# PRICES, QUEUES, AND DUAL MARKET STRUCTURE

Tim Hazledine*

NUMBER 73

WARWICK ECONOMIC RESEARCH PAPERS

DEPARTMENT OF ECONOMICS

UNIVERSITY OF WARWICK
COVENTRY

# PRICES, QUEUES, AND DUAL MARKET STRUCTURE

Tim Hazledine*

NUMBER 73

August 1975

* Balliol College, Oxford, and Economics Branch, Research Division, Department of Agriculture, Ottawa, Canada. The author would like to thank K. G. Cowling and A. K. Dixit, and participants in the Warwick Economic Staff Seminar for their helpful comments.

# I. Introduction

This paper analyses the extent to which firms and groups of firms in the same industry may set differing prices. The analysis bears on two main issues; first, the extent to which 'price-taking' behaviour is likely, and secondly, the possibility of 'dual' or segmented market structure.

The assumption that firms take prices as given or parametric when deciding their output and factor proportions is essential to the derivation of the optimality of general economic equilibrium in a market system. The price-taking assumption is justified by supposing that each firm is very small, or 'atomistic', relative to the total market, and so can sell all it wishes without lowering its price below the going market rate, but would lose all its sales to the numerous other firms should it raise its price.

This assumption may not be very plausible. Even if there are many firms in an economy, the size of groups of firms selling identical products may be rather small, especially when location of the product is relevant, so that, unless there is a lot of excess capacity, the remaining firms in a group might not be able to absorb all the customers of one firm that raises its price.

However, it turns out (section II) that firms need not be 'atoms' to behave as price-takers. Even if there is no excess capacity in a market, and the number of firms is quite small, price-taking may still be stable, in the sense that each firm will reject the idea of unilaterally raising its price.

The second issue, duality, has generated much recent controversy amongst labour economists.[1] All agree that there are differences in job characteristics such as wages, security, promotional chances, and so on. The dual theorists, however, claim that good and bad characteristics are divided rather unevenly between two groups - 'primary' and 'secondary' workers, and that the allocation of a worker to a group tends to be determined by non-economic criteria such as race, sex, and class, so that the differentials may persist. This is an important divergence from orthodoxy. As Reich *et al* write

> "These continuing labor market divisions pose anomalies for neoclassical economists. Orthodox theory assumes that profit-maximising employers evaluate workers in terms of their *individual* characteristics and predicts that labor market differences among groups will decline over time because of competitive mechanisms. But by most measures, the labor market differences among groups have not been disappearing. The continuing importance of groups in the labor market is thus neither explained nor predicted by orthodox theory." (1973, p.359)

Possible sources of labour market segmentation include 'positive feedback' mechanisms that reinforce differences rather than removing them (Vietorisz and Harrison), discreteness in wage payment institutions (Hazledine), and duality in product markets (Reich *et al*.)

Product market duality, which is the concern of this paper, is analysed by Reich *et al* in terms of the historical development of capitalism. Here, we are concerned, more modestly, to explain duality with the use of quite orthodox market assumptions, which will, it is hoped, be acceptable to neo-classical as well as radical economists.

Two sorts of product market duality are of interest. First, within a market, there is the possibility of the same good being sold at a different price by different sellers. Microeconomic theory normally assumes that only one price will be observed in a market,[(2)] but this assumption does not appear to be empirically valid. Stigler and Kindahl summarize their extensive evidence on the prices actually paid in markets:

> "The Unique Price ... is a myth. Differences among prices paid or received are almost universal" (p.88).

We will see, in the next section, how, in an industry with limited capacity, a cartel may form and charge a higher price than that of the remaining firms, which remains at the (competitive) level.

Secondly, there may be a duality of structures between markets - a division of the economy into 'competitive' and 'monopolistic' (Reich _et al_) or 'planning' (Galbraith) sectors. The empirical evidence for clear-cut duality, rather than a finer distribution of market structures, is not so persuasive as the evidence against the unique price,[(3)] but it does receive theoretical support from the results of section II. It turns out that there may be a minimum size, below which a cartel will not be profitable, so that we would expect to observe industries either with cartels of this size or greater, or with a non-collusive, 'competitive' structure.

The results of the paper depend, to some extent, on the assumption that, when prices differ, _queues_ may form. The role that queuing may play as a non-price rationing device has been studied by Barzel and by Cheung, and also in some of the dual labour market literature. It is the possibility of queuing that generates a minimum viable size of cartel, thereby increasing the stability of price-taking behaviour, and, at the same time, sharpening the duality in structure between those industries which remain competitive and those in which viable cartels do succeed in setting up.

We also look, briefly, in section III, at price formation when queuing is not possible. In section IV the analysis is extended to the case when, because of stochastic demand, industry capacity does not equal demand. An important function of cartelization may be to reduce the costs of uncertainly fluctuating demand. In section V some stability properties of dual behaviour are mentioned, and section VI outlines the welfare aspects of cartels when queues may form and when demand is stochastic.

## II. Price-setting with Queues

Suppose an industry in long-run equilibrium, as shown in figure 1. Industry output is $q_c$ and price $p_c$. The number of firms, n, is such that the surplus over operating costs, or profit, per firm, $rq_c/n$, equals the 'normal' profit determined by conditions elsewhere in the economy, such that there is no tendency for entrepreneurs to be entering or leaving the industry. We assume that $q_c$ is the constant and certain demand at price $p_c$, and that firms have had time to adjust to this so they are not carrying any spare capacity; thus the industry marginal and average cost curves become vertical at $q_c$. We also assume that marginal and average costs are constant up to $q_c$ and are equal to $(p_c - r)$ per unit of output. It would be more realistic to have cost curves without sharp corners, but this would make results much harder to obtain, without altering them substantively.

