ESSAY 4

THE LAW OF DECREASING COSTS

In a former article I made an attempt to analyse the conditions of equilibrium in the long and short periods with reference to marginal prime, average prime and supplementary costs. Two classes of case were considered, first that of pure competition, and secondly that in which 'the source of supply is not small in relation to the whole industry'. It was maintained that in the second case the volume of output is determined by the intersection of the marginal prime cost curve and a curve derived from the demand curve which I called the increment of aggregate demand curve, and that the law of decreasing costs might then prevail in the long and short periods.

The increment of aggregate demand curve becomes relevant and the possibility of decreasing costs arises if and when a firm is confronted with a demand for its product of less than infinite elasticity. The definition 'where the source of supply is not small in relation to the whole industry' is too narrow to cover all firms confronted with a demand of this kind. Mr. Sraffa has, in a well-known article,¹ laid stress on the case when small individual firms are held in equilibrium by being subject to increasing marketing expenses. Where the product is not completely standardised or the market not organised, the individual producer may, although quite small, have increasing difficulty in marketing increments of produce.

I propose to examine in what follows the relation between the kind of conditions which Mr. Sraffa has envisaged and the law of decreasing costs. The first paragraph is concerned with the compatibility of competitive equilibrium with

Economic Essays

short-period decreasing costs,\(^1\) the second is concerned with the compatibility of competitive equilibrium and short-period decreasing costs with profit, the third with the compatibility of competitive equilibrium with long-period decreasing costs,\(^2\) and the fourth with the possibility that short- and long-period decreasing costs may be the normal condition of certain industries.

I

A firm whose product is not standardised or whose market is not organised may meet the difficulty of marketing increments of produce in two ways: by lowering the price, or by increasing marketing expenses. In so far as the conditions of the market allow a difference of price for the product of different sources, and the former method is adopted, the analysis of the equilibrium of the firm in this case may be assimilated to that provided in my previous essay, section II, 'where the source of supply is not small in proportion to the whole industry' (see page 84).

It is important also, however, to consider the status of marketing expenses. Mr. Sraffa holds that it is possible and 'formally correct' to include marketing expenses in the cost of production, but gives grounds for holding such a method of approach unsatisfactory and misleading. But so long as we use the concepts of supply and demand schedules in analysing the market complex, it is difficult to avoid putting these costs on the supply side.

For the purpose in hand we may confine our attention to marginal competitive marketing costs, i.e. those costs of marketing which are necessary to ward off the competitor at the frontier of a sphere of influence. It is assumed that any attempt to push out into the competitor's territory is attended with rising marketing costs per unit of sales, and that a surrender of territory to him would allow a reduction in them.

\(^1\) 'Short-period decreasing costs' is defined as the condition in which a rise in demand for a short period brings about a fall in the marginal cost of production.

\(^2\) See the definition of 'short-period decreasing costs', but substitute the word 'long' for 'short'.

90
The Law of Decreasing Costs

Marginal competitive marketing costs can thus be represented as a function of the output of the individual firm. But it appears that they do not depend on this only. For let a rise in demand supervene on equilibrium, causing an increase of output: if the rise is evenly diffused over the whole market, firms should be able to maintain their frontiers without increase of marketing effort. A higher competitive marketing cost is the price of trespass into the neighbour's territory. If no trespass in either direction occurs, no rise in this cost per unit at the margin should occur. But all will be producing more in the new equilibrium.

It seems to follow from this that the marginal competitive marketing cost is a function not only of the quantity of output, but also of the state of demand. But if this is so, a complete reconstruction of the notion of a supply schedule becomes necessary. In the usual analysis supply and demand schedules are regarded as independent of one another. On the new view every demand schedule has its own appropriate supply schedule. To determine equilibrium after a change in the former, the latter also must be changed. The customary graphical representation of supply is no longer possible. Any given supply schedule of the old type is only valid while the demand remains constant. To draw a single supply schedule to be valid for all states of demand, it is necessary to use three dimensions. Cost becomes a function of two independent variables, quantity of output and state of demand. Thus the traditional analysis breaks down.

