefore examines more closely the behaviour underlying firms' actions. Collusion amongst firms focusing on the possibility of joint profit maximisation is brought to the centre of the analysis. It is suggested that industry equilibrium be analysed in terms of its deviation from the joint profit maximum, the deviation depending upon firms' retaliatory power, cost functions, and demand functions. This is illustrated by examining the formal specification of a firm's price-cost margin.

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This paper is circulated for discussion purposes only and its contents should be considered preliminary.

## 1. INTRODUCTION

The aim of this paper is to consider the way in which industry equilibrium is analysed and, in particular, to explore the role of collusion. Its purpose is to establish a theoretical perspective for the analysis of industry equilibrium. It is assumed that, in equilibrium, firms maximise short run profits; short run implies that cost and demand functions, and the number of rivals, are given.

Section 2 uses a duopoly example to discuss the conjectural variation (cv) model of industry equilibrium. Three responses are considered to Fellner's (1960)<sup>1/</sup> criticism that the model does not allow firms to change their conjectures when they are clearly wrong. The conclusion reached is that a cv model can only be used to describe equilibrium, but that it says little about the determinants of equilibrium. The implication is a need to examine more closely the behaviour underlying firms' actions. This is the concern of Section 3. Collusion amongst firms focusing on the possibility of joint profit maximisation is brought to the centre of the analysis. It is suggested that industry equilibrium be analysed in terms of its deviation from the joint profit maximum, the deviation depending upon firms' retaliatory power, cost functions and demand functions. This is illustrated by considering the formal specification of a firm's price-cost margin. Finally, Section 4 concludes the paper.

## 2. CONJECTURAL VARIATION

A great deal of work has characterised industry equilibrium using the cv concept.<sup>2/</sup> The typical analysis can easily be illustrated by considering a duopoly which produces a homogeneous good. Define:  $Q_i$   $\equiv$  firm  $i$ 's sales;<sup>3/</sup>  
 $c_i$   $\equiv$  firm  $i$ 's (constant) marginal costs;  $F_i$   $\equiv$  firm  $i$ 's fixed costs.  
Suppose the industry faces a linear inverse market demand function:  $p = a - b(Q_1 + Q_2)$

where  $a, b > 0$ . Firm 1's profits are then given:

$$\pi_1 = [a - b(Q_1 + Q_2)]Q_1 - c_1Q_1 - F_1 \quad (1)$$

Given that firm 1 maximises its profit, it is argued that it produces where  $d\pi_1/dQ_1 = 0$ , i.e. where:

$$a - b(Q_1 + Q_2) + Q_1(-b)(1 + \lambda_1) - c_1 = 0 \quad (2)$$

$\lambda_1$  is firm 1's cv, the amount by which the firm conjectures its rival's output will alter in response to a marginal change in  $Q_1$ . That is,  $\lambda_1$  is firm 1's conjecture regarding the value of  $dQ_2/dQ_1$ .

This cv model can be interpreted by rearranging (2) to obtain firm 1's reaction function:

$$Q_1 = \frac{a - c_1}{b(2 + \lambda_1)} - \frac{Q_2}{(2 + \lambda_1)} \quad (3)$$

Thus, given  $a, b, c_1$ , and  $\lambda_1$ , equation (3) plots firm 1's profit maximising output as a function of firm 2's output. In Figure 1, (3) is plotted as  $R_1$ . Similarly, a reaction function can be obtained for firm 2, and this is plotted as  $R_2$ .  $R_1$  and  $R_2$  describe the duopolists behaviour at all times. For example, if firm 1 produces OA, firm 2 will choose an output of AB. In reply, firm 1 cuts production to OC, precipitating a rise in  $Q_2$  to CE. This continues until the industry reaches equilibrium - point F in Figure 1. At F, neither firm, given its rival's sales, desires to change its output level.

Insofar as  $\lambda_i$  is firm i's conjecture regarding the actual response of its rival, Fellner (1960) has made a valid and damning criticism

5/  
of this analysis. Consider again the movement towards F. In response to firm 2 producing AB, firm 1, taking account of its rival's reaction, chooses to produce OC. But then firm 2 alters its output level and causes firm 1 to make further changes. This clearly indicates to firm 1 that its original cv is wrong and should be altered, yet the model does not allow this to happen.