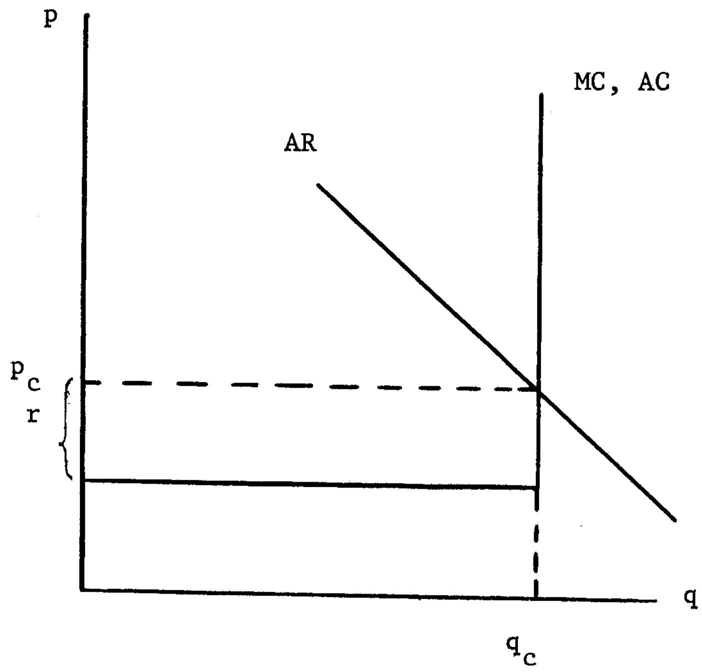



Figure 1 : Competitive Equilibrium

In this equilibrium the firms are acting as price-takers - accepting price $p_c$, producing up to their full capacity, and making normal profits. We wish to know if this situation is unstable; that is, if there is any tendency for a firm or group of firms to upset the equilibrium by becoming price-makers - by offering goods for sale at a price other than $p_c$.

Consider what will happen if a cartel of $m$ firms forms $(1 \leqslant m \leqslant n)$ and sets its price at $p_m$, greater than $p_c$. All customers will attempt to purchase the good from the remaining $(n - m)$ firms still selling at $p_c$. However, in the situation depicted in figure 1, of an industry with no spare capacity, the firms selling at $p_c$ will only be able to supply $q_c(n - m)/n$, whereas they will have $q_c$ willing would-be customers. Price $p_c$ is no longer sufficient to equate supply and demand. The price mechanism may be augmented by a lottery, or by sellers discriminating between customers; for example, by favouring those whose custom has been most regular in the past. However, in a large proportion of such situations, we may expect that the allocation will be determined by the formation of a <u>queue</u>. It is the role that queuing may play in markets that we will examine in this section (in section III the analysis is duplicated for the case where queuing is not possible). It is assumed that a 'queue' , which may take the form of customers physically lining up at the counter, or of them putting their names on a waiting-list, generates disutility, d, a function of $d(w)$ of waiting time, w; the time between joining the queue and being served. For simplicity, $d(w)$ is assumed to be the same for each customer. Customers have to choose between queuing to buy at $p_c$, and being served immediately by the cartel at price $p_m$. Their decision will depend on the length of the queue. The value of w, w' which causes a customer to be indifferent between buying at $p_c$ and at $p_m$ will satisfy

$$p_c + d(w') = p_m \tag{1}$$

If (1) holds, then $p_m$ is effectively the price faced by <u>all</u> customers in the industry, not just by those of the cartel, since the cost of not buying from the cartel is $p_c$ <u>plus</u> the disutility, $d(w')$, of queuing. Thus even if the other firms persist in selling at $p_c$, total industry demand, q', can be read off from the original industry demand curve, as shown in figure 2.

We can satisfy ourselves that w' is a stable equilibrium queue length. For suppose that w is less than w'. Then all the