This at once seems to throw light on the vexed question of how a condition of decreasing costs may be compatible with competitive equilibrium. In equilibrium the state of demand may be taken to be constant and the cost of production becomes a function of one variable, viz. quantity of output. It is thus a sufficient condition of equilibrium that costs should rise for increasing quantities of output. The expressions decreasing and increasing costs are, however, usually taken to refer to the response in supply price to...

\footnote{If a change in the state of demand may be complex, i.e. involve elasticity as well as intensity, four (or more) dimensions are necessary for a representation of supply.}
changes in demand. So long as the supply schedule was conceived as independent of the demand schedule, the effect of a change in the latter could be read off from a curve showing cost as a function of output; if that had an upward gradient between its points of intersection with the old and new demand curves, prices were expected to rise. But if to determine the new equilibrium a new supply schedule has to be drawn, derived from a cost curve, a component part of which is marginal marketing cost (now reduced throughout the relevant range), it cannot be determined *a priori* from the upward slope of the old curve whether the point of intersection of the two new curves will be above or below the old point. If the new price is below the old one, then in the accepted sense of the term the firm is subject to decreasing costs, and, if we may suppose the firm to be an equilibrium one in Professor Pigou's sense, the whole industry is subject to decreasing costs. Thus competitive equilibrium is compatible with decreasing costs in the ordinary sense of that expression.

If it be supposed that in a firm costs other than competitive marketing costs are falling at the old equilibrium, but that the rise in the latter more than offsets the fall in the former, so that the total cost schedule (old type) is a rising one, it can be shown that the firm is subject to decreasing costs. For suppose an increase in demand evenly diffused among the various particular spheres of influence: an increase of market can then be secured for each firm without trespass on its neighbour's sphere, and therefore without increase of marginal competitive marketing cost per unit. But if the marginal marketing cost is the same as in the old equilibrium, and the residual marginal costs are lower owing to the larger output, combined marginal costs will be lower in the new equilibrium than in the old. Thus a firm which has costs other than competitive marketing costs falling, but is held in equilibrium by total costs, considered as a function of output only, rising, is subject to the law of decreasing costs.

The Law of Decreasing Costs

The second difficulty in supposing a competitive equilibrium to be compatible with the condition of short-period decreasing costs arises from the fact that if marginal costs are falling, the marginal prime cost will probably be less than the average prime cost, and if the price is equal to the marginal cost, total prime costs will not be covered.

This difficulty is resolved when it is remembered that while competitive marketing costs must be excluded in determining whether an industry is subject to decreasing costs, in equilibrium the price must cover the marginal competitive marketing costs. The aggregated marginal cost curve (old type) is supposed to be rising in equilibrium. Marginal marketing costs will stand above the average marketing costs, and the difference should more than make up for the fact that marginal productive costs are below average productive costs; in this case combined marginal prime costs, to which the price is equated, will stand above combined average prime costs.

A complete account of the matter is not quite so simple. Where the market is not thoroughly unified even a small individual firm may, as Mr. Sraffa observes, be confronted with a demand curve of less than infinite elasticity. The curve of the demand for the products from an individual source of supply is not in these circumstances a wholly unambiguous concept. Starting from a given equilibrium, if an individual firm desires to expand sales, it may adopt both the device of lowering prices and of increasing marketing costs; the converse applies to contraction inside a given point. How, then, should we plot out the demand curve with which the individual is confronted? It seems to be the best plan to assume that in departing from a given equilibrium the individual will follow the path of maximum receipts, will cut down prices by that amount and increase selling expenses by that amount which will in the aggregate

1 See above, p. 78.
2 The expression 'productive costs' is here used as equivalent to all prime costs less competitive marketing costs.
Economic Essays

involve him in least loss of net receipts; or will raise prices by that amount and cut down selling expenses by that amount which will bring the greatest net gain. Then we may plot that section of the demand curve which lies on either side of equilibrium on the assumption that he would combine price regulation and selling expense in the way most advantageous to himself.