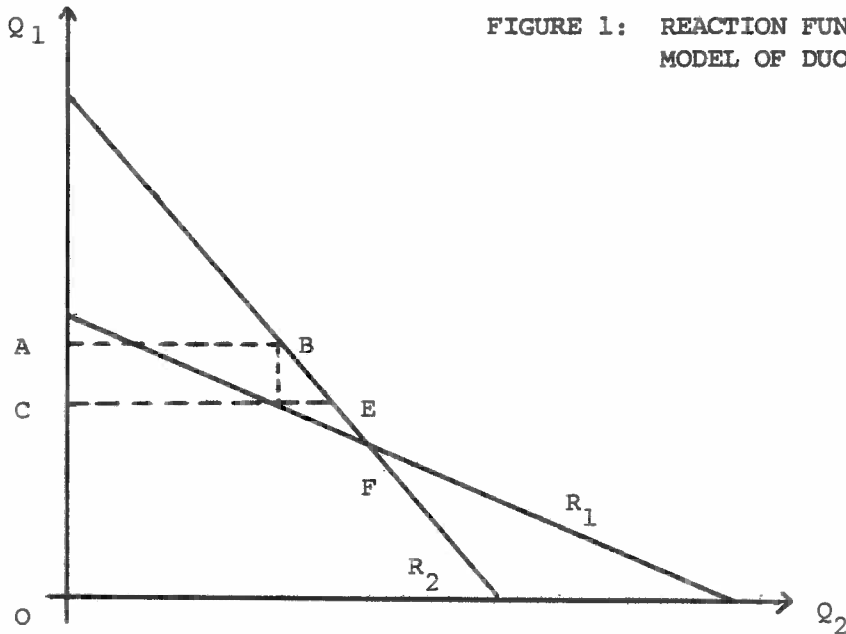


FIGURE 1: REACTION FUNCTIONS IN A CV MODEL OF DUOPOLY.

There are at least three responses to such criticism. Each will be considered in turn.

(i) The first is to require consistent conjectures. That is, to require that, at least in the neighbourhood of equilibrium, firm  $i$ 's conjecture coincides with the way its rival in fact reacts; see Kamien and Schwartz (1983), Perry (1982), and Ulph (1983). Consider firm 2 in the duopoly example. Its rival's output is given by equation (3). Thus, its rival's reaction to a marginal change in  $Q_2$  is given by  $\frac{dQ_1}{dQ_2}$  calculated from equation (3), implying:

$$\lambda_2 = -\frac{1}{2+\lambda_1} \quad (4)$$

Similarly,

$$\lambda_1 = -\frac{1}{2+\lambda_2} \quad (5)$$

Kamien and Schwartz (1983) examine the case where  $\lambda \equiv \lambda_1 = \lambda_2$ . From (4) or (5), this requires:

$$-\frac{1}{2+\lambda} = \lambda \Rightarrow (\lambda+1)^2 = 0 \Rightarrow \lambda = -1$$

From equation (2),  $\lambda = -1$  means that price equals marginal cost,<sup>6/</sup> i.e. the firms behave as though they are in a perfectly competitive situation.

Whilst the consistent conjectures approach is initially appealing, Kamien and Schwartz's (1983) example shows its failure to correctly analyse industry equilibrium. Requiring symmetric duopolists facing a linear inverse market demand function to price at marginal cost is wrong.<sup>7/</sup> For instance, ignoring legal constraints - reasonable in the context of these theoretical models - it is undoubtedly possible for the firm to formally agree to maximise joint profits and therefore price above marginal cost. The importance of this possibility will be pursued in more detail later; suffice it here to note that joint profit maximisation is a feasible equilibrium. Thus, the problem with an analysis based upon consistent conjectures is that other factors need to be analysed to discover whether or not its conclusions are valid.

(ii) The second possible response is to argue that equations like (2) hold only when the industry is in equilibrium. Equilibrium implies that no firm wishes to change its output, given the production of rivals, and thus from the profit

maximising assumption, that equation (2) holds. However, there is nothing to suggest that the same equation also holds in disequilibrium. Rearranging to give (3) does not yield a function which can be plotted in  $Q_1, Q_2$  space, and therefore does not produce a reaction function from which to calculate conjectural variations.

This is an improvement on the consistent conjectures response because it does not rule out feasible equilibria. But simply to argue that equation (2) is valid only in equilibrium is merely to describe equilibrium, and is to say little about why an actual equilibrium arises - i.e. little about the factors which cause an equilibrium to arise, either in a dynamic or static context. Thus, whereas it is clear that it is not determined by a set of simple reaction functions, it is not clear what it is determined by.

(iii) The third response is illustrated by Clarke (1982). Consider again the symmetric firms example of Kamien and Schwartz (1983). Whilst it is true that  $\lambda > -1$  appears myopic - in disequilibrium, firm  $i$ 's conjecture will not equal its rival's actual response - this charge misses the point because it is in the combined interests of the firms to adopt these conjectures and thus increase joint profits. That is,  $\lambda_i$  is not firm  $i$ 's conjecture regarding the actual response in the sense discussed by Fellner (1960).