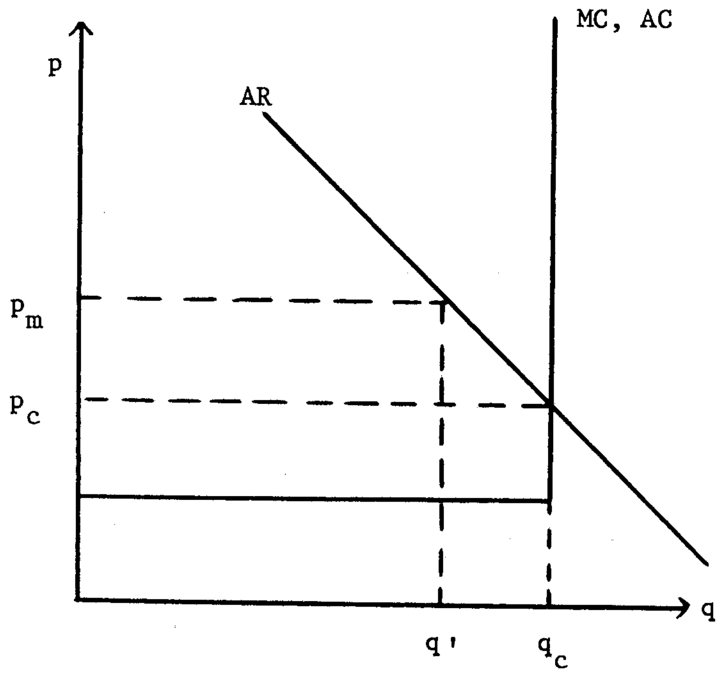



Figure 2 : Market with cartel

prospective customers of the industry in a time period - some number between $q_c(n - m)/n$ and $q'$ - will choose to join the queue rather than go to the cartel. But this means that people will be joining the queue at a faster rate than the rate, $q_c(n - m)/n$, at which they can be served by the price-taking sector. Therefore the queue will be lengthening. It cannot, however, get longer than $w'$, the length at which new customers arriving on the scene are indifferent between buying at $p_c$ and at $p_m$, since no-one would be prepared to wait longer than $w'$.

At $p_m$, industry sales are $q'$, of which $q_c(n - m)/n$ will be in the price-taking sector, so that the cartel's demand, $q_m$, is such that

$$q_m = q' - q_c (n - m)/n \tag{2}$$

If the industry demand curve is

$$q = f(p) \tag{3}$$

then the demand curve facing the cartel is

$$q_m = f(p_m) - q_c (n - m)/n \tag{4}$$

which is just the industry curve moved to the left by $q_c (n - m)/n$.

With the assumption of constant costs, profits of the cartel, $\pi_m$, are given by

$$\pi_m = (p_m - p_c + r) q_m \tag{5}$$

which are to be maximised subject to (4) and the capacity constraint

$$q_m \leqslant mq_c/n \tag{6}$$

Substituting (4) into (5) and differentiating with respect to $p_m$ gives

$$d\pi_m/dp_m = p_m f'(p_m) + f(p_m) - (p_c - r)f'(p_m) - f(p_c)(n - m)/n \tag{7}$$

We cannot put (7) equal to zero and solve for profit-maximising price without being explicit about the form of the function f. However, we can derive the conditions to be satisfied for it to be worthwhile forming a cartel at all. Note that if price is less than $p_c$ the inequality (6) will not be satisfied. Therefore, assuming (5) to be a single-peaked function of $p_m$, we need only calculate the sign of $d\pi_m/dp_m$ at $p_m = p_c$.

$$d\pi_m/dp_m(p_m = p_c) = p_c f'(p_c) + f(p_c) - (p_c - r)f'(p_c) - f(p_c)(n - m)/n$$

$$= (m/n + \eta^I_{p_c} \cdot r/p_c)\, f(p_c) \qquad (8),$$

which is less than or equal to zero if and only if

$$|\, \eta^I_{p_c} \,| \geq mp_c/nr \qquad (9),$$

where $\eta^I_{p_c}$ is the industry price elasticity of demand.

That is, if (9) holds, there is no advantage to forming a cartel to set price - a price above $p_c$ would yield lower than competitive profits, and a price below $p_c$ would be pointless, due to the capacity constraint (6).

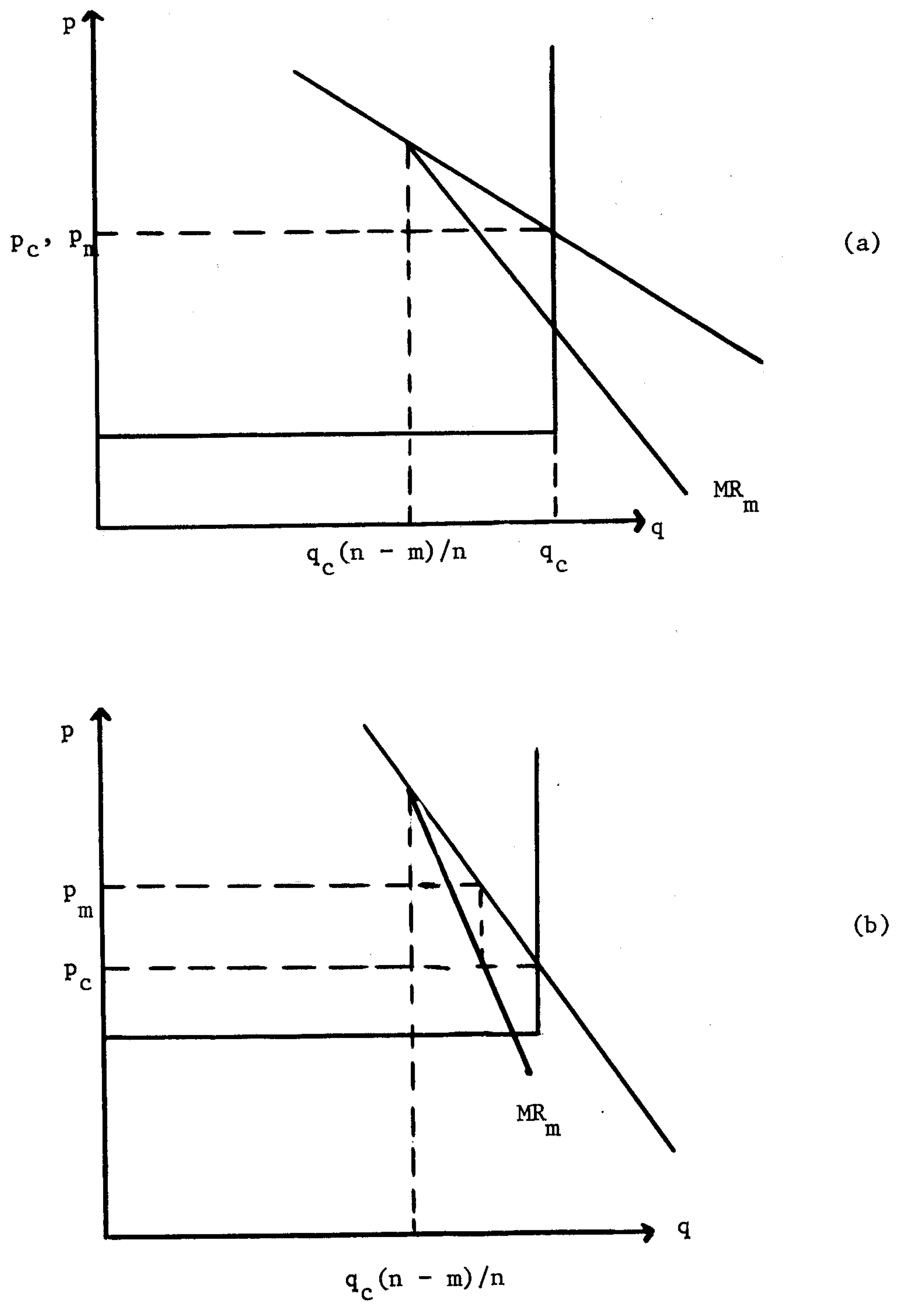
Of particular interest is the situation when $m = 1$ - the one-firm 'cartel' - since, in the absence of price controls, the option of unilaterally becoming a price-maker, without going to the trouble of setting up a cartel with other firms, is always open to each of the $n$ firms in the industry. It appears that for a wide range of plausible values of the parameters inequality (9) will be satisfied. For example, even if industry price elasticity is as low as -0.5, and there are only ten firms in the industry, (9) will be satisfied if competitive price is no more than five times normal unit profits, $r$. This suggests that many industries may not need to be 'atomistic', in the sense of having a very large number of firms, in order that the firms should behave as price takers.