To illustrate how a falling particular demand curve affects the relation of costs to price, we may suppose that the whole manipulation of the market at the disposal of the individual firm consists of price regulation, and that the selling expenses are null. In such a case the marginal cost curve would be composed solely of productive costs. Even so, falling marginal costs are compatible with profit. For the point of equilibrium is determined by the point of intersection of the marginal cost curve, and the increment of aggregate demand curve.¹ A halt is called to production at the point at which the net increment of cost rises above the net increment of receipts due to it. But if the demand curve is falling, the increment of net receipts due to an extra unit is less than the price per unit. If \( y \) is the price per unit and \( \eta \) the elasticity of demand at the point of equilibrium, the increment of receipts falls short of the price by \( \frac{y}{\eta} \).² If the elasticity is equal to or less than one, there are no net receipts. It must be remembered that the particular demand curve with which the individual is confronted has a far greater elasticity than that of the market, since the products of competitors are available as substitutes; indeed, it approaches infinity as the organisation of the market approaches perfection.

The statement that the marginal cost of production is, in equilibrium, equal to the price, less the price divided by the elasticity of demand, has universal applicability. Pure

¹ See above, pp. 84-6.

² The increment of aggregate receipts is \( \frac{d(xy)}{dx} \).

\[
\frac{d(xy)}{dx} = y + xy' = y \frac{y}{\eta}
\]
competition with a perfectly organised market is the special case in which elasticity is infinite, and the marginal cost of production is therefore equal to the price.

Since the price exceeds the marginal cost of production by \( \frac{y_1}{\eta} \), there is a possibility of profit. Receipts will exceed total prime costs if the gradient of the particular demand curve is greater than that of the average prime cost curve.\(^1\) If \( z_i \) is the average prime cost at equilibrium and \( K \) represents overhead cost plus a normal return to capital invested, profits in equilibrium will be super-normal or sub-normal according as \( x(y_1 - z_i) \) exceeds or falls short of \( K \).

The diagram on page 96 illustrates a position of equilibrium with normal profit and falling costs where marketing expenses are null. \( KC_m, KC_p \) and \( LC_i \) represent marginal prime, total prime and total costs respectively. \( DD' \) is the demand curve and \( DD'' \) the increment of aggregate demand curve.\(^2\) \( Q \) is the point of intersection of \( KC_m \) and \( DD'' \). A perpendicular, \( QM \), to the horizontal axis cuts \( DD' \) and \( KC_p \) at \( P \) and \( R \). \( QM \) represents marginal cost and \( PM \) price. \( QR \) represents the excess of average over marginal prime cost, and \( PR \) the excess of price over average prime cost. If \( LC \), the total costs curve happens, as in the diagram, to intersect \( DD' \) at \( P \), normal profits are earned.

The intention of the foregoing analysis has been to demonstrate the possibility of the law of decreasing costs.

\(^1\) In equilibrium the marginal prime cost is equal to the increment of aggregate demand. If \( y_1 \) is the equilibrium price and \( z_i \) the average prime cost in equilibrium, \( \frac{d(y_1)}{dx} = \frac{d(xz_i)}{dx} \), i.e. \( y_1 + \frac{dx_1}{dx} = z_i + \frac{dxz_i}{dx} \). Then \( y_1 > z_i \) if \( \frac{dy_1}{dx} = \frac{dz_i}{dx} \), i.e. if the gradient of the particular demand curve is greater than that of the average prime cost curve.

From the further condition of equilibrium that the increment of aggregate demand curve falls below the marginal prime cost curve, i.e. that \( \frac{d^2(y_1)}{dx^2} > \frac{d^2(xz_i)}{dx^2} \), it can be deduced that \( \frac{dy_1}{dx} \) will be greater than \( \frac{dz_i}{dx} \), and therefore that \( y_1 \) will be greater than \( z_i \) if \( \frac{dy_1}{dx^2} > \frac{dz_i}{dx^2} \). Thus in the simple case of linear supply and demand functions, \( y_1 \) must exceed \( z_i \).

\(^2\) *Economic Journal*, June 1930.

\(^3\) Ibid.
Economic Essays

co-existing with competitive equilibrium. To do this it had to be assumed either that there were competitive marketing costs, or that the market failed to be completely unified, so that a falling demand for the products of an individual firm was possible, or both. In the first case it was necessary to abandon the orthodox notion that the supply price can be appropriately regarded as a function of one variable, viz. quantity of output of the source, or, even as, in the manner of Professor Pigou, a function of two variables, viz. the

quantity of output of the source and that of the whole industry. It must be regarded as also dependent on the state of demand.

