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ANNUAL SURVEY OF ECONOMIC THEORY: THE THEORY OF MONOPOLY

By J. R. HICKS

I PROPOSE in this survey to confine attention to the progress which has recently been made in one particular part of economic theory. Such a limitation has obvious advantages in facilitating more detailed discussion; and when one has decided to confine oneself to a particular field, it is obvious that monopoly has the best claim to be chosen. The last five or six years have seen the appearance of at least four important works specially devoted to this subject—those of Dr. Zeuthen, Dr. Schneider, Professor Chamberlin, and Mrs. Robinson;¹ while there is, I think, no theoretical subject which has received more attention in the recent volumes of most of the chief economic journals than the theory of monopoly and imperfect competition. To most of these articles we shall refer as we proceed; but the names of Mr. Harrod, Mr. Shove, Dr. v. Stackelberg, and Professor Hotelling, cannot be omitted from even a preliminary bibliography.²

The preoccupation of contemporary theorists with problems of monopoly does not appear to be due, as might perhaps be expected, to their consciousness of the increased urgency of these problems in the modern world. It may very well be that monopoly is more important today than it was fifty years ago, though it is not so obvious as it appears at first sight. It is certain, however, that the phenomena of monopolistic competition to which attention has so particularly been directed are not new phenomena; they were observed and analyzed, however imperfectly, by older economists, by Cairnes and Wicksell, if by no others.³

The widespread interest in monopoly theory is much easier to account for on grounds inherent in the development of economic theory itself, though here an element of coincidence is present. On the one hand, the generally increased interest in mathematical economics dur-

¹ F. Zeuthen, *Problems of Monopoly and Economic Warfare*, London 1930; Schneider, *Reine Theorie monopolistischer Wirtschaftsformen*, Tübingen 1932; E. H. Chamberlin, *Theory of Monopolistic Competition*, Harvard 1933; J. Robinson, *Economics of Imperfect Competition*, London 1933.

² R. F. Harrod, "Notes on Supply," *Econ. Jour.* 1930; "Law of Decreasing Costs," *E.J.* 1931; "Doctrines of Imperfect competition" *Q.J.E.* 1934; G. F. Shove, "The Imperfection of the Market," *E.J.* 1933; H. Hotelling, "Stability in Competition," *E.J.* 1929.

³ Cairnes, *Political Economy*, pp. 115–116 (quoted Chamberlin, *op. cit.* p. 106); Wicksell, *Lectures on Political Economy*, I, pp. 87–88.

ing the last few years (of which this journal is itself a symptom) has naturally turned attention back to the work of Cournot, the great founder of the subject, and still one of its best teachers. It was Cournot's creation of elementary monopoly theory which was the first great triumph of mathematical economics; yet Cournot had left much undone, and it is not surprising that the endeavor to complete his work should have been an attractive occupation for his successors.

But if some modern monopoly theorists have been seeking to fill the gaps in Cournot, others have been more concerned with the gaps in the work of Marshall. These gaps were more skilfully passed over, and it was not until after many years' criticism that they were clearly discerned. But the controversy on the "Laws of Returns," begun by Mr. Sraffa in 1926, and carried on more or less continuously in the *Economic Journal* for some years afterwards,⁴ made it increasingly evident to the most convinced Marshallians that the device of "external economies," by which Marshall sought to reconcile the postulate of perfect competition with the observed facts of increasing returns, would not bear the weight that had been imposed upon it. A tendency therefore developed away from the postulate of perfect competition. The participants in the discussion began to assume as the normal case that a firm can influence to some extent the prices at which it sells, that it is confronted with a downward sloping demand curve for its products, though this demand curve may have a high elasticity. With this assumption, the cardinal difficulty of increasing returns disappeared, since a firm might still be in equilibrium under conditions of diminishing cost. But numerous other difficulties started up, and it became necessary for these writers, like those mentioned before, to make a detailed examination of the theory of monopoly.

From each line of approach a substantially similar theory has emerged, though there are important points which still remain controversial. It remains convenient for us to discuss the modern theory under the old headings: (1) *Simple monopoly*, where the individual firm is confronted with given demand functions for its products, and given supply functions for its factors; (2) *Monopolistic Competition*, the relations of a group of firms producing similar products, i.e., an industry; (3) *Bilateral Monopoly*, where one firm is selling to another.

I. SIMPLE MONOPOLY

As far as simple monopoly is concerned, the improvement on Cournot is mainly a matter of exposition, although there has been some further enquiry into the effect of monopoly on the demand for factors of production.

⁴ See bibliography in *Economic Journal* (1930), p. 79.

1. If the prices at which the monopolist hires his factors are fixed, his cost of production can be taken as a simple function of output. Let $\phi(x)$ be the total cost of producing an output x .

If the monopolist's selling price is p , and $p=f(x)$ is the demand curve confronting him, his profit on selling an output x will be

$$xf(x) - \phi(x)$$

which is maximised when

$$xf'(x) + f(x) = \phi'(x).$$

So much has been familiar since Cournot; the principal recent innovation has been to give the expression on the left of the last equation a name "Marginal Revenue."⁵ The equation can then be written

$$\text{Marginal Revenue} = \text{Marginal Cost}$$

which is certainly a convenient way of expressing the first condition of monopolistic equilibrium.