It may even be true that full monopolisation of the industry - $m = n$ - would not result in a change in the price from $p_c$. This occurs if the absolute value of demand elasticity is greater than $p_c/r$.

If (9) is satisfied when $m = 1$, but not when $m = n$, there is a minimum viable size of cartel - the value of $m$ such that strict equality holds in (9).

These results are illustrated in figures 3a and 3b. The cartel works on the part of the industry demand curve to the right of $q_c(n - m)/n$, equating marginal revenue to marginal cost. (9) holds when the marginal revenue is greater than $p_c$ at $q_c$, as in figure 3a. In this case the cartel will not change price from $p_c$. In figure 3b the marginal revenue curve cuts the marginal cost before $q_c$, and price will be raised to $p_m$ - the cartel is viable. It can be seen from the figures how, given $p_c$ and $n$, a smaller $r$, larger $m$, and lower elasticity at $p_c$ each increase the likelihood of viability.

These results suggest, I think, that price-taking behaviour may often be rather stable, especially should there be costs associated with the formation of cartels. They show, also, how the two sorts of product market duality referred to in the introduction may occur if a cartel does form. The cartelized firms will set a higher price than that of the remaining price-taking firms with consumer equilibrium being restored by queuing for the cheaper good. The cartel will be above a certain size, so that there will be a break, or duality, in the size distribution of firms between competitive and cartelized sectors. By comparing the results with those of the next section, we will be able to note that the probability of firms being content to remain price-takers is considerably enhanced when queuing is possible, and that queuing is necessary for the emergence of the second type of duality.




Figures 3a, 3b: Cartel Price-setting

## III. Price Formation when Queuing is Not Possible

Consider an industry selling a good which is such that a customer's demand for it, when aroused, must be gratified immediately or not at all. It is hard to think of more than a few obvious examples of such a good, so the analysis of this section will be brief. At any industry price, each firm would receive, on average, $1/n$ of the customers prepared to buy at that price, assuming that customers are randomly distributed among firms. The demand curve facing a cartel of $m$ members when the rest of the industry prices at $p_c$ is shown in figure 4, transposed $q_c(n - m)/n$ to the right, as was done with the cartel demand curve in the earlier diagrams, and drawn only for $p \geqslant p_c$. In contrast to the situation when queuing is possible, the cartel demand curve (before transposition) has the same intercept as the industry curve, but a steeper slope. This is because queues cannot form to drag up the effective price of the whole industry to that of the cartel and so restrict industry demand to an extent greater than the price-setting of the cartel alone would justify. In the no-queuing case, if industry demand is given by