With either or both of these assumptions, the two main difficulties in the way of supposing equilibrium to be compatible with decreasing costs are overcome, viz. the difficulty that the equilibrium firm would be tempted to expand output, and the difficulty that the equilibrium firm would be making a loss.

1 [The figure in my original article was erroneous, since it made DD' intersect LG, (cf. text). Although the principle of tangency is shown in reference to the relation between long-period and short-period costs in Fig. 2, I appear to have overlooked that the mathematics clearly requires that the total cost and demand curves should also be tangential. 1952.]
The Law of Decreasing Costs

III

The next question to be considered is how far this equilibrium can be regarded as a long-period one. It should be noted, however, that orthodox theory does not even provide for a short-period equilibrium with decreasing costs. That is clearly a matter of importance for the analysis of the trade cycle. [Compare pages 132-8 below.]

If a source is subject to decreasing costs, it must be producing at what is, from the productive point of view, less than the optimum rate. Is this consistent with long-period equilibrium? Will it not be in the interest of sources in this condition to amalgamate, and so to raise the output of some to a point of increasing costs, while putting others out of commission?

It was put forward above that sources subject to decreasing costs may be held in equilibrium by increasing competitive marketing expenses. These should be understood to include all costs involved in invading a competitor's territory, and therefore to include the costs of transport. These costs form a part of the class of costs which rise per unit with an increase of output if the demand is constant, but depend on the intensity of demand in a given area. If the expansion of a source, a, is checked by the rising costs of transporting into b's area, an amalgamation by which a received b's good-will would not reduce these costs, or, consequently make any expansion of a, ceteris paribus, profitable. If the population or the market is sufficiently sparsely spread, it may be cheaper from every point of view to have a larger number of sources than would be desirable if transport charges could be neglected, to have, that is, sources producing at less than their optimum rate. Concentration might bring economies on the productive side; but these would only be net economies if and when the market became denser. Thus an industry may be in long-period equilibrium with productive costs falling, whenever the rise in transporting costs attendant on greater concentration would alone suffice to make gross marginal costs rise as a result of the
Economic Essays

concentration. Such an industry may be in long-period equilibrium and subject to the law of decreasing costs.

The rise in competitive marketing costs may be due to the more intensive salesmanship required and not to higher transport charges. If it could be assumed that all firms were willing to lose their individual identity in the interest of long-period profit, then the equilibrium maintained by rising competitive salesmanship costs could not be regarded as a long-period one. Individualism should probably be treated as an influence of lasting importance. It might be assumed, for the sake of argument, that errors of tenacious individualism are at all times and in all countries likely to be offset by a frivolous inclination to rush into injudicious amalgamations. Such an assumption would constitute a pedantic refusal to take relevant factors into account, a parody of the proper use of the concept, economic man. Mr. Shove has made a further elaboration of this point unnecessary. The period of the equilibrium maintained by the presence of these kinds of costs is a sufficiently long one.

IV

It remains to consider how far a condition of decreasing costs can be normal to certain industries. Must we content ourselves with saying that any industry may get into the condition of decreasing costs for short or long periods, but that such a condition does not arise out of the nature of any special class of industries? Must we abandon the expression 'increasing returns industries'?

This topic must be divided into two parts. (1) Costs are rising in response to short-period increases in demand, but falling in response to long-period increases, if the plant of the equilibrium firm is being used up to capacity, but is constructed on less than the optimum scale. (2) Costs are falling in response to short-period increases in demand, if the plant of the equilibrium firm is not being used up to full capacity.

1 Economic Journal, March 1930.
The Law of Decreasing Costs

(1) Is there any general characteristic of an industry which is likely to lead to the result that the equilibrium firm has its plant constructed on less than the optimum scale? The presence of transport charges of appreciable importance or individualism or both must be assumed. By presence of individualism is meant that the pertinacious desire of firms to retain their individual identity prevails over the tendency to rush into injudicious amalgamations. The general characteristic may be stated simply: it is that, if technical improvements of a kind that involve a larger optimum source of supply are occurring, the rate of expansion of the optimum source of supply exceeds the rate of increase of the demand. Roughly, then, we may think of industries in which technical inventions make the optimum size of the source of supply increase rapidly as likely to be increasing returns industries. The decrease in cost will occur in this case in response to long-period, i.e. sustained, rises in demand.