But the crucial question remains: why should firms seek to increase combined profits? Moreover, if combined profits are so vital, how can Clarke contemplate any outcome other than joint profit maximisation? In short, this response suffers from the same problem as (ii); it is not clear why an actual equilibrium arises.

The conclusion to be drawn from (i)-(iii) is: whereas a cv model can be used to describe equilibrium, it says little about the factors which determine equilibrium. This implies that an analysis of the determinants of equilibrium needs to examine more closely the behaviour underlying a firm's actions.

Where should this examination begin? Stigler (1968) suggests that a basic problem with cv models is that behaviour is postulated, rather than deduced from the profit maximisation assumption. That is, Stigler argues that

"profit maximising must imply the form of behaviour - economic behaviour is a means to achieve this end, not a separate part of man to be supplied by a psychiatrist or a sociologist." (p.36)

Such reasoning underlies the criticism of consistent conjectures raised earlier in this Section - i.e. that they cannot accommodate equilibria which profit maximisation implies are feasible. Moreover, this suggests a starting point for an alternative analysis, namely: it is wrong to conclude that the only feasible equilibrium requires zero price-cost margins when there is a possibility of explicit collusion. It is to this analysis that the following Section turns.



3. COLLUSION

It was assumed at the outset of this paper that the driving force behind a firm's activities is the maximisation of its own profits. If a firm operates in a perfectly competitive product market, it receives normal profits. Clearly, pursuit of maximum profits implies that a firm will attempt to get away from a perfectly competitive environment and dominate its product market. The vital question is: can it ?

A possibility<sup>8/</sup> is for firms to assume an attitude of live and let live towards each other, i.e. for firms to collude. For example, in an industry comprising two symmetric firms selling an identical product at constant marginal cost, rather than engaging in blind competition that pushes product price down to the perfectly competitive level, the firms are likely to realise that, if they tolerate each other's presence, both can obtain above normal profits.

Baran and Sweezy (1966) make this point:

"The typical giant corporation ... is one of several corporations producing commodities which are more or less substitutes for each other. When one of them varies its price, the effect will immediately be felt by the others.

If firm A lowers its price, some new demand will be tapped, but the main effect will be to attract customers away from firms B, C and D. The latter, not willing to give up their business to A, will retaliate by lowering their prices, perhaps even undercutting A. While A's original move was made in the expectation of increasing its profit, the net result may be to leave all the firms in a worse position.

.....

Unstable market situations of this sort were very common in the earlier phases of monopoly capitalism, and still occur

from time to time, but they are not typical of present-day monopoly capitalism. And clearly they are anathema to the big corporations with their penchant for looking ahead, planning carefully, and betting only on the sure thing. To avoid such situations therefore becomes the first concern of corporate policy, the sine qua non of orderly and profitable business operation." (p. 67)

Recognition of their interdependence causes firms to collude, i.e. not to behave such that all firms in the industry become worse off.

Similarly, Scherer (1980) observes:

"When the number of sellers is small, each firm recognises that aggressive action such as price cutting will induce counteractions from rivals which, in the end, leave all members of the industry worse off. All may therefore exercise mutual restraint and prevent prices from falling to the competitive level." (p. 514)

Although Baran and Sweezy (1966) refer to giant corporations, and Scherer (1980) to industries with a small number of sellers, it is particularly important to note that recognition of interdependence, and thus the existence of collusion, is not confined simply to industries comprising a few firms. Indeed, Phillips (1962) points out: "Interdependence may involve but a few firms or it may include thousands" (p. 29). By definition, an industry comprises firms producing goods which are substitutes for each other. Interdependence therefore spreads throughout the industry. There is no reason to expect firms to fail to recognise this fact.<sup>9/</sup>

What is the importance of collusion in establishing the set of feasible equilibria? As a starting point, it is at least possible to restrict the possibilities by considering four propositions:<sup>10/</sup>

- (i) For profit maximisers, the polar extreme to a perfectly competitive industry is joint maximisation. This is true by definition of perfect competition and the joint maximum.

(ii) If all firms in an industry seek to do so, they will be able to maximise joint profits. The only real difficulty could be with firms communicating their views to each other; see, for example, Phillips (1962). However, there are a number of factors discussed by Scherer (1980)<sup>11/</sup> which facilitate communication, for instance:

- (a) in the absence of legal constraints, overt meetings between firms.
- (b) social gatherings amongst firms' representatives.
- (c) informal trade association meetings.
- (d) collusive price leadership, i.e. the "dominant" firm leads its 'followers' towards the joint maximum.
- (e) centralised information gathering networks.