Since the elasticity of the demand curve $= \eta = -\frac{f(x)}{xf'(x)}$, marginal revenue

$$= \text{price} \left(1 - \frac{1}{\eta} \right).$$

The second condition of maximum profits is that

$$\frac{d}{dx} \{ xf'(x) + f(x) - \phi'(x) \}$$

should be negative. This can be written

$$\frac{d}{dx} (MR) < \frac{d}{dx} (MC).$$

Monopolistic equilibrium is therefore stable, so long as the marginal revenue curve slopes downwards more steeply than the marginal cost curve. All cases where the marginal revenue curve slopes downwards and the marginal cost curve upwards are therefore stable, but instability may occur if either of these conditions is not fulfilled. Upward sloping marginal revenue curves, though possible, are unlikely to be very important, since the demand curve from which a marginal revenue

⁵ So Mrs. Robinson. It seems the most convenient of the names which have been suggested.

curve is derived may be taken to be always downward sloping. Much more important is the fact that stable equilibrium with a downward sloping marginal cost curve is possible, so long as the downward slope is less than that of the marginal revenue curve, and so long, also, as total receipts exceed total costs by an amount sufficient to keep the monopolist in business.

The question of stability once settled, it becomes possible to apply the apparatus in the ordinary manner, familiar in elementary theory, to simple problems of change. A rise in the marginal cost curve will reduce output, a rise in the marginal revenue curve will increase it; but a rise in the demand (average revenue) curve may not increase output, unless it is such as to cause a rise in the marginal revenue curve. Similarly a rise in average costs will not contract output, unless it is associated with a rise in marginal costs, or is otherwise large enough to drive the monopolist out of business.

2. *The monopolist and the factors of production.*⁶—It is convenient, for the analysis of this problem, to conceive of the monopolist as owning certain factors of production (his *private factors*, we may call them) and hiring others. If he is unable to vary the supply of these private factors, then it is strictly correct to suppose him endeavouring to maximize his profits, that is to say, to maximise the net earnings of these private factors. If this assumption cannot be made, difficulties emerge, which had better be examined later.

If the quantities of factors hired are a, b, c, \dots , their prices $\pi_a, \pi_b, \pi_c, \dots$, and their supply curves to the monopolist are given, then

$$\text{Monopoly profit} = xp - a\pi_a - b\pi_b - c\pi_c - \dots$$

This is maximised when

$$\left(p + x \frac{dp}{dx}\right) dx - \left(\pi_a + a \frac{d\pi_a}{da}\right) da - \left(\pi_b + b \frac{d\pi_b}{db}\right) db - \dots = 0$$

which becomes

$$MRdx - MC_a da - MC_b db - \dots = 0,$$

if we write MC_a for $\pi_a + a \frac{d\pi_a}{da}$, and so on.

Taking $x = \phi(a, b, c, \dots)$ as the production function, technically given, then

⁶ Robinson, *op. cit.*, Books VII-IX; Schneider, "Bemerkungen zur Grenzproductivitätstheorie," *Zeitschrift für Nationalökonomie*, 1933. See also Dr. Schneider's *Theorie der Produktion* (1934); pp. 57, 76.

$$dx = \frac{\partial x}{\partial a} da + \frac{\partial x}{\partial b} db + \dots$$

Substituting in the above, we have

$$\left(MR \frac{\partial x}{\partial a} - MC_a \right) da + \left(MR \frac{\partial x}{\partial b} - MC_b \right) db + \dots = 0.$$

Since this equation must hold for all values of da , db , \dots , it follows that

$$MR \frac{\partial x}{\partial a} = MC_a, \quad MR \frac{\partial x}{\partial b} = MC_b, \dots$$

for all factors.

MC_a , MC_b , \dots , are the *marginal costs to the monopolist* of hiring an additional unit of the factors, a , b , \dots . If the supply curves of the factors slope upwards, these marginal costs will exceed the prices of

the factors by $a \frac{d\pi_a}{da}$ etc., respectively, that is to say, by the additional

amounts which have to be paid on earlier units in order to keep their

prices on a level with that of the marginal unit of the factor. $MR \frac{\partial x}{\partial a}$

is conveniently described as the "marginal value product" of the factor a ; it is the increment in the total value of the product which results from the application of an additional unit of a . The condition of factor equilibrium is thus that the marginal value product of a factor should equal its marginal cost.

The stability conditions for factor equilibrium do not appear to have been fully investigated; but a cursory examination suggests that there are several ways in which the presence of monopoly brings into the possible range of stable equilibria positions which would not be stable under perfect competition.

If the supply curve of any factor to the monopolist is horizontal, so that the monopolist is unable to affect the price of that factor, then even so his demand for that factor will be reduced below what it might have been, if the product demand curve confronting him is imperfectly elastic. Monopolistic exploitation of the consumer therefore brings about a directly consequent reduction in the demand for factors. And if a number of monopolists are employing a particular factor, they may each be unable by isolated action to influence the price of the factor; and yet, in their efforts to exploit the consumer, they will

each reduce their demand for the factor, and the price of the factor may, in consequence, be reduced. But this is a different thing from the additional reduction in demand which comes about if a monopolist is able to influence the price of a factor directly, so that he takes into account the saving on other units which he gets by reducing his demand at the margin. The first type of reduction would be called by Mrs. Robinson "monopolistic exploitation" of the factor, while she has invented the term "monopsonistic" to describe exploitation of the second type.

3. *Simple monopoly and joint production.*—Nearly all the writers here discussed have confined their analysis of simple monopoly to the case where the monopolist produces only one product.⁷ For reasons which will appear later, this limitation seems rather unfortunate. A brief but illuminating discussion of the problem has, however, been given by Dr. von Stackelberg, which we may here reproduce.⁸

It is convenient, in order to isolate the problem, to assume that the prices of the factors are now given to the monopolist; we can then introduce a cost function expressing the total cost of production of quantities x_1, x_2, \dots , of the different products. Let $\phi(x_1, x_2, \dots)$ be the cost function.