$$q = f(p) \qquad (3),$$

the demand curve of the cartel is

$$q_m = f(p_m)\, m/n \qquad (10).$$

Substituting (10) into (5) -

$$\pi_m = (p_m f(p_m) - p_c f(p_m) + rf(p_m))m/n \qquad (11)$$

and differentiating with respect to $p_m$ gives

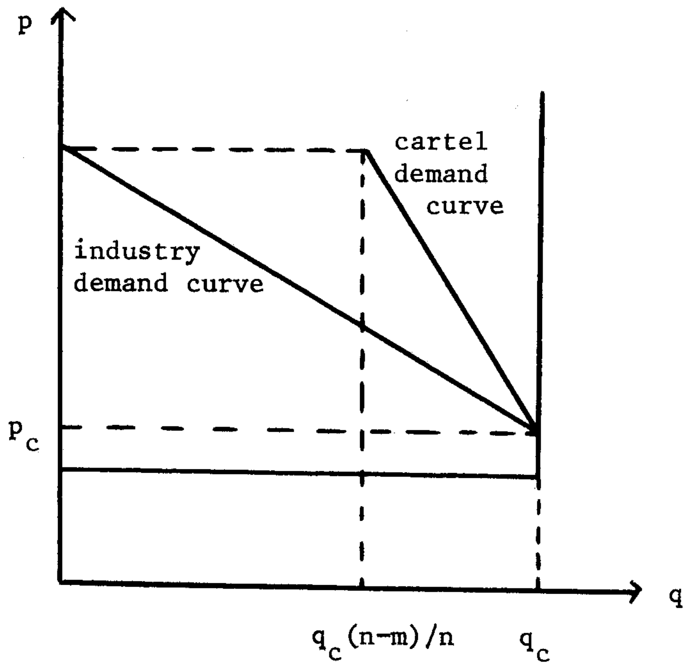



Figure 4 : Demand with no queuing

$$d\pi_m/dp_m = (f(p_m) + p_m f'(p_m) - p_c f'(p_m) + rf'(p_m))m/n \qquad (12),$$

which, evaluated at $p_m = p_c$, becomes

$$d\pi_m/dp_m\ (p_m = p_c) = (f(p_c) + rf'(p_c))m/n$$

$$= (1 + \eta^I_{p_c} \cdot r/p_c)\ f(p_c)m/n \qquad (13),$$

which is less than or equal to zero if and only if

$$|\eta^I_{p_c}| > p_c/r \qquad (14).$$

Note that the relative size of cartel, m/n, does not enter into (14) - if a cartel of one member is profitable, so is a cartel of any size. Therefore, we have no reason to expect market structure duality to arise. This is reflected in the value of profit per cartel member calculated by dividing the right hand side of (11) by m not being a function of m. We may also note that cartelization is much more likely to be profitable when queuing does not occur, since condition (14) is only the same as (9) in the extreme case of full monopolisation of an industry with queuing. All this is because, with no queuing, a cartel can raise its price above $p_c$ without dragging up the real price of the whole industry, so its action does not reduce demand as much as when queues may form.

Although the no-queuing case may be empirically rather unusual, analysing it highlights the role that queues may play in stabilising price-taking behaviour in an industry, and in generating duality when cartels do form.

## IV. Cartelization when Industry Capacity does not equal Demand

In specifying the cost curves it has so far been assumed that firms have installed capacity just sufficient to cope with sales at the competitive price. This is generally only plausible if demand is constant and perfectly predicted. If demand fluctuates stochastically, firms may install capacity that is more or less than mean demand, depending on the relative importance of fixed costs.[4] For an industry initially in competitive equilibrium this can be generally expressed as

$$q_c = \theta\overline{q} = \theta f(p) \qquad (15),$$

where $q_c$ is the competitive industry's capacity, $\bar{q}$ is mean industry demand, and $\theta$ is greater or less than 1, depending on costs and the expected distribution of demand.

A striking feature of cartelization is that it may be able virtually to eliminate stochastic variability from the industry, at least when the means of each firm's sales are constant and their distributions independent. This is because one of the useful things that a cartel may be able to do for its members, as well as setting price, is to redistribute sales amongst firms. Consider the extreme case of a full monopoly of the industry. Suppose that the $n$ units in the monopoly receive sales orders $x_i$ $(i = 1,..., n)$ distributed with mean $\mu$ and variance $\sigma^2$, which are reported to the co-ordinating centre of the monopoly. The centre adds up all $n$ lots of orders, and then redistributes them evenly between the $n$ units, who therefore end up each receiving the average number of orders, $\bar{x}_n$. It is a theorem of Statistics (cf. Mood & Graybill, pp.145-6) that the mean of a random sample of size $n$ from a density is distributed with mean $\mu$ and variance $\sigma^2/n$, where $\mu$ and $\sigma^2$ are the mean and variance of the population density. That is, the variability of sales will be reduced in direct proportion to the number of firms in the monopoly.

Under incomplete cartelization things are more complicated. Suppose that the cartel's price, set to maximise members' profits, is above the competitive price(this is no longer a necessary condition for the viability of a cartel, as it was in the full-capacity case). Then all prospective customers will attempt first to buy from the remaining competitive firms. So long as the cartel is not too small relative to the variance of sales, the number of prospective customers will usually be greater than the capacity of the competitive sector of the industry.

If this is so, each competitive firm will be able to maintain a constant rate of sales, though the length of its queue of customers will vary.

What of the cartel? The fact that it has to bear the variance in sales of not only its own members but also of the remaining competitive firms will reduce, relative to a full monopoly, its ability to smooth production by redistributing orders. The number of orders, y, received by each member of the cartel can be expressed as

$$y = \sum_{i=1}^{n} x_i/m - \mu(n - m)/m \qquad (16),$$

so long as the cartel is big enough, or the variance of demand small enough, for the right hand side of (16) to be non-negative. It is as though all the batches of orders $x_i$ $(i = 1, \ldots, n)$ are directed to the cartel, which hands over a constant number $(n - m)\mu$ to the competitive sector, and divides the remainder evenly amongst its members.