It is reasonable to conclude that if the firms wish to communicate, they will find the means to do so. Nevertheless, it could be argued that the costs of communication may be so exorbitant as to render it unprofitable. However, at least in many industries, this is unlikely. For instance, the cost of social gatherings is likely to be very small compared to the profits attainable at the joint maximum. Moreover, as a starting point, it is reasonable to ignore such costs. This does not deny that, in a more sophisticated analysis, the problem posed by communication deserves more detailed treatment. For example, the influence of the number of firms may prove important, and insights may be obtained from analysing a trade-off at the margin between the costs and benefits - in the form of increased profits - of communication. However, such considerations do not undermine

the purpose of this paper.

(iii) A firm will seek joint profit maximisation when it believes it can obtain higher profits by some other means. This follows from the profit maximising assumption.

(iv) If a firm seeks joint profit maximisation, because its profits are less than at the joint maximum, it does not thereby run a risk that it can be made even worse off. In particular, a firm seeking joint maximisation does not provide rivals with information about its iso-profit map<sup>12/</sup> that can lead to its being made even worse off; the exact meaning of this statement should become clearer after the discussion of "response power", the issue involved, later in this paper. However, as will also become clear, verifying the assumption's feasibility involves complex issues - in short, a more detailed analysis of collusion than has thus far been attempted - and it will not be pursued here. Nevertheless, the notion that a firm can simply tell its rivals that it would rather maximise joint profits, and not thereby suffer, does seem at least a not unreasonable starting point for an analysis.

Given (i) - (iv), then: if joint profits are not being maximised in an industry, it must be because at least one firm believes it is obtaining higher profits than it would receive at the joint maximum. That is, given the feasibility of joint maximisation, firms will collude to avoid situations in which they are all worse off than at the joint maximum. The implications of this conclusion can be illustrated using a duopoly example.

Suppose each firm produces a homogeneous good and faces identical variable cost functions. It seems reasonable to assume that each firm's assessment of the output levels maximising joint profits will coincide; this merely requires that each firm realises output is homogeneous and cost functions are identical. Then, the shaded area in Figure 2 depicts the set of feasible equilibria implied by (i) - (iv).  $J$  is the firms' assessment of the joint maximum, and  $\pi_h^J$  is firm  $h$ 's iso-profit contour for the level of profits it obtains at  $J - h = 1, 2$ .  $J$  is on the  $45^\circ$  line because of the symmetric output and cost assumptions. At any point within  $\pi_h^J$ , firm  $h$ 's profits are greater and

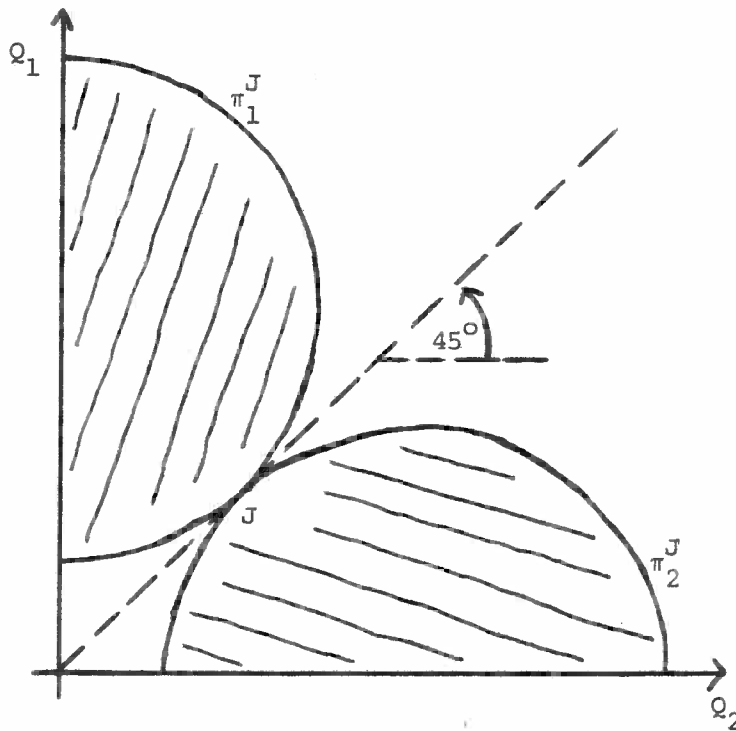


FIGURE 2 : THE SET OF FEASIBLE EQUILIBRIA IN A SYMMETRIC DUOPOLY

firm  $k$ 's profits less than those at  $J - h \neq k$ .

This is in stark contrast to the consistent conjectures example in Kamien and Schwartz (1983). No matter where industry equilibrium is within the shaded area, at least one firm is obtaining at least the profits

it would receive at the joint maximum. If marginal costs are constant - as Kamien and Schwartz assume - price must be higher than marginal cost. Moreover, Figure 2 shows that the only feasible equilibrium in which  $Q_1 = Q_2$  is J. This rules out, for instance, the possibility of a Cournot equilibrium. Such an outcome is not obvious in a bald cv model.