Then Monopoly profit = $p_1x_1 + p_2x_2 + p_3x_3 + \dots - \phi(x_1, x_2, \dots)$.

If we assume that the demand curves for the various products are independent, so that p_1 depends upon x_1 only, not on x_2, x_3, \dots , then the conditions of equilibrium are

$$\frac{d}{dx_1}(p_1x_1) = \frac{\partial \phi}{\partial x_1}, \quad \frac{d}{dx_2}(p_2x_2) = \frac{\partial \phi}{\partial x_2}, \quad \dots$$

The ordinary "marginal revenue marginal cost" condition still holds.

If, however, the demand curves are not independent, then the conditions become

$$p_1 + x_1 \frac{\partial p_1}{\partial x_1} + x_2 \frac{\partial p_2}{\partial x_1} + \dots = \frac{\partial \phi}{\partial x_1}$$

$$p_2 + x_1 \frac{\partial p_1}{\partial x_2} + x_2 \frac{\partial p_2}{\partial x_2} + \dots = \frac{\partial \phi}{\partial x_2}$$

and so on. That is to say, the monopolist has to take into account, when fixing the output of any particular product, not only the reaction

⁷ Professor Chamberlin gives us an interesting account of the factors which determine what that one product shall be (*op. cit.* ch. 4 and 5).

⁸ H. von Stackelberg, *Grundlagen einer reinen Kostentheorie* (Vienna 1932), p. 68. See also Hotelling, "Edgeworth's Taxation Paradox," *Journal of Political Economy* 1932.

of an increased supply upon the price of that product, but also its reaction upon the prices of all other products which he is selling. If the

cross-coefficients $\left(\frac{\partial p_2}{\partial x_1} \text{ etc.}\right)$ are negative (roughly speaking, the

case when the different products are competitive in consumption),⁹ these reactions will lower the marginal revenue curve for any particular product, and so tend to restrict output. But in the opposite case, when the cross-coefficients are positive, the marginal revenue curve will be raised; so that here the restriction of output under monopoly will be less than we should have at first expected.

If $x_2 \frac{\partial p_2}{\partial x_1} + x_3 \frac{\partial p_3}{\partial x_1} + \dots$ is positive, and greater than $\frac{\partial \phi}{\partial x_1}$, it may

pay the monopolist to produce a finite output of x_1 , even if he has to give it away. And such a phenomenon is surely not uncommon; a very considerable part of what are usually described as "selling costs" comes very conveniently under this head. The subject of selling costs has been analyzed at considerable length and with much insight by Professor Chamberlin, who maintains, however, the single-product firm as the foundation of his analysis. It may be suggested that the subject could be further illuminated, and brought closer into relation with fundamentally analogous cases where the "bait" is not actually given away, if a start had been made from Dr. von Stackelberg's more general case.¹⁰

4. *Discrimination*.—From one point of view, discrimination is a limiting case of joint production. When we say that a single commodity is sold by a monopolist at various different prices, the singleness of the commodity consists solely in its various units being perfect substitutes on the supply side. We can introduce this condition of being perfect substitutes in production, and so go over from joint production to discrimination.

But this line of approach, although it has conveniences, and brings discrimination into a very satisfactory relation with general monopoly theory, is not that which has traditionally been adopted. Of recent writers, Mrs. Robinson is the only one who has added anything substantial to the traditional theory of discrimination. She has devoted to it what is probably the best, as it is certainly the most ingenious, part

⁹ I say "roughly speaking," for it is becoming apparent that the terms *competitive* and *complementary* conceal a great many ambiguities. (See Hicks and Allen, "A Reconsideration of the Theory of Value," *Economica* 1934.)

¹⁰ The same foundation might be used for an analysis of monopolistic exploitation by "compulsory joint supply."

of her book; there can be no question that these chapters will find their place along with Dupuit and Pigou on the very select bibliography of discrimination theory.

5. *The "private" factors.*—Most modern writing on monopoly, as we have said, has been content to assume a monopolist simply seeking to maximise his profits, that is to say, it neglects possible changes in the supply of private factors. This omission seems to me unfortunate, though it must be confessed that the subject presents grave difficulties.¹¹ On the one hand, unless we assume that the marginal utility of money to the monopolist is constant, we cannot unambiguously express in monetary terms the subjective cost to the monopolist of producing additional units of output; we are therefore unable to introduce the private factors into the "marginal revenue = marginal cost" equation, and are obliged to fall back upon Paretian indifference curves, more cumbrous, and in this case decidedly less informative. The second difficulty is even more formidable. Under conditions of monopoly, there is no reason to suppose any particular connection between subjective cost and *output*, since it is probable that a considerable part of the monopolist's efforts and sacrifices will be devoted, not to increasing his output, but finding to what precise point he should restrict it. Now, as Professor Bowley¹² and others have pointed out, the variation in monopoly profit for some way on either side of the highest profit output may often be small (in the general case, it will depend on the difference between the slopes of the marginal revenue and marginal cost curves); and if this is so, the subjective costs involved in securing a close adaptation to the most profitable output may well outweigh the meagre gains offered. It seems not at all unlikely that people in monopolistic positions will very often be people with sharply rising subjective costs; if this is so, they are likely to exploit their advantage much more by not bothering to get very near the position of maximum profit, than by straining themselves to get very close to it. The best of all monopoly profits is a quiet life.

II. MONOPOLISTIC COMPETITION

1. We come now to the "group problem," the equilibrium of a group of firms producing similar but not identical products. The treatment of this problem by Professor Chamberlin and by Mrs. Robinson (the same applies, though with some qualification, to Mr. Harrod) is based upon a very neat geometrical proposition.¹³ Since the products of the

¹¹ Cf. Robinson, "Euler's Theorem and the Problem of Distribution," (*E. J.*, 1934).

