CHAPTER 10

Individual Sales and Cost Curves

The theory of price determination discussed in the preceding chapters runs in terms of elasticities and changes in demand and supply. This broad general theory is simple, just as most of the general theories of the natural sciences are simple. It is the bringing of these theories closer to earth, closer to reality, that makes them complicated.

Both in economics and the natural sciences, it is advantageous to start at a high level of abstraction, with the most general laws that underlie diverse particular applications, in order to provide the student with broad working concepts. The student can then apply these broad concepts, with appropriate modifications and specialized additional concepts, to particular cases. These broad concepts are necessary but not sufficient for an explanation of the phenomena of the world about us. The modifications and additions may be more important than the broad general concepts, in explaining actual phenomena.

To be specific in the case of economics: The general laws of supply and demand, necessary as they are, are not sufficient to explain business cycles, the comparative stability of industrial prices, the cyclic behavior of hog prices, and a host of such phenomena. It would be possible, and in some respects desirable, to begin with specialized explanations of these particular phenomena and then move to the broader and more general underlying principles. The opposite approach is generally used, however, for two reasons: (1) There are so many diverse specialized applications that if the student started with those, before he had begun to specialize within the field, he would acquire more diverse bits of truth than he could assimilate or organize later on. But the broad explanations are needed in all specialized subfields; the student can use them in whatever subfield he decides to specialize in later on. (2) The second reason for beginning with the broad principles is that they are simpler than the specialized ones. "Economists, like other scien-

tists, have chosen the hypothesis from which they set out, and which they offer to beginners, because it is the simplest, and not because it is the nearest to the facts."[1]

INDIVIDUAL SALES AND COST CURVES UNDER PERFECT COMPETITION

We begin, then, with the principles of price determination under conditions of perfect competition, just as the physicist begins with $\frac{1}{2}gt^2$, the formula for the velocity of a body falling in a perfect vacuum—though neither a perfect vacuum nor perfect competition has ever existed on this earth.

Under conditions of perfect competition, prices and production are determined by the intersection of the demand and supply curves for the commodity. The positions and elasticities of the demand and supply curves determine how prices and production will change when any disturbance strikes the system. In the simplest expositions of the law of supply and demand it is assumed that the demand curve has a negative slope and the supply curve has a positive slope. So the law is formulated in two parts, thus: When the demand increases (the supply remaining constant) production increases and prices rise; when the supply increases (the demand remaining constant) production increases, but prices fall. The reverse situation holds for decreases in demand and supply. This is familiar ground to any high school student nowadays, and we do not need to elaborate upon it any further.

The real task is to go behind or break down the supply and demand curves, and find out what determines them. They merely show mass behavior; they represent the sums of the reactions of individual producers and consumers. We need to study now what these individual reactions are and how they add up to the sort of demand and supply curves we have been dealing with up to this point, which may be called "general" demand and supply curves. We turn now from these general curves to consider the individual curves that make them up.

INDIVIDUAL SALES CURVES

Under conditions of perfect competition (a large number of buyers and sellers of a homogeneous commodity, freedom of entry

[1] John Maynard Keynes, *The End of Laissez Faire*, Hogarth Press, London, 1926, p. 28.

into and exit from the industry, and perfect knowledge of supply, demand, and prices on the part of all participants) the individual producer is so small an element in the total situation that the amount he produces has no appreciable effect on the price of the commodity as a whole. If a man can produce and sell 10 pounds of butterfat at 22 cents per pound, he can sell 100 pounds, or 1,000 pounds, at the same price. The demand curve for this producer's butterfat, therefore, is a horizontal straight line at 22 cents. It is (within reasonable limits) infinitely elastic.

The concept of the demand schedule for an individual producer's product just presented is essentially simple. The description or name, however, as given in the preceding sentence, is long and clumsy. The shorter phrase, "individual producer's demand curve" is inaccurate; it is likely to be misunderstood as the individual producer's demand curve for the raw materials he buys, rather than for the finished products he sells. The term "individual producer's sales curve" has recently been proposed,[2] and will be adopted here.

INDIVIDUAL SUPPLY CURVES

The individual producer of butterfat incurs certain costs of production. Some of these costs are rather fixed, and remain much the same for the farm as a whole whether he raises much or little. Examples of these fixed costs are: interest on investment, or rent if he does not own the farm, and taxes. Since these costs remain fixed, in total for the farm, regardless of how much butterfat is produced, it follows that the fixed costs per pound of butterfat vary inversely with the number of pounds produced. This is shown in column 3 of Table 16 and the lower curve in Figure 45.[3] This curve is a rectangular hyperbola, the equation being of the form $xy = c$.