So much for the set of feasible equilibria. How can the actual equilibrium be analysed? The vital factor is the existence of collusion amongst firms recognising the possibility of joint profit maximisation. Consider, for example,<sup>13/</sup> the analysis of feasible equilibria based on propositions (i) - (iv). In particular, consider the case where an industry is in an equilibrium which is not the joint profit maximum. Define  $\pi_i^E$  as firm i's profits at the equilibrium, and  $\pi_i^J$  as the profits i believes it would get at the joint maximum. For at least one firm, for example firm h,  $\pi_h^E > \pi_h^J$ . This follows from the fact that all industries collude at least to the extent that no industry will be in equilibrium at a point where all firms believe they would be better off maximising joint profits. However, it is also generally<sup>14/</sup> true that for at least one firm, for example firm k,  $\pi_k^E < \pi_k^J$ . This follows from the definition of a joint maximum. The reason the industry is not maximising joint profits is that firm k does not possess the retaliatory power<sup>15/</sup> to force firm h into a position where it too would prefer joint maximisation. If firm k did possess the retaliatory power, the firms would collude to maximise joint profits; i.e. the firms would avoid any behaviour which moved the industry from the joint maximum because the outcome would leave all worse off.

This suggests that an actual equilibrium can be analysed in terms of its deviation from the joint maximum, the deviation depending upon the

retaliatory power of firms. The concept of retaliatory power is complex. However, its crucial importance makes it worthwhile examining some of its general characteristics.

There are two critical determinants of a firm's retaliatory power, namely the firm's ability to

- (i) detect activity by rivals which leads to the latter gaining at the firm's expense, and to
- (ii) respond to such activity by inflicting damage, in the form of decreased profits, on those rivals.

These can be referred to, respectively, as a firm's detection power and response power.

The importance of detection power is seen most clearly by considering an extreme case: if firm  $i$  cannot detect at all the activity by its rivals which leads the latter to gain at the firm's expense, the firm will not retaliate to the activity. No matter what a firm's response power, zero detection power implies zero retaliatory power. More generally, the lower is detection power the lower is retaliatory power.

A number of analyses have studied the determinants of detection power.<sup>16/</sup> Particularly influential has been Stigler's (1964) suggestion that it is an increasing function of an industry's Herfindahl index of sales concentration. However, it is necessary to emphasise that, collectively, firms can agree on measures which improve their detection powers. For example, firms could publish the prices at which they trade; or they could

use more sophisticated devices, such as sales contract clauses which allow a seller the option of meeting any lower prices which a buyer may be offered. See Salop (1982). Thus, detection power is, at least to some extent, determined by firms' actions; it is not merely a function of market characteristics like concentration.

Why is this worth emphasising? It was argued earlier that, if an industry is not at the joint maximum, it is because at least one firm does not possess the retaliatory power to force its rivals to that point. Suppose an industry is observed in which all firms, for instance, publish their trading prices. There is at least a suggestion that, if each firm has a significant response power, the industry is maximising joint profits. Certainly, those firms which would gain by being away from the joint maximum would not unnecessarily increase the losers' retaliatory power. Put another way, in such an industry the deviation of the equilibrium from the joint maximum is determined entirely by response power.

The importance of response power is shown in particular by Osborne (1976) and Holohan (1978). Consider, for example, the duopoly characterised in Figure 3, where  $J$  is the joint profit maximum. Assume the industry is initially at  $J$  but that firm 2 contemplates increasing its output to  $\hat{Q}_2$ . Suppose there are no detection problems for firm 1. If firm 1 would respond to  $Q_2 = \hat{Q}_2$  by increasing its output beyond  $\hat{Q}_1$ , firm 2 will not attempt to move to point A. The reason is that 2 would obtain greater profits by remaining at  $J$ . The crucial question is: would firm 1 respond in this way? Clearly, if  $Q_1 > \hat{Q}_1$  implies firm 1's profits exceed those it would obtain at A, it is unlikely to remain at A. Problems arise when