¹² *Mathematical Groundwork of Economics*, pp. 25, 60.

¹³ Chamberlin, *op. cit.* p. 84; Robinson, pp. 94–95; Harrod, "Doctrines of Imperfect Competition," *Q.J.E.* 1934, p. 457.

various firms are not identical, the demand curve which confronts each individual firm will not be horizontal, but will slope downwards.¹⁴ On the other hand, if entry into the industry is free, it will be impossible for the firms in the industry to earn more than "normal profits." On the basis of the first assumption, it is concluded that the output of each firm will have to satisfy the condition of monopolistic equilibrium, marginal revenue = marginal cost. On the basis of the second, it is concluded that the price of each product will have to equal average cost, when average cost is calculated in such a way as to include "normal profits."

If then we write π_x = average cost (in the above sense) of producing an output x , and p_x = the price at which the firm can sell that output, the second condition gives us

$$p_x = \pi_x \quad (1)$$

while we have from the first condition

$$\begin{aligned} \frac{d}{dx}(xp_x) &= \frac{d}{dx}(x\pi_x) \\ \therefore p_x + x \frac{dp_x}{dx} &= \pi_x + x \frac{d\pi_x}{dx} \\ \therefore \text{from (1), } \frac{dp_x}{dx} &= \frac{d\pi_x}{dx} . \end{aligned} \quad (2)$$

From (1) and (2) it follows that the demand curve and the average cost curve must touch at a point of equilibrium.

Since the demand curve is downward sloping, the average cost curve must also be downward sloping at the equilibrium point. Equilibrium under monopolistic competition is only possible when average costs are diminishing; that is to say, the equilibrium output of a firm will be less than the output which would give minimum average costs—the output which would actually be reached under conditions of perfect competition. From this Professor Chamberlin proceeds to the conclusion that analysis based on perfect competition makes "the price always too low, the cost of production too low, the scale of production too large, and the number of producers too small."

In order for us to estimate the importance of this result, we must begin by examining the premises on which it is based. To take first the "average cost curve." When Walras and Pareto reckoned profits into

¹⁴ Professor Chamberlin constructs this individual demand curve on the assumption that the prices of the rival commodities remain unchanged (p. 75). Mrs. Robinson's formulation seems distinctly ambiguous (p. 21).

costs, they were thinking of conditions of perfect competition, and their conclusion that $\text{price} = \text{average cost}$, so that the entrepreneur makes "ni bénéfice ni perte," meant nothing else than that the private factors of the entrepreneur could get no other return in the static equilibrium of perfect competition than would have accrued to them if they had been directly hired out on the market. But is it possible to transfer this conception to the theory of monopolistic competition? So far as the private factors are to some extent unique, so that there are no perfect substitutes for them (and this seems the most likely case in which monopolistic competition might arise), they can have no market price which is not to some extent monopolistically determined. If there are perfect substitutes for them, why are those perfect substitutes not being employed in making perfect substitutes for the product?

There is only one way out of this dilemma, and I can only suppose that it is this which the writers in question have in mind. The factors of production, private or hired, may be sufficiently divisible, and sufficiently scattered in ownership, to ensure that there is a perfect market for them, or something sufficiently perfect for the imperfections to be negligible. But there may still be a range of increasing returns in the production of any particular product, due to indivisibilities in the production function, not in the factors themselves.¹⁵ If this is the case, substantially homogeneous factors may be put together by a limited number of firms into a limited number of different products, each of which is unique, and the demand curve for each of which is downward sloping.

This is the only state of affairs of which the Chamberlin-Robinson apparatus seems to be an exact description; it is probable that it does correspond with a certain region of reality. But I cannot help feeling that the application of the apparatus is implicitly much exaggerated. This is only partly because of the actual heterogeneity of factors—both writers accept this difficulty, and at the worst it only means that the technical apparatus is over-rigid. They can still claim to have shown that monopolistic restriction of output is compatible with earnings in no way out of the ordinary. A much more serious objection arises from the variability of the product.

There are two relevant sorts of product variation. One, the only kind which has been much discussed, is where each firm produces a single product, but the nature of that product is capable of being changed. This problem has been dealt with mostly in terms of location;

¹⁵ Kaldor, "The Equilibrium of the Firm," *Econ. Jour.* March 1934, p. 65n. On the general question of indivisibilities and costs, see also the appendix to Mrs. Robinson's book; also Schneider, *Theorie der Production*, ch. 1.

a product available in a different place is economically a different product, and a change in the location of the firm is one of the ways of varying the product. (Professor Chamberlin's discussion of location is, however, reinforced by a discussion of the same problem in more general terms.)

In his paper, "Stability in Competition,"¹⁶ Professor Hotelling had demonstrated that there is a tendency, when two firms are competing for a given market, for them to get together in the centre of the market. This tendency in itself would thus be favorable to the establishment of conditions of approximately perfect competition, if it could be shown to hold for more firms than two.

Unfortunately, as Professor Chamberlin shows, this is not so.¹⁷ Once there are more than two firms in the market, they will tend to scatter, since any firm will try to avoid being caught between a pair of others. It seems evident that this general tendency to dispersion will be present when it is a question of quality competition as well as of competition in location, though of course the possible kinds of variation are even more complex.

Thus, so long as we retain the "one firm one product" assumption, variability of the product is not sufficient to prevent an appreciable degree of imperfection in the elasticity of the demand curve confronting any particular firm. The position seems, however, to be different once we drop this assumption.