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[2] Robert Triffin, *Monopolistic Competition and General Equilibrium Theory*, Harvard University Press, 1940, p. 5.

[3] The discussion in this chapter runs in terms of short-run costs. Here, as in the case of supply curves discussed in Chapter 6, the longer the time involved, the greater the elasticity of the cost curve. In fact, a single producer's long-time cost curve is not one curve but a series of U-shaped short-time curves like the one shown in Figure 45 ranged along a broader U-shaped long-time curve like oyster shells along the edge of a plate. Each small curve shows the cost conditions for a given size of plant; the large curve shows the costs for different-sized plants. For a full discussion of this matter, *see* Jacob Viner, "Cost Curves and Supply Curves," *Zeitschrift Fur Nationalökonomie, Sonderabdruck aus Band III*, Heft 1; Benjamin Higgins, "Indeterminacy in Non-Perfect Competition," *American Economic Review*, XXIX, No. 3, September, 1939, pp. 469, 471–475; and George Stigler, "Production and Distribution in the Short Run," *Journal of Political Economy*, XLVII, No. 3, June, 1939, p. 305.

The producer also incurs variable costs. The more cows he milks, the more feed he has to raise (or buy), the more labor he uses, and the more equipment he needs. These costs vary with the number of cows the farmer milks, and are called variable costs for that reason.

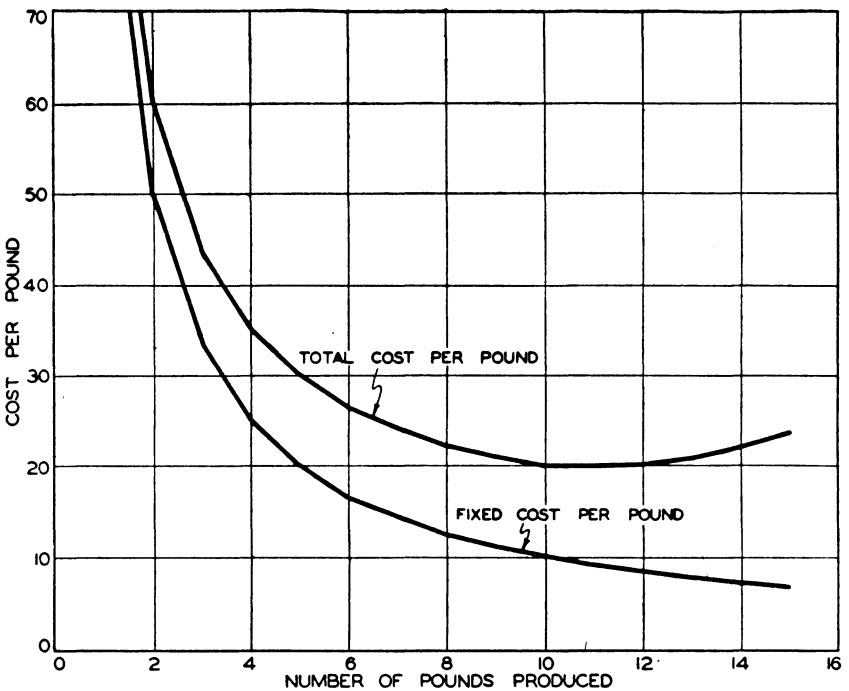

FIG. 45.—Effect of quantity produced upon fixed cost and total cost per unit. Hypothetical data.

Expressed as so much per pound of butterfat, the variable costs may remain constant at so much per pound as the scale of milk production increases; but as the number of cows becomes very large, diminishing returns set in and these variable costs per pound of butterfat begin to rise. This is shown in column 5 of Table 16. Beyond a certain point this rise in variable costs per pound more than offsets the decrease in fixed costs per pound (especially since these fixed costs fall rapidly for the first few thousand pounds of total output, but more and more slowly for larger and larger outputs) and the *total costs per pound* begin to rise.