If $x_i$ is distributed with mean $\mu$ and variance $\sigma^2$, it can be shown that the mean, $\mu_y$, and variance, $\sigma_y^2$, of y are given by

$$\mu_y = \mu \qquad (17)$$

$$\sigma_y^2 = \frac{n\sigma^2}{m^2} \qquad (18).$$

We can see from (18) how the cartel is affected by having to bear the burden of sales variance for the whole industry. If $m = n$ we have $\sigma_y^2$ equal to $\sigma^2/n$, as already noted above. For a rather small cartel, such that

$$n > m^2,$$

members' sales variance will actually be greater than before cartelization (assuming that $\sigma^2$ is not a function of industry price).

The reduction of variance by pooling orders clearly will have effects on costs in the long-run, when capacity is variable: these are mentioned in section VI. In the remainder of the present section, the short-run implications of equation (15) are discussed. In the cause of a manageable analysis, it will be assumed that the demand-pooling process described above is successful enough to render insignificant the residual variance of sales in both cartelized and competitive sectors of the industry.

Given (15), the cartel demand curve (4) is replaced by

$$q_m = f(p_m) - \theta\bar{q}(n - m)/n \qquad (19),$$

with a capacity constraint

$$q_m \leqslant \theta\bar{q}\ m/n \qquad (20).$$

Substituting (19) into the profits function (5), and differentiating with respect to $p_m$ now gives

$$d\pi_m/dp_m = p_m f'(p_m) + f(p_m) - (p_c - r)\ f'(p_m) - \theta\ f(p_c)(n - m)/n \qquad (21),$$

noting that $\bar{q} = f(p_c)$.

This is as far as we can go without being more specific about the form of the function f. For, substituting (19) into (20) the capacity constraint is

$$\theta f(p_c) \geq f(p_m) \qquad (20)'.$$

If $\theta = 1$, as in sections II and III above, the equality solution of (20)' is $p_c = p_m$, which can be substituted into $d\pi_m/dp_m$, and the sign examined (as in (9)) to settle the condition for cartelization to be profitable. However, with $\theta$ now not, in general, equal to one, more must be known about $f$ before the value of $p_m$ when (20)' holds as an equality can be known.

The simplest assumption is that $f$ is linear -

$$q = a - bp \qquad (22);$$

Then the capacity constraint is

$$\theta(a - bp_c) \geq a - bp_m, \qquad \text{or,}$$

$$p_m \geq \frac{a(1-\theta)}{b} + \theta p_c \qquad (23).$$

Substituting (22) and (23) as an equality, into $d\pi_m/dp_m$, eventually gives

$$\frac{d\pi_m}{dp_m} = \left[1 - \theta\left(\frac{n-m}{n}\right) + \eta^I_{p_c}\frac{r}{p_c}\right](a - bp_c) \quad (24),$$

which is less than or equal to zero if and only if

$$|\eta^I_{p_c}| \geq \frac{p_c}{r}\left[1 - \theta\left(\frac{n-m}{n}\right)\right]$$

$$\geq \frac{m}{n}\cdot\frac{p_c}{r} + (1-\theta)(n-m)\,p_c/nr \quad (25).$$

(25) reduces to (9) when $\theta = 1$.

We may look at the two possibilities for $\theta$ (apart from $\theta = 1$) :

(a) $\theta > 1$

Therefore $(1 - \theta)$ is negative. When there is excess capacity, the inequality (25) is more likely to hold than when $\theta = 1$ - cartelization is less likely to be profitable.

(b) $\theta < 1$

In this case $(1 - \theta)$ is positive, and cartelization is more likely.

These results are as one would expect - excess capacity allows the price-taking firms to satisfy at least some of the additional customers diverted to them when the cartel raises its price, while insufficient capacity means that there is a pool of excess demand which the cartel can mop up by increasing price. Note that the importance of $\theta$ declines as $m$ approaches $n$ - in a large cartel, capacity conditions in the remaining competitive sector are less important.

## V. Stability

It is natural to ask if the duality of the same good being sold at two different prices, $p_m$ and $p_c$, can persist. Even if, in the absence of cartels, the competitive price is stable because the minimum size of cartel is greater than one, is it not 'irrational', once a viable cartel has been formed, for the remaining firms not to raise their price to the cartel's level? In fact, we shall show below that there is good reason to expect a cartel to try to grow until it monopolizes the industry.

However, our simple analytical concept of a 'firm' and a 'cartel' probably excludes many relevant institutional factors. A typical competitive or price-taking firm may be quite small, run by its owner, with a small clientele, many of whom will be 'regulars' known personally and, perhaps, socially, to the owner, who may live in the same neighbourhood, and send his children to the same school as do his customers. In this situation, the seller may not wish or be able to set a price that maximises narrowly defined accounting profits. The price set will be governed more by notions of 'fairness' than of maximisation, such that each entrepreneur receives a return not much more or less than others of similar ability and resources. This is the competitive equilibrium price at which entry and exit will tend not to take place.

In contrast, a cartelized firm will be run by managers under the control of a centralized authority - 'head office' - with no social linkages to any of the market areas that it sells in. Prices may be standardised for all cartel members and set without constraint from the bilateral buyer-seller relationships that limit the actions of the competitive seller. For such cartels, the assumption that price is unilaterally set by the seller so as to maximise profits is more likely to be valid than it is for 'competitive' firms.