In fact, when "product" is interpreted in the strict economic sense of a collection of articles that are to the consumer perfect substitutes, almost every firm does produce a considerable range of different products. It does so largely because there are economies to be got from producing them together,¹⁸ and these economies consist largely in the fact that the different products require much the same overheads. Further, at any time the products it is actually producing will probably not exhaust the list of products it could produce from approximately the same plant. Thus it will have various potential products which it could produce in small quantities at quite a low marginal cost.

Now when other producers are able to supply small quantities of highly competitive products at low prices, this is at last an effective force tending to keep the demand curve for a particular product of a particular firm very highly elastic. Of course, it will probably not be

¹⁶ *Op. cit.* See also Zeuthen, "Theoretical Remarks on Price Policy," *Q.J.E.* 1933.

¹⁷ *Theory of Monopolistic Competition*, Appendix C.

¹⁸ In the sense that it costs less to produce outputs x_1 and x_2 in a single firm, than it would cost (in total) to produce output x_1 in one firm and output x_2 in another.

perfectly elastic; for in fact any degree of specialization on a particular line offers a *prima facie* case that the specializing firm has some particular facilities for that line, and it may be able to carry out a certain degree of restriction before it tempts other firms to follow it. Further, a firm is always likely to be on the lookout for a line in which it is relatively safe from such competition. Nevertheless, this consideration does seem to go a good way to justify the traditional practice of economists in treating the assumption of perfect competition as a satisfactory approximation over a very wide field.¹⁹

A considerable degree of the sort of market imperfection we have been discussing seems likely to arise in two cases only: (1) where the producer has command of some specialized "factor," such as patent, legal privilege, site, or business capacity, for which no clear substitute is available; (2) where economies of scale are narrowly specialized, so that it would be impossible for another firm to produce commodities highly competitive with these produced by the first firm excepting at much greater marginal cost. There is no doubt that such conditions as these are fairly frequent, but they are, after all, precisely the cases which have been traditionally treated under the heading of monopoly.

2. *Duopoly*.—There is, however, one further difficulty of great importance. We have suggested that the demand curve for a particular product of a particular firm will usually be kept highly elastic by the incursion of other producers selling small quantities of highly competitive products, if the first firm raises its price. But if they do so, will not the first firm retaliate on them?

Two cases have thus to be distinguished. The first is when the other potential producers are fairly numerous. In this case, they are not likely to be much deterred by the fear of retaliation. For although the first firm may find it profitable to turn its attention to some other product if it meets with competition in the line it had first chosen, the chance of that other product being highly competitive with the products of any particular other producer is small.

In the other case, when the other potential producers are few, the fear of retaliation is likely to be more serious, and it may very well stop poaching.

The difficult problem which arises from the relations of a very small number of competing firms has been much studied in recent years, but there has not yet developed any very close agreement on the solution. Largely owing to the difficulty of the problem, it has been chiefly studied in its most simple case, that of two firms producing an identical product—duopoly.²⁰

¹⁹ Cf. Shove, "The Imperfection of the Market," *Econ. Jour.* 1933, pp. 115-116.

The theory of duopoly has a long history; and here we can do no more than allude to the classical theory of Cournot, and the displacement of Cournot's theory by the criticisms of Bertrand and Edgeworth, which form the ancient history of the subject. Edgeworth's solution, based on "the characteristic freedom of the monopolist to vary price," involved such peculiar assumptions about costs that it could hardly have held the field forever. The post-war period therefore saw a renaissance of Cournotism, led by Amoroso and Wicksell;²¹ this movement is represented also by the chapter on "Mehrfaches Monopol" in Dr. Schneider's book.²² In the next stage, criticisms of both the Cournot and Edgeworth solutions were offered by Dr. Zeuthen and by Professor Chamberlin;²³ it then became clear that each of the rivals had pointed the way towards a possible solution, but that even together they did not exhaust the list.

A very convenient line of approach, which sets these alternative solutions in their places, and so opens a path towards a general theory, can be developed from a hint given in Professor Bowley's *Mathematical Groundwork*.²⁴ It is this approach which appears to be gaining ground at present. Its main principle can be expressed as follows.²⁵

The marginal revenue, which a duopolist endeavors to equate to his marginal cost,

$$= \frac{d}{dx_1} (px_1)$$

where x_1 is his output, and $p = f(x_1 + x_2)$, x_2 being the output of his rival. Thus

$$MR_1 = \frac{d}{dx_1} (px_1) = p + x_1 f'(x_1 + x_2) + x_1 f'(x_1 + x_2) \frac{\partial x_2}{\partial x_1}.$$

The marginal revenue curve which confronts the duopolist is thus in

part dependent upon a quantity $\frac{\partial x_2}{\partial x_1}$, which we can only interpret

²⁰ Chamberlin, however, has made at any rate a preliminary investigation of the more complex cases where several firms are involved. See his sections on "oligopoly" (*Theory*, pp. 100, 170).

²¹ Amoroso, *Lezioni d'economia matematica*; Wicksell, Review of Bowley's *Mathematical Groundwork*, *Archiv für Sozialwissenschaft* 1927.

²² Schneider, *Reine Theorie*, ch. 4.

²³ Zeuthen, *Problems of Monopoly*, ch. 2; Chamberlin, *Theory*, ch. 3, which substantially reproduces his article on "Duopoly," *Q.J.E.* 1929.

²⁴ P. 38.

²⁵ The following owes much to some yet unpublished work by Mr. W. M. Allen, of Oxford.

as the degree to which the duopolist expects his rival to expand (or contract) output, if he himself expands his output by an increment

dx_1 . Since $f'(x_1+x_2)$ is negative, a negative value of $\frac{\delta x_2}{\delta x_1}$ will raise

the adjusted marginal revenue curve of the duopolist, and thus be favorable to an expansion of output; a positive value will favor a contraction.