The phrase, total costs per pound, is clumsy, and the briefer

phrase, average total costs, or still more briefly, average costs, is generally used instead. The nature of a typical average cost curve is shown by the upper line in Figure 45. In this figure the variable costs per unit are added to the fixed costs per unit to give the average

TABLE 16
COST SCHEDULE FOR DIFFERENT OUTPUTS
(Hypothetical Data)

Number of Pounds	Total Fixed Cost	Fixed Cost per Pound	Total Variable Cost	Variable Cost per Pound	Total Fixed and Variable Costs	Total Cost per Pound (Average Cost)
thousands	*dollars*	*cents*	*dollars*	*cents*	*dollars*	*cents*
1.....	1,000	100	100	10	1,100	110
2.....	1,000	50	200	10	1,200	60
3.....	1,000	33.3	300	10	1,300	43.3
4.....	1,000	25	400	10	1,400	35
5.....	1,000	20	500	10	1,500	30
6.....	1,000	16.7	600	10	1,600	26.7
7.....	1,000	14.3	700	10	1,700	24.3
8.....	1,000	12.5	800	10	1,800	22.5
9.....	1,000	11.1	900	10	1,900	21.1
10.....	1,000	10	1,000	10	2,000	20
11.....	1,000	9.1	1,210	11	2,210	20.1
12.....	1,000	8.3	1,440	12	2,440	20.3
13.....	1,000	7.7	1,690	13.4	2,690	21.0
14.....	1,000	7.1	1,960	15	2,960	22.1
15.....	1,000	6.7	2,250	17	3,250	23.7

costs shown by the upper line. This average cost curve has a characteristic broad U shape.

THE MOST PROFITABLE SCALE OF PRODUCTION

Figure 45 shows that the farmer reaches his lowest cost of production (20 cents) when he produces 10 units.

In the section dealing with demand, we saw that this producer's sales curve was a horizontal straight line at 22 cents. Under those conditions how many thousand pounds of butterfat will this man produce?

He will naturally carry his production to the point where he is making the greatest profit. One might reply offhand, then, that he would produce 10 thousand pounds, since his costs of production reach a minimum (20 cents) at that figure. But a little arithmetic

shows that this is incorrect. If he stopped at 10 thousand pounds, his net profit (his total returns minus his total costs) would be $\$2,200 - \$2,000 = \$200$. But if he went to 12 thousand pounds, his net profit would be $\$2,640 - \$2,440 = \$240$. His total profit at 12 thousand pounds is greater than at 13 thousand pounds.

The exact point at which he would stop can be determined by making separate calculations of this sort for each quantity. But the point can be determined more neatly and quickly by use of the concept of marginal rather than the average cost.

MARGINAL COST

An earlier chapter dealt with marginal revenue—the increase in total revenue when $x + 1$ units are sold, over the total revenue when only x units are sold. Marginal cost is analagous to this marginal revenue. Marginal cost is the increase in total cost when $x + 1$ units are produced, over the total cost when only x units are produced. Here, as with marginal revenue, the concept of marginal cost is precise only in the limiting sense, as the units get smaller and smaller.

Marginal costs are independent of the amount of the total fixed costs. The amount of the total fixed costs affects the average costs per unit, but not the marginal costs. This follows directly from the definition of marginal costs (the difference between successive total costs) since if the fixed costs remain constant, as they must by definition, the differences between successive total costs are the same whether the fixed costs (which enter alike into all the total costs, and therefore cancel out in the subtractions or differences) are $1,000, $100, or zero. The significance of this will become apparent later.

It is clear from these definitions that a man will increase his production all the time that his marginal revenue is greater than his marginal cost. That is, if producing one unit more than before adds 50 cents to his total cost, but selling one unit more adds 60 cents to his total revenue (that is, if his marginal cost is 50 cents and his marginal revenue 60 cents) he will produce and sell that one unit more, for it will add 10 cents to his total profit. He will as a matter of fact keep on expanding his production until his marginal cost becomes as great as his marginal revenue. That maximizes his total profits.

A table showing the average, total, and marginal *costs* of pro-

ducing various quantities in one part, and average, total, and marginal *revenues* from the sale of various quantities in another, can be used to show where equilibrium will be reached. Hypothetical cost and revenue data of this sort are shown in the two parts of Table 17.