Reinforced by the market structure duality resulting from cartels having a minimum efficient size, these differences in motivation and environment may cause competitive firms to maintain their price below the cartel's price. Their ability to do so indefinitely, however, may be dependent on the actions of the cartel. Will the cartel be content to remain at a certain size, or will it attempt to grow until it monopolizes the industry?

To answer this with our model, we need an explicit expression for the profitability of the cartel, which requires specification of the demand function, $f(p)$. For simplicity, assume the linear form (22), and that queuing is possible and there is no excess capacity, as in section II. Then substituting (22) and (4) into (5), and dividing through by the number of firms in the cartel, profits per cartel member are given as

$$\pi_m/m = (p_m - p_c + r)\left[b(p_c - p_m)/m + (a - bp_c)/n\right] \quad (26).$$

The derivative of (26) with respect to $p_m$ is

$$d(\pi_m/m)/dp_m = \frac{2b}{m}(p_c - p_m) + (a - bp_c)/n - br/m \quad (27),$$

which is zero at the value, $p_m^*$, of $p_m$ such that

$$p_m^* = p_c + m(a - bp_c)/2bn - r/2 \quad (28).$$

Substituting $p_m^*$ into (26) to get maximum profits per member, $\pi_m^*/m$, yields

$$\pi_m^*/m = r^2b/4m + m(a - bp_c)^2/4bn^2 + r(a - bp_c)/2n \quad (29).$$

The derivative of (29) with respect to $m$ is

$$d(\pi_m^*/m)dm = (a - bp_c)^2/4bn^2 - r^2b/4m^2 \qquad (30),$$

which has a minimum at the value of $m$, $m^*$, such that

$$m^* = rbn/(a - bp_c) \qquad (31)$$

Substituting (31) into (28) gives

$$p_m^* (m = m^*) = p_c + rbn(a - bp_c)/2bn(a - bp_c) - r/2$$

$$= p_c \qquad (32).$$

Therefore a value for $m$ less than $m^*$ would imply a $p_m^*$ less than $p_c$, which is ruled out by the capacity constraint (6); thus, in the permitted range of $m$, maximal profits per cartel member are everywhere an increasing function of $m$, so that the optimal cartel has $n$ members - all the firms in the industry.

Note that (31) gives the minimum viable size of cartel in this special case of a linear demand curve.

To the extent that the results of this section are true for more general assumptions about demand, they suggest that only the extreme duality of market structure may be stable in the long run. If the minimum viable size of a cartel is large, relative to setting-up costs, the firms in an industry may remain competitive price-takers, as demonstrated in sections II and III. If, however, a viable cartel does get formed, it will tend to increase membership, by takeover or merger, until it monopolizes its industry.

There are some qualifications. Even if a cartel is effective in policing its own members, as we have assumed throughout, it may still have trouble with other firms in the industry which may refuse membership and set their price just below the cartel's level. By so doing, they would increase their own profits without affecting the profits of the cartel. However the cartel is likely to consider this to be unfair behaviour, and may take measures, such as temporary price-cutting, to force the renegrade firms into joining up.

There is the possibility that firms from other industries may enter and copy the cartel's price, thereby reducing its profits. However, if the costs of setting up cartels are small, it would be more profitable for potentially mobile firms to remain in their original industry, and cartelize it. The existence of high profits in an industry is not a sufficient condition for entry to take place.

The cartel's position will be stronger, of course, if it possesses genuine cost advantages such as those discussed in section IV. It will be able to use the lower costs to finance price wars, and as an additional inducement to encourage new membership. The cartel would be better placed too, in a model dropping the assumption, maintained here, that all the firms are located in the same market-place, and allowing them to be spread about geographically. Then, if there are transport costs, a cartel could conduct a localized price war against a deviant, without lowering the profitability of all of its members.

## VI. Welfare and Policy

In this section we look briefly at the welfare aspects of cartelization, and some policies that they suggest.

First, note that, if queuing can occur, full monopoly may be preferable to limited cartelization. Consider figure 6. $p_c$ is the competitive price, and the price charged by non-members of cartels, $p_m$ is the price that would be set by some subset of the firms acting as a cartel, and $p_m'$ is the price of a monopoly cartel of all the firms in the industry. Other notation is as in figure 2.

Compared with perfect competition, monopoly involves a deadweight consumer surplus loss equal to the area of the triangle HIF. Partial cartelization carries a smaller consumer surplus loss - the triangle GEF, plus a deadweight loss equal to the rectangle ABCD - the cost of the queues for the output $q_c'$ still sold at $p_c$ by the non-cartel firms. Under monopoly there is no welfare loss from queuing because there are no queues.

If the area of ABCD is greater than that of HIEG, then full monopolization is less wasteful than partial cartelization.

In this situation, therefore, useful policies might be to encourage the 'rationalization' of a partially cartelized industry into a full monopoly, or to impose retail price maintenance on those firms who, for social, ethical, or ignorant reasons, are unwilling to change their price from $p_c$. A better policy, of course, is to control the industry price at $p_c$.

To the credit of cartelization in general will be any genuine cost advantages that may be generated, perhaps after some time, by, for example, the pooling of orders and consequent elimination of excess capacity suggested in section IV above.