The conception of these "conjectural variations," $\frac{\delta x_2}{\delta x_1}$ etc., has been

analysed in very general terms by Professor Frisch.²⁶ There is, in the short period, no need for any particular degree of consistency between

the conjecture of the first duopolist $\frac{\delta x_2}{\delta x_1}$, and that of the second $\frac{\delta x_1}{\delta x_2}$.

The equation of marginal revenue and marginal cost thus determines the output of the first duopolist, once the output of the second duopolist, and the first duopolist's conjecture as to the variation of this output are given. For any particular type of conjecture, we can thus construct a "reaction curve," similar to that employed by Cournot, giving the preferred output of the first duopolist, corresponding to each possible output of the second. A similar reaction curve can be constructed for the second duopolist, and the intersection of the two will give the point of equilibrium.

In the majority of cases, these reaction curves will be negatively inclined;²⁷ and in the majority of these cases, the inclination will be such that an increased output by the other duopolist will react on the first in such a way as to increase the total output of both together. If we

²⁶ "Monopole—Polypole—La Notion de Force dans l'économie," *Nationalökonomisk Tidsskrift* 1933.

²⁷ The condition for negative inclination is that $1 + \frac{hx_1}{x} \left(1 + \frac{\delta x_2}{\delta x_1} \right)$ should be positive; where h is the "adjusted concavity" of the market demand curve.

(That is to say, $h = \frac{(x_1+x_2)f''(x_1+x_2)}{f'(x_1+x_2)}$. Cf. Robinson, *Economics of Imperfect*

Competition, p. 40.) Since we may assume that in all sensible cases, $1 + \frac{\delta x_2}{\delta x_1}$ is positive, it follows that the reaction curve will be negatively inclined in all cases when h is positive (when the demand curve is convex upwards) and also for a considerable number of cases when h is negative. It has been further shown by Mr. Allen that in such cases of negative inclination, the slope of the reaction

confine our attention to these *normal* cases, which are much the most likely to yield stable solutions, the more interesting assumptions about conjectures which have been made by recent writers fall into their places very simply.

(1) If the conjectural variations are both zero, we have of course the Cournot case. (2) If one of the conjectural variations is zero, but the other duopolist takes as his conjectural variation the actual slope of the reaction curve of his rival, we have the case of an "active" policy by one duopolist.²⁸ In *normal* conditions, this will make the conjectural variation of the active duopolist negative; thus, as compared with the Cournot case, it will raise his marginal revenue curve, increase his output, and (again in normal conditions) lead to an increased total output, and so a lower price. (3) If both duopolists act in this manner, each calculating conjectural variations from the other's Cournotian reaction curve, we have a curious case which has been investigated by Dr. von Stackelberg and Mr. Harrod.²⁹ In normal conditions, once more, this will lead to a further expansion of total output, and a further fall in price. (4) There does not seem to be any reason why we should stop here. One duopolist may become doubly "active," and calculate a conjectural variation from the reaction curve of his rival on the assumption that the rival is active. In most, though not (it appears) quite all, *normal* cases, this would lead to a further fall in price. The process becomes similar to one of price-cutting.

But once we are on the road of competitive price-cutting, it is reasonable to suppose that, sooner or later, one duopolist or the other would perceive that his conjecture that an increase in his output was leading to a contraction of his rival's was proving wrong. Once he acted on this, and constructed a conjectural variation based on this experience (and consequently a *positive* variation) the whole situation would be transformed. Price-cutting would give place to "tacit combination"; positive conjectures, again in normal conditions, would give a higher price than that given by the Cournot equilibrium.³⁰

The method just described is capable of extension to the case where

curve will also (for reasons of stability) be numerically less than 1, excepting when there is a high degree of asymmetry between the positions of the two duopolists. "Normal cases" are defined as satisfying these two conditions, so that dx_1/dx_2 , taken along the reaction curve of the first duopolist, lies between 0 and -1.

²⁸ V. Stackelberg, "Sulla teoria del duopolio e del polipolio," *Rivista italiana di statistica*, June 1933. This article also contains an important and ingenious extension of the theory to the case of several producers.

²⁹ V. Stackelberg, *ibid.* Harrod, "The Equilibrium of Duopoly," *Economic Journal*, June 1934.

³⁰ Nicoll, "Professor Chamberlin's Theory of Limited Competition," *Q.J.E.*

the product of one duopolist is not a perfect substitute for that of the other. We have only to write $p_1=f_1(x_1, x_2)$, $p_2=f_2(x_1, x_2)$; the two sellers will now of course usually sell at different prices. We then have

$$\begin{aligned} \text{Adjusted marginal reve-} &= \frac{d}{dx_1} (p_1 x_1) = p_1 + x_1 \frac{\partial p_1}{\partial x_1} + x_1 \frac{\partial p_1}{\partial x_2} \left(\frac{\partial x_2}{\partial x_1} \right), \\ \text{nue of first seller} \end{aligned}$$

from which we proceed much as before. This highly general solution can be applied whatever is the relation between the demands for the products; it can thus be applied to cases where the products are com-

plementary instead of competitive.³¹ Here $\frac{\partial p_1}{\partial x_2}$ will probably be

positive, so that it is an anticipated consequential expansion of the other's output which will raise the marginal revenue curve of the first duopolist, and *vice versa*.³²

III. BILATERAL MONOPOLY

"Bilateral Monopoly" is a phrase which has been applied to two different problems, and it is well to keep them distinct. The first is the case of isolated exchange, or of exchange between a group of buyers and a group of sellers, each acting in combination. Now so far as this problem is concerned, when the exchange is studied *in vacuo*, without reference to other people (outside the two groups) who may be indirectly concerned, I think one may say that there is complete agreement among economists. It has been evident since the days of Edgeworth that isolated exchange leads to "undecidable opposition of interests,"³³ and that therefore the problem is indeterminate, in the sense that the mere condition of each party seeking its maximum advantage is not sufficient to define an equilibrium.