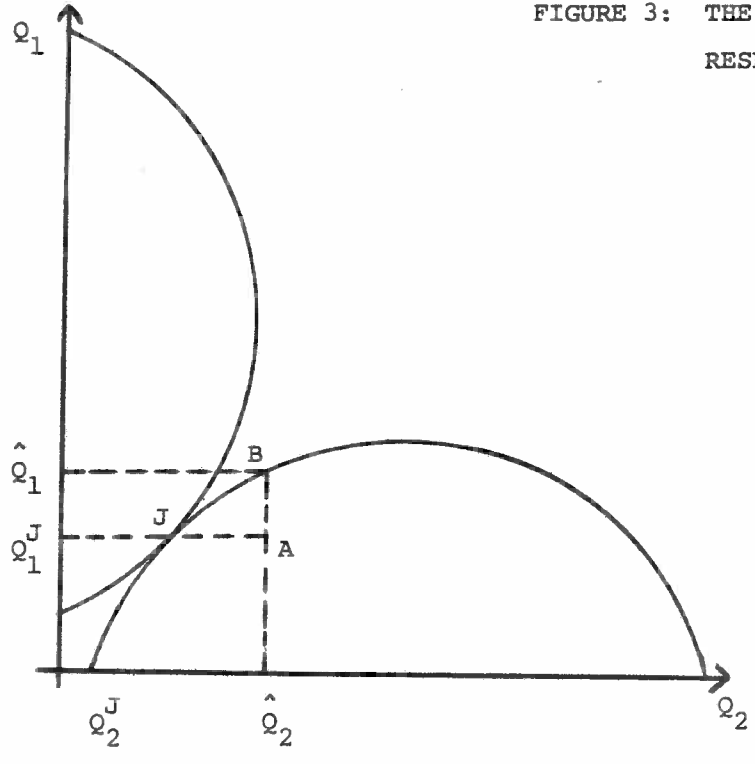


FIGURE 3: THE IMPORTANCE OF RESPONSE POWER.

$Q_1 > \hat{Q}_1$  implies less profits than at A.

In reality, firms will play a game of bluff and counter-bluff. Firm 2 will be uncertain<sup>17/</sup> whether or not its rival will obtain higher or lower profits when  $Q_1 > \hat{Q}_1$ . Thus, a threat by 1 to push the industry north of B may be credible even though in fact firm 1 would become worse off than at A. Indeed, firm 1 may actually increase its output beyond  $\hat{Q}_1$  even though it is worse off than at A, if it believes this will push its rival back to J sufficiently quickly. This illustrates the importance of getting away from the simple reaction function approach that characterises the consistent conjectures interpretation of a cv model.<sup>18/</sup>

Again, there are various studies of the determinants of response power.<sup>19/</sup> Especially important - as seen from Figure 3 - is that, for example, firm 1 has the plant capacity to increase output beyond  $\hat{Q}_1$ ; this is explored in, for instance, Cowling's (1982) analysis of excess capacity. However, it is essential to emphasise a point which is easily forgotten and often ignored, namely: in a world characterised by multi-market enterprises - i.e. firms that sell and/or produce in a number of markets - it is wrong to analyse individual markets in isolation. Edwards (1979) notes, as regards so-called "powerful enterprises" :

"The chief danger to competition from such enterprises is still conceived as the danger that one of them will try to obtain, or succeed in obtaining, the power of a monopoly in some particular market, or that, in a particular market, a few of them may obtain oligopoly power. Although competition sometimes is impaired in these ways, I think that the chief and growing danger is that competition will be eroded by users of power that transcend particular markets." (p. 285, emphasis added.)

He goes on:

"When powerful enterprises have reiterated contacts that each considers important, each is likely to decide what it should do in such contacts by considering what would be best for the enterprise as a whole. Each is likely to modify conduct that would be its adjustment to the contact in a particular market after considering the effect of that conduct upon its relationships with the same enterprise in the other markets in which it encounters that enterprise." (p. 294.)

Suppose, for example, that firms 1 and 2 sell their output in markets X and Y. If firm 1 contemplates any activity causing it to gain at 2's expense in market X, it will consider firm 2's response in markets X and Y. That is, firm 2's response power in each market is given by its ability to inflict damage on rivals in all markets in which they have contact. Moreover, even if the firms only sell their output in market X, if they have production facilities in various markets they can use output from any of these facilities to inflict damage on rivals.

However, retaliatory power is only part of the story that analyses actual industry equilibrium. Consider again firm h. The set of output combinations within the iso-profit contour  $\pi_h^J$  will be classified by h according to the profit they yield. If its rivals retaliatory power leaves h any choice over its output, the choice will be made using this classification, which is determined by h's cost and demand functions. For example, consider a duopoly in which firm 2's output is fixed at  $Q_2^E$ .<sup>20/</sup> Thus, firm 2 has no retaliatory power. Suppose joint profits are maximised when  $Q_1 = Q_1^J$ . This is depicted in Figure 4, where the vertical line through  $Q_2^E$  represents the set of feasible equilibria. Firm 1 can choose any point on this vertical line; no matter what output firm 1 chooses, firm 2 cannot retaliate to force 1 to  $Q_1^J$  because it has no options available. What will

firm 2 produce? Firm 2 will choose the output which, given  $Q_1 = Q_1^E$ , maximises its profit. For instance, in the duopoly illustration of Section 2, from equation 3, firm 1 chooses the output given by :