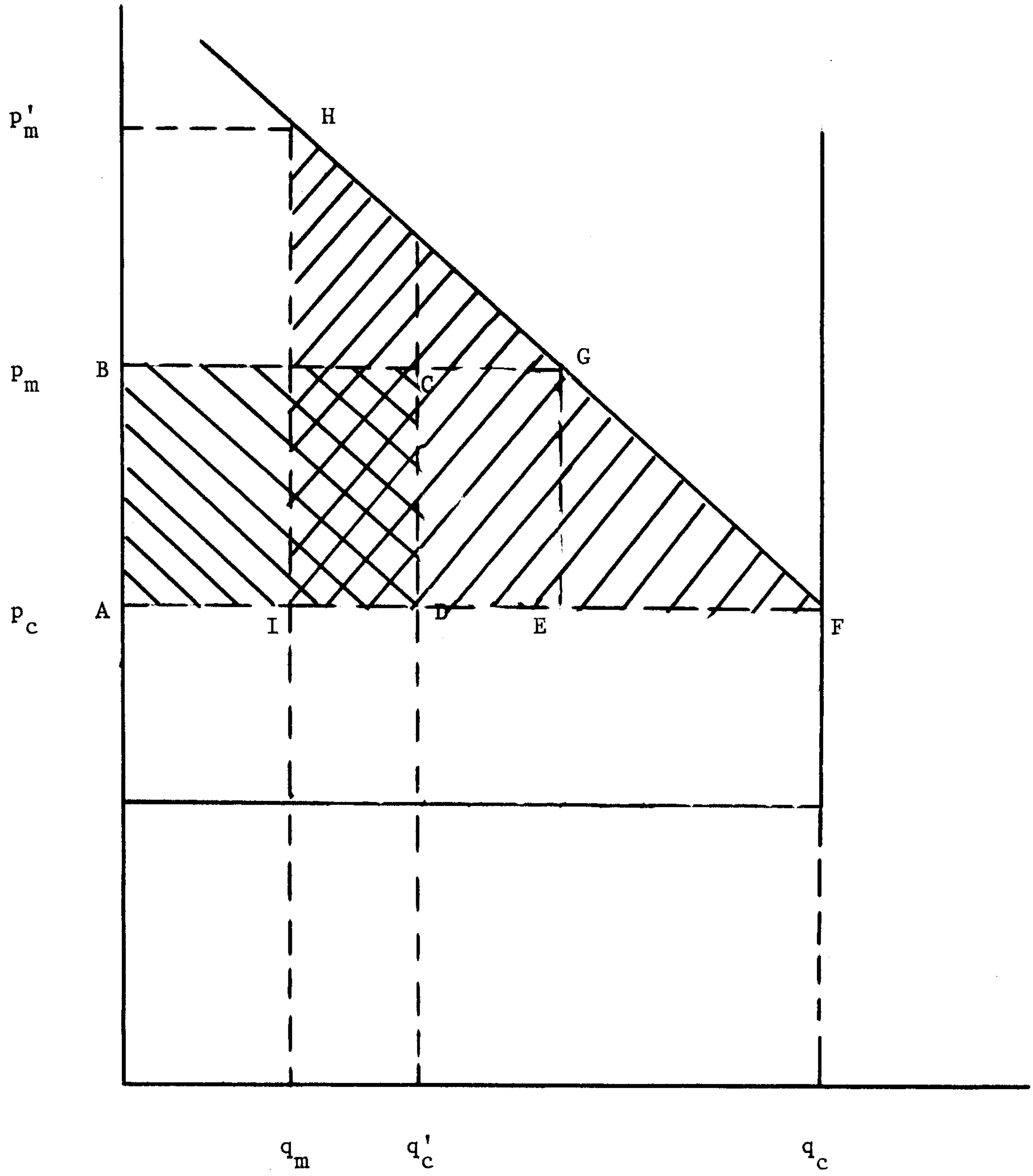



Figure 6 : Welfare Losses

Footnotes

(1) cf. the critical survey by Wachter and discussion in the Brookings Papers on Economic Activity.

(2) At least when buyers have perfect information, as we assume here.

(3) Galbraith (p. 43) contrasts the '333 industrial corporations' with 70 per cent of all assets employed in manufacturing with the 'several hundred thousand small manufacturers' who share the remainder of the assets. However, striking though this contrast is, it does not imply a break, or duality, in the size distribution of firms.

(4) cf. T. Hazledine, 'Equilibrium of the Competitive Firm and Industry with Stochastic Demand', mimeo.

References

Barzel, Yoram; 'A Theory of Rationing by Waiting', The Journal of Law and Economics, April, 1974.

Cheung, Steven N.S., 'A Theory of Price Control', ibid.

Galbraith, John Kenneth, Economics and the Public Purpose, André Deutsch, 1974.

Hazledine, Tim, 'Dual Labour Markets', University of Warwick Economic Research Paper, Number 37, 1974.

Mood, A.M. and F. A. Graybill, Introduction to the Theory of Statistics, 2nd edition, McGraw-Hill, 1963.

Reich, Michael David M. Gordon and Richard C. Edwards, 'A Theory of Labour Market Segmentation', American Economic Review, May 1973.

Stigler, G.J. and J. K. Kindahl, The Behaviour of Industrial Prices, National Bureau of Economic Research, 1970.

Vietorisz, Thomas and Bennett Harrison, 'Labour Market Segmentation: Positive Feedback and Divergent Development', American Economic Review, May 1973.