The second problem is a more complex one. It arises when the commodity sold is a raw material or factor of production; so that we have also to take into account the relation of the buyer of the raw material to another market—that in which he sells his finished product. For this problem there existed a solution alternative to Edgeworth's, that

February 1934. Mr. Nicoll's case of tacit combination emerges if we write

$$\frac{\frac{\partial x_2}{\partial x_1} \frac{x_2}{x_1}}{\frac{\partial x_1}{\partial x_2} \frac{x_1}{x_2}} = \frac{\frac{\partial x_1}{\partial x_2} \frac{x_1}{x_2}}{\frac{\partial x_2}{\partial x_1} \frac{x_2}{x_1}}.$$

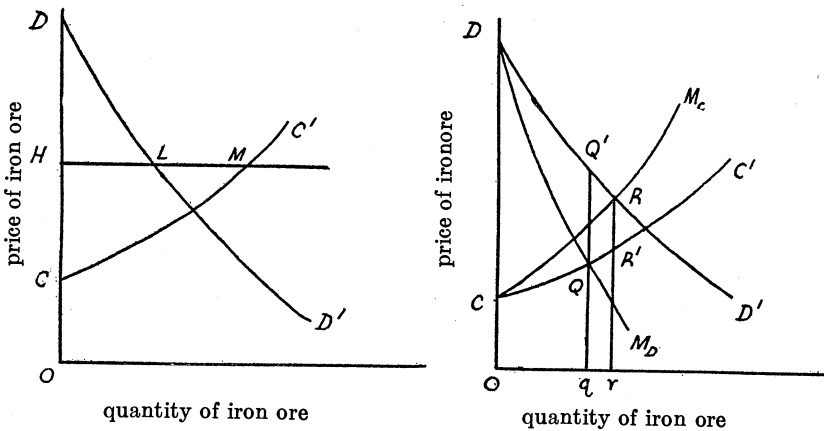
³¹ Cf. Edgeworth, "The Pure Theory of Monopoly," *Papers* II, 122–126.

³² See further, on the subject of duopoly, Professor Divisia's paper to the Leyden meeting of the Econometric Society, summarized in *ECONOMETRICA*, June 1934, and also in the *Revue d'Économie politique*, May 1934.

³³ *Mathematical Psychics*, p. 29.

of Cournot; Cournot had concluded that this more general problem is determinate. Here, as in the question of duopoly, Cournot has his modern followers; his position is defended by Dr. Schneider, and also, though with considerable qualifications, by Dr. Zeuthen.³⁴

It must be confessed, however, that the reader of their works finds it very difficult to see just how the presence of a consumers' market makes any difference to the opposition of interests deduced by Edgeworth; and we have the authority of Professor Bowley in support of the view that there is indeterminateness also in the more general case.³⁵ Personally, I find myself in agreement with Professor Bowley; but I think it may be worth while to restate Professor Bowley's argument in terms of the *marginal revenue* concept, since this seems to make the crux of the dispute clearer than it has been made up to the present.



A, a monopolist producer of raw material (iron ore), is selling to B, a monopolist producer of finished product (steel). Now, as we have seen, B's demand curve for iron ore (DD') is given by the marginal value product of iron ore (i.e., marginal physical product of iron ore in steel production \times marginal revenue from the sale of steel); while A's supply curve of iron ore will be given by his ordinary marginal cost curve (CC'). That is to say, if a particular price OH is fixed by some external authority, A would be willing to supply HM units, B would be willing to take HL units; the amount actually sold will be whichever of these is the less. Now, within limits, the higher the price fixed, the greater will be A's profits, the lower the price fixed, the greater will be the profit of B. There is thus an opposition of interests. But this only within limits; for after a point it would not pay A to push up the price

³⁴ Schneider, *Reine Theorie*, ch. 2; Zeuthen, *Problems of Monopoly*, pp. 65 ff.

³⁵ "Bilateral Monopoly," *Econ. Jour.* 1928.

any further. The output which maximizes A's profits will be given by the intersection of the curve marginal to DD' with CC' . DD' is the demand curve confronting A; we can draw a marginal revenue curve (DM_D) corresponding to it, to cut CC' at Q . A vertical line through Q cuts the horizontal axis in q , and DD' in Q' . Then the most profitable position for A is when his output is Oq and his price $Q'q$.

If on the other hand, B can fix the price, what is the point where his profits are maximized? This is found by drawing a curve marginal to CC' (CM_C), to intersect DD' in R . Draw $RR'r$ perpendicular to the horizontal axis. The output most favourable to B will then be Or , and the price $R'r$.

Thus there does seem to be an "opposition of interests"; how did Cournot and his followers come to an opposite view? They would hold that there is an equilibrium with the price at $Q'q$, for in this case both producers are earning a maximum monopoly profit, B from the consumers of steel, A from B. That is perfectly true; no monopoly action by A can stop B earning a monopoly profit from the consumers. But B is not only a monopoly seller with regard to the consumers; he is also a monopoly buyer with respect to A. If he is allowed to do so, he will also extract a monopsony profit from A; it was this that Cournot left out of account.