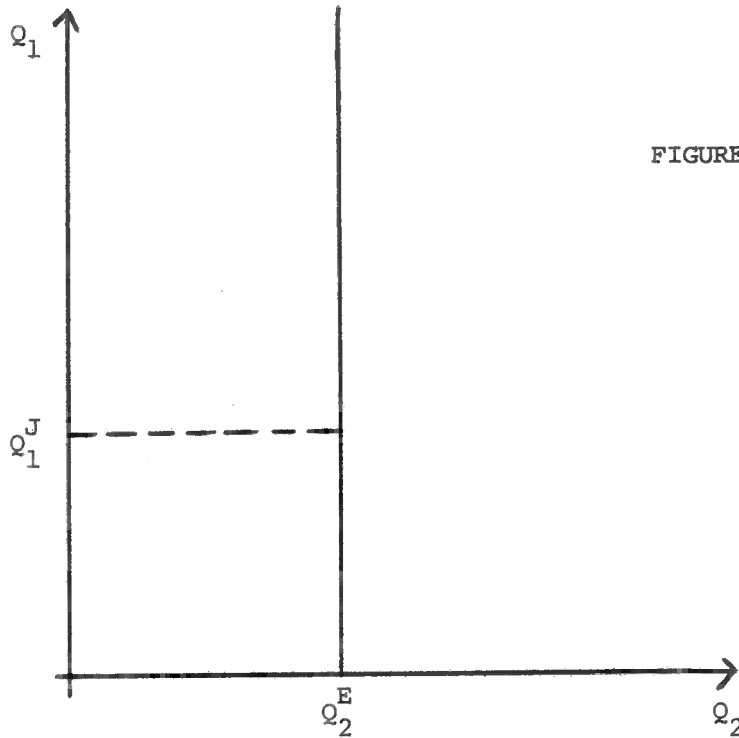


FIGURE 4 : THE INFLUENCE OF COST AND DEMAND FUNCTIONS.

$$Q_1 = \frac{a - c_1}{2b} - \frac{Q_2^E}{2}$$

where:  $c_1$  is firm 1's marginal production costs, and  $a$  and  $b$  are the inverse market demand function parameters. In contrast<sup>21/</sup>,

$$Q_1^J = \frac{a - c_1}{2b} - \frac{Q_2^E}{2}$$

Thus, an actual equilibrium can be analysed in terms of its deviation from the joint profit maximum, the deviation depending upon the firms' retaliatory power, cost functions, and demand functions. Consider, for

example, an industry of  $N$  firms producing a homogeneous good.

Firm  $i$ 's price-cost margin at the joint maximum is

$$\frac{p - c_i(Q_i)}{p} = \frac{1}{\eta^*} \quad ; \quad i = 1, 2, \dots, N \quad (6)$$

where:  $p$  is the product price,  $c_i(Q_i)$  firm  $i$ 's marginal cost function, and  $\eta^*$  the absolute value of the industry's elasticity of demand. More generally,  $i$ 's price-cost margin can be represented<sup>22/</sup>:

$$\frac{p - c_i(Q_i)}{p} = \beta \frac{1}{\eta^*} \quad ; \quad i = 1, 2, \dots, N \quad (7)$$

where:

$$\beta \equiv \beta(r_1, r_2, \dots, r_N; C_1, C_2, \dots, C_N; f(Q)).$$

$$r_i \equiv \text{the retaliatory power of firm } i.$$

$$C_i \equiv \text{the total cost function of firm } i. \quad 23/$$

$$f(Q) \equiv \text{the industry's inverse market demand function.}$$

$$Q \equiv Q_1 + Q_2 + \dots + Q_N.$$

It is revealing to compare (7) with the result given by a cv framework in the simplified case where the inverse market demand function has constant elasticity. (It was recognised in Section 2 that a cv model can reasonably be used to describe equilibrium.) Following Cowling and Waterson (1976),<sup>24/</sup> such a model yields an expression for firm  $i$ 's price-cost margin:

$$\frac{p - c_i(Q_i)}{p} = (1 + \lambda_i) \frac{Q_i}{Q} \frac{1}{\eta^*} ; \quad i = 1, 2, \dots, N \quad (8)$$

Whereas equation (8) might be used to suggest that structure, in the form of market share, is a determinant per se of the equilibrium price-cost margin, it is clear from equation (7) that its only influence can be via the arguments of  $\beta(\cdot)$ . This underlines the view that, when used to describe equilibrium, the cv model is silent on the determinants of equilibrium.<sup>25/</sup> Similarly, it is clear from (7) that, given  $\eta^*$  is a function of  $f(Q)$ , market demand characteristics influence  $\eta^*$  and  $\beta(\cdot)$ . In contrast, it is not as obvious from equation (8) that the inter-relationships between  $\eta^*$ ,  $Q_i/Q$ , and  $\lambda_i$  will be recognised. This is because, unlike equation (8), equation (7) focuses upon the determinants of equilibrium. Such considerations are amplified in the case where the inverse market demand function does not have constant elasticity, in which case  $\eta^*$  in equation (8) is simply the elasticity in equilibrium.