TABLE 17
COST AND REVENUE SCHEDULE
(Hypothetical Data)

Quantity	Cost Data			Revenue Data		
	Total Cost	Average Cost	Marginal Cost	Total Revenue	Average Revenue	Marginal Revenue
1	64	64	64	20	20	20
2	83	41.5	19	40	20	20
3	101	33.7	18	60	20	20
4	118	29.5	17	80	20	20
5	134	26.8	16	100	20	20
6	149	24.8	15	120	20	20
7	163	23.3	14	140	20	20
8	176	22.0	13	160	20	20
9	188	20.9	12	180	20	20
10	200	20.0	12	200	20	20
11	213	19.4	13	220	20	20
12	227	18.9	14	240	20	20
13	242	18.6	15	260	20	20
14	258	18.4	16	280	20	20
15	275	18.3	17	300	20	20
16	293	18.3	18	320	20	20
17	312	18.4	19	340	20	20
18	332	18.4	20	360	20	20
19	353	18.6	21	380	20	20
20	375	18.8	22	400	20	20
21	398	19.0	23	420	20	20
22	422	19.2	24	440	20	20

The marginal cost in each case is simply the difference between two successive total costs; the same thing holds with marginal revenues.

It takes only a moment to determine from this table that production will be carried out to 18 quantity units, for at that point marginal costs are equal to marginal revenues; they are both $20.

The location of this equilibrium point is particularly simple in this case, for the marginal revenues are the same ($20) for all quantities. The reason for this is that average revenues remain constant (this is a case of perfect competition). No matter what quantities are produced, the sale of one more unit always brings in

another $20; so the marginal revenue (addition to total revenue) is always $20.

A little more light is thrown on the subject if the data shown in Table 17 are plotted in graphic form. This is done in Figure 46.

This figure shows how the marginal cost curve at first falls, and then rises, to cut the average cost curve at its lowest point. It must necessarily do this, because a very small section of the average cost curve at its lowest point may be regarded as a horizontal straight line, and we saw (in connection with average and marginal revenue curves) that where the average curve is a horizontal straight line the marginal values are necessarily the same as the average values.

The figure also shows that at the point where the marginal cost equals the marginal revenue, the total revenue rises to its greatest height above the total cost. That is, the difference between the total revenue and the total cost (i. e., the profit) is the greatest at that point. This also is necessarily true.

Finally, the figure shows that under conditions of perfect competition, the average revenue and marginal revenue curves coincide throughout their length. It shows, furthermore, that production is carried on at the lowest possible average cost—almost. The reason for the "almost" is that prices in the illustration used here exceed average costs, at the point to which production is carried, and profits (in excess of wages of management, interest on capital, and all other normal costs) exist. If these profits induced others to enter this field of production, as they would under perfect competition, supplies would increase and prices would fall to equality with the lowest point on the average cost curve. These are important results or concomitants of perfect competition, as we shall see.[4]

INDIVIDUAL SALES AND COST CURVES UNDER IMPERFECT COMPETITION

Under perfect competition, each producer sells so small a part of the total production of a commodity that his actions have a negligible effect upon the price; his sales curve is a horizontal straight line.

This used to be regarded as the typical case, and the major part of the structure of economic theory rested on that foundation, the assumption of perfect competition. But it is now being recognized

[4] The relation between prices and costs is examined in factual detail in the next chapter.