As we have said, this indeterminateness does not mean that the law of causality is suspended; it only means that the static assumptions of fixed demand and cost curves do not suffice to determine the price. Attempts have been made by Dr. Zeuthen and myself to reach a determinate solution by introducing more "dynamic" factors.³⁶ Dr Zeuthen's solution proceeds by examining the probability of each side breaking off relations, which correspond to each set of terms; mine by considering the length of time for which either party would be willing to "strike" in order to get any particular price. The two methods appear to be complementary.

IV. CONCLUSION

I have so far confined my remarks to the purely formal aspect of recent work on monopoly; but in conclusion something ought to be said about the applicability of this now well-developed technique. It is evidently the opinion of some of the writers under discussion that the modern theory of monopoly is not only capable of throwing considerable light on the general principles underlying an individualistic eco-

³⁶ Zeuthen, *op. cit.* ch. 4; "du Monopole Bilatéral," *Revue d'Économie politique*, 1933; Hicks, *Theory of Wages*, ch. 7; A treatment somewhat similar to Dr. Zeuthen's is to be found in G. di Nardi, "L'Indeterminazione nel Monopolio bilaterale," *Archivio Scientifico*, Bari, 1934.

monic structure, but that it is also capable of extensive use in the analysis of particular practical economic problems, that is to say, in applied economics. Personally, I cannot but feel sceptical about this.

We have already seen, in the case of duopoly, that the marginal revenue of a duopolist depends upon a term which can properly be called "conjectural." It is not the actual degree to which the second seller's output would change—it is the estimate of this degree on the part of the first seller. But once we have seen this, why mark this term only as conjectural? Is not the slope of the individual demand curve confronting a simple monopolist conjectural too? There does not seem to be any reason why a monopolist should not make a mistake in estimating the slope of the demand curve confronting him, and should maintain a certain output, thinking it was the position which maximized his profit, although he could actually have increased his profit by expanding or contracting.³⁷

It is this subjective character of the individual demand curve which leads one to scepticism about the applicability of the apparatus. For what are the objective grounds from which we can deduce the existence of a significant degree of imperfect competition? It may be said that as soon as we find firms concerning themselves with a price policy, or undertaking selling costs, some degree of imperfect competition must be present. This may be granted;³⁸ but what degree? Is it important or negligible? There is no means of finding out but to ask the monopolist, and it will be kind of him to tell us.

Whether competition is perfect or imperfect, the expansion of the individual firm will be stopped by factors which are purely subjective estimates; in the one case by rising subjective costs or costs of organization;³⁹ in the other by an estimated downward slope of the marginal revenue curve. Objective facts give us no means of distinguishing between them.

The new theories seem to make little difference to the laws of change as they are exhibited in the traditional analysis; usually they do no more than suggest new reasons why we should get certain familiar effects, and there is very little means of distinguishing between the

³⁷ This argument is fortified if the demand curve is interpreted (as for most purposes it probably ought to be) as a fairly "long-period" demand curve.

³⁸ Professor W. H. Hutt, "Economic Method and the Concept of Competition," *Economic Journal of South Africa*, June 1934, disputes this as far as selling costs are concerned. His argument would appear to be valid so long as advertisement and product are sold in fixed proportions, but it ceases to be so if the "co-efficients of consumption" are variable.

³⁹ Cf. E. A. G. Robinson, "The problem of management and the size of firms," *Econ. Jour.*, June 1934, and the same author's *Structure of Competitive Industry*. Also Kaldor, *op. cit.*

new reasons and the old. Whether an industry is monopolized, or duopolized, or polypolized, or operates under conditions of perfect competition, we shall expect a rise in demand to lead to a rise in output (though in all cases there are possible, but highly improbable, exceptions); and it is still likely that the rise in demand will be accompanied either by no change in price, or by a rise. New reasons are indeed adduced why a rise in output may be accompanied by a fall in price; it may be due to a rise in the elasticity of demand to the individual firm, rather than to economies of the Marshallian type. But the new explanation is not overwhelmingly convincing, and does not drive the Marshallian from the field.⁴⁰

It does indeed now become possible that a rise in supply—if it takes the form of an influx of new firms—may actually lead to a rise in price, as would not be possible under perfect competition. Yet the conditions for this to happen, that the influx of firms should make the demand curve confronting each firm in the industry *less elastic*, is so peculiar, that it is hard to attach very much importance to this case—at least, as analyzed.

It is therefore hard to see that the new analysis does much to displace Marshallian methods. Marshall's assumptions are simpler, and if we are unable to tell which of two hypotheses is more appropriate, the simpler has the obvious claim to be chosen. But of course this is not to say that in strong cases—cases, for example, where discrimination is practiced—we are not obliged to assume monopoly conditions, and to make what use we can of the elaborations here described.

From this point of view, substantial gains have certainly been made; we are now in the possession of a much more complete theory of monopoly than was the case a very few years ago. If, when we have it, it seems less use than had been hoped, this is not an uncommon experience in the history of human thought.

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⁴⁰ It is tempting to propose a rehabilitation of Marshall on the basis of these recent developments. Since it has become clear that "increasing returns" are mainly a matter of indivisibilities and discontinuities, it is very possible that a firm may be in perfect competitive equilibrium with its (conjectured) demand curve horizontal, at the point of equilibrium, although it knows that a considerable increase in output would enable it to diminish average costs (of hired factors) considerably. But it is uncertain whether so large an increase in sales could be brought about without a considerable reduction in price, and refrains from expansion because it is unwilling to take the risk. This seems at least as plausible a construction as the other, and better suited to a world of very imperfect knowledge.

On the general question of discontinuity in cost, see M. Joseph, "A Discontinuous Cost Curve," *Econ. Jour.*, Sept. 1933.