#### 4. CONCLUSION

It is clear from equation (7) that the analysis of industry equilibrium requires a detailed examination of functions like  $\beta(\cdot)$ . As it is, to state that equilibrium should be analysed in terms of its deviation from the joint profit maximum, the deviation depending upon  $\beta(\cdot)$ , is merely to state the problem. It remains to examine the problem in greater detail. For example, exactly what influence do  $r_i$ ,  $C_i$ , and  $f(Q)$  have within  $\beta(\cdot)$ ? What are the determinants of  $r_i$ ? How important are fixed costs? What are the critical demand function parameters?

However, this involves many complex issues. These will not be

pursued here - important though they undoubtedly are - because enough has already been commented upon to serve this paper's purpose.

Thus, the crucial argument is that collusion amongst firms focusing upon the possibility of joint profit maximisation is given the centre stage. As a result, the determinants of equilibrium are brought to the fore and, for example, it is possible to analyse the determinants of a firm's price-cost margin. This is a considerable improvement on the cv model, which, in its consistent conjectures form, for example, suggests conclusions that an appreciation of the possibilities for collusion show to be erroneous.

Nevertheless, further development of this theoretical perspective must await subsequent study.

NOTES

1. The influence of Fellner (1960) can be seen throughout this paper.
2. See, for example, Sawyer (1979).
3. Inventories are ignored throughout the analysis.
4. Although Figure 1 depicts a stable equilibrium, Fellner (1960) points out that the position of the reaction functions need not give this result.
5. Stigler (1968) also notes this criticism.
6. This implies  $c \equiv c_1 = c_2$ .
7. Moreover, the case cited in the text is only an illustration. Kamien and Schwartz (1983) show that in a symmetric duopoly - i.e. both firms have identical costs, conjectures, and output levels - where profit maximising first order conditions are used to model firm behaviour, consistent conjectures yields positive price - cost margins only with a limited set of inverse market demand functions.
8. Other possibilities are the search for differentiated products, and for advantageous cost functions. All of these issues are inextricably bound up with entry barrier problems. In this paper, however, market demand functions, cost functions, and the number of firms are all taken as given. More generally, see Sugden (1983a).
9. Scherer (1980) disagrees with this view, but does not give a reason.
10. The idea here is that, beginning with all possible output combinations across firms as the set of feasible equilibria, consideration of four propositions leads to a restriction of this set. This is not to deny that the set of feasible equilibria may be restricted by other means in a more detailed analysis.
11. Scherer (1980), chapter 6.
12. See, for example, Dixit (1979) for an examination of iso-profit contours.
13. The analysis that follows relies essentially upon collusion, not simply collusion as depicted using propositions (i) - (iv). That is, if a more detailed study leads to the set of feasible equilibria being restricted by other means, it would not undermine the analysis that follows. Moreover, the latter raises issues - e.g. retaliatory power - which, examined in detail, may lead to the set of feasible equilibria being restricted other than by using propositions (i) - (iv).



14. It could be that firms disagree over their assessment of the joint maximum and all see themselves as better off in the actual equilibrium.
15. Consider again the views of Baran and Sweezy (1966), quoted earlier in the paper.
16. See Scherer (1980), chapters 6 and 7, for a review.
17. Uncertainty is also important vis-à-vis detection power. See Cubbin (1983).
18. It also illustrates the way in which proposition (iv) in the earlier discussion of the set of feasible equilibria is essentially a problem of response power.
19. See Scherer (1980), chapter 7, for a review.
20. Whilst this is clearly unrealistic, it nevertheless illustrates the point in issue.
21. Thus, joint profits  $\pi$ , are given :

$$\pi = \left[ a - b(Q_1 + Q_2^E) \right] (Q_1 + Q_2^E) - c_1 Q_1 - c_2 Q_2^E - F_1 - F_2$$

Maximising with respect to  $Q_1$  requires :

$$a - b(Q_1 + Q_2^E) + (Q_1 + Q_2^E)(-b) - c_1 = 0$$

Thus,

$$Q_1 = \frac{a - c_1}{2b} - Q_2^E$$

22. Note that, insofar as industry elasticity is a meaningful concept in such a case, equation (7) is also valid for a differentiated goods industry.
23. The potential importance of fixed costs is implied by Dixit (1979).
24. See also Sugden (1983).
25. See also Clarke and Davies (1982).

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