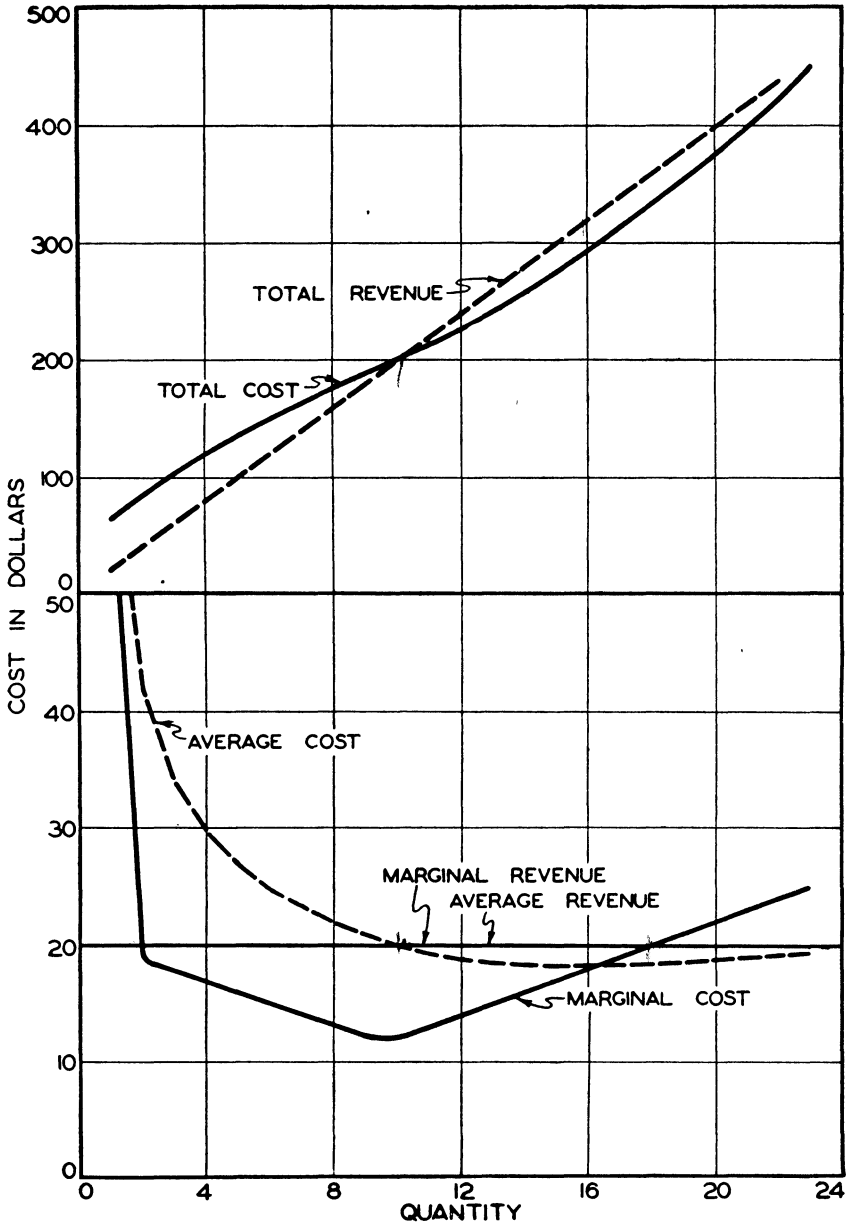

FIG. 46.—Effect of quantity produced upon total, average, and marginal revenue and cost. Hypothetical data.

that this is not the typical case; it (perfect competition) is merely the limiting case at one end of a scale. At the other end of the scale is perfect monopoly.

In actual fact, there is no such thing as perfect monopoly (monopoly means "single seller") any more than there is any perfect vacuum in actual life. It is possible to conceive of a pathological case, however, to illustrate the point. A man may be held for ransom, under threat of death. His abductors have a perfect monopoly of his freedom, within the range of his pocketbook. He will offer $1,000, $5,000, $10,000, etc., as far as his resources go. His demand curve for his life is a *vertical* straight line; there is no substitute for life. But this concept of perfect monopoly is merely a convenient bench mark at one end of the scale, rather than an important case.

The important cases in actual life are those where the monopolist has control of an essential product such as salt (which as a matter of fact is controlled by a government monopoly in many countries). Or, to take a less extreme case, we may consider aluminum, which before World War II was produced only by one corporation in the United States, the Aluminum Company of America. The demand curve confronting the producer of these products was not completely inelastic. The curve for aluminum no doubt had a considerable degree of elasticity, even though aluminum production was "completely monopolized," that is to say, in the hands of only one producer.

WHAT IS MONOPOLY?

The criterion of monopoly is, however, not the numbers of sellers of the commodity. Colgate is the sole producer and seller of Colgate's toothpaste. He has a monopoly of that product. But if several other kinds of toothpaste are very similar to Colgate's, and if consumers have no preference for any one brand, then Colgate's monopoly of Colgate's toothpaste doesn't mean much. The monopoly of aluminum possessed by the Aluminum Company of America meant more, because it was more difficult to substitute other metals for aluminum than it is to substitute other toothpastes for Colgate's. The basic criterion of monopoly is not the number of sellers so much as it is *the width of the gap between the monopolized product and the next nearest substitute.*

Monopoly, therefore, can be defined in terms of cross-elasticity of demand. This is measured by plotting the quantity of the commodity

concerned not against its own price but against the price of its nearest substitute. Under perfect monopoly, the cross-elasticity of demand for the nearest substitute is zero; under perfect competition, it is infinitely large. These are merely limiting cases. The great bulk of the situations in actual life fall between these two extremes.