(2) Are there any industries in which decreasing costs in response to short-period rises in demand can be considered as normal? Prima facie the condition in which the plant of the equilibrium firm was working under capacity would seem to be peculiar to certain phases of the conjuncture. Who, it might be asked, would construct a plant, the optimum capacity of which was in excess of the prospective normal demand? The objector to decreasing costs can be met even on this ground. If the prospective normal demand of the equilibrium firm is such that it will not absorb the optimum output of the optimum plant, it is probable that the firm will construct a plant, the optimum output of which will exceed the prospective normal output. In this case the plant, when producing for the normal demand, will show decreasing costs. If a firm is considering the desirability of reconstruction and the proper scale of operations, the question which it asks is, not — What is the plant the optimum output of which the normal demand will absorb? but — What is the plant with which the normal demand can be met most cheaply? If an increase of scale provides substantial economies, such an increase may be desirable, even if full advantage of the economies cannot be taken.
Economic Essays

The truth of this can be very simply illustrated diagrammatically (Fig. 2). The cost of production may be represented by a family of parabolas, each of which shows the cost of any output from a plant of given size. The lowest point of the parabola shows the cost of the optimum output from its plant. The minimum point is supposed lower the larger the size of plant, and the locus of these points a curve falling smoothly for increasing values of $x$, the output. It is required to find the proper size of plant for any given prospective normal demand, $x_n$. This is the plant the

parabola of which has of all the parabolas the lowest value for $x_n$; $x_n$ units can be produced most cheaply from a plant of such a size. Plot a curve (see Fig. 2) the ordinate of which is equal to the lowest of the ordinates of all the parabolas for each value of $x$. Such a curve (the envelope) may be called the long-period productive cost curve, for it shows the cost of producing the normally required output $x_n$, if that is properly foreseen. If, as we suppose, the equilibrium firm has its plant constructed on less than the optimum scale, the long-period productive cost curve is falling in the neighbourhood of equilibrium. The long-period productive cost curve must never intersect any parabola of the family, for if it did, it would for some value of $x$ stand above the lowest value of one
The Law of Decreasing Costs

of the family. It follows that the long-period productive cost curve is for every value of \( x \) tangential to the parabola of the appropriate plant. But the long-period productive cost curve has a downward gradient. The parabola of the appropriate plant has, therefore, also a downward gradient at the point of normal output. This means that when the demand for the output of a firm is precisely that which the firm had in mind in constructing its plant, the parabola showing the costs of that plant has a downward gradient for that output, and the plant is being worked at less than its optimum capacity. Consequently in normal times the output of this firm may be subject to decreasing costs in response to a short-period rise in demand,\(^1\) and the rate at which costs decrease in the neighbourhood of normal is precisely equal to the rate at which costs decrease in response to a long-period rise in demand.

The conclusions of this article may be briefly summarised.

1. If competitive marketing costs are present, or if the equilibrium source is confronted with a falling demand schedule, competitive equilibrium is consistent with decreasing costs in the short period. To give a correct representation of the effect of competitive marketing costs, the orthodox supply schedule is inadequate. Supply price must be considered as a function of the state of demand as well as of output. If marginal costs other than competitive marketing costs are falling at equilibrium, the firm is subject to the law of decreasing costs in the short period.

2. Profit is consistent with this equilibrium.

3. Competitive equilibrium is consistent with decreasing costs in the long period also, if appreciable transport costs are involved, or if a spirit of individualism is prevalent among entrepreneurs.

4. Competitive equilibrium with decreasing costs in the short and long periods may be regarded as normal to industries, the rate of expansion in the optimum plant of which exceeds the rate of increase in demand.

\(^1\) It is not possible to say that the output is subject to decreasing costs in response to a short-period rise in demand, since the parabola is a total costs curve and rising marginal are consistent with falling total costs.
Economic Essays

There has been no reference to the question of external economies.

The considerations brought forward seem sufficient to establish the legitimacy of the conception of increasing returns industries.