Monopoly, in this wider view, is not an absolute, to be clearly differentiated from competition as black from white. In fact, there is no such thing as monopoly to be sharply distinguished from non-monopoly or competition; there are only different degrees of monopoly. The thing that determines the degree of monopoly is the ease or difficulty of substituting other products for the monopolized product. There is a high degree of monopoly in the salt industry, because it is so difficult for the consumer to substitute any other product for salt. There would be a lower degree of monopoly in the aluminum industry than in the salt industry, even if practically all of the aluminum industry in America were in the hands of one large concern, because aluminum consumers will turn to other metals if the monopolist gets his prices unduly high. The degree of monopoly in the textile industry, or in the toothpaste industry, is still lower; and so on.

It might be thought that this line of reasoning, sound as it may be when applied to different products, does not apply within products, that is, to different producers of the same product. But it does apply thus, for two reasons.

WHAT IS "A PRODUCT"?

The first reason is the inherent ambiguity of the term "product." For what is a "product"? Aluminum is a different product from steel, yes; but the one will be substituted for the other if their prices get far out of line. Is a Ford a different product from a Chevrolet? An Arrow shirt from another make? There is really no sharp or definite distinction between different products and different producers' makes of a product. Each producer strives to make it appear that his make of automobile, or breakfast food, or antiseptic, is in a different class from other makes, i. e., is a different product. Here again the question is not a simple yes-or-no type of question—whether one product is or is not different from another product. Strictly speaking, every producer's "product" is different from every other producer's "product," and every producer is a monopolist. But the range of differences between "products" runs all the way from very

great in the case of salt, to moderate in the case of aluminum, to small in the case of automobiles or shirts, to nearly zero in the case of wheat or hogs. The range of degrees of monopoly corresponds with this range of differences between products.

The situation may be represented graphically by filling in the gap between a steeply sloping line representing a high degree of monopoly and a horizontal line representing perfect competition, by a series of individual producer's sales curves grading down from inelastic to elastic and very elastic. The almost completely inelastic curve at one end of the scale represents the sales curve for some commodity such as salt, for domestic household purposes, where the differences between it and its substitute are very wide and the amounts purchased take only a very small proportion of the buyers' total income. Next comes a less inelastic curve, for aluminum, let us say. Next, a curve for some other metal which is more susceptible to substitution; this curve is relatively elastic. Next, the curve for a certain manufacturer's clothing material, highly elastic, and so on, until finally we reach individual farmer's sales curves for corn, or beef cattle, or hogs, which for all practical purposes are horizontal.

The second reason why the theory of imperfect competition applies within "products," if the producers are few in number, is this: Even when each producer is not able to differentiate his make of product greatly from those of other producers, he sets his production and price with close attention to theirs. For if he disregarded them, and expanded his production and lowered his prices in an attempt to hog the whole market, in the great majority of cases the other producers would meet his price cuts with equal price cuts, each would retain his share of the market, and all would lose.

Accordingly, each producer refrains from this sort of price cutting. There may be no overt collusion or conscious collective action among the producers, but the effects upon production and prices are substantially the same as if the production were all in the hands of one producer. Each producer's sales curve becomes as inelastic as the total demand curve for that "product." The whole industry then behaves, as far as prices and production are concerned, as if it were in the hands of one monopolist, even though the industry is, like the automobile industry, "fiercely competitive." This situation is described as "oligopoly" (a few sellers).

WHERE MARGINAL COST EQUALS MARGINAL REVENUE

In earlier chapters the concepts of marginal revenue and marginal costs were set forth, and it was shown that under conditions of perfect competition (where marginal revenue and average revenue curves are coincidental horizontal straight lines) profits were maximized at the point where marginal costs equalled marginal revenue. Does this hold true also for imperfect competition, where the average revenue and marginal revenue curves both have a negative slope?

A moment's mental exercise with these concepts shows that it does hold true. The point of greatest profit is that point at which marginal cost equals marginal revenue, under all conditions—imperfect competition as well as perfect competition. If you do not trust your powers of reasoning, set up a hypothetical average revenue curve, together with its marginal revenue curve, and go through the arithmetic.

EFFECT ON PRODUCTION, PRICES, AND PROFITS

It was shown earlier that under perfect competition, wherever the (horizontal) marginal revenue curve lies above the lowest point of the average cost curve, then prices are higher than costs and the profits will induce increased production. Prices, therefore, will fall until the marginal revenue curve shifts downward to the point of tangency with the average cost curve at its lowest point. This is the point at which the marginal cost curve rises from below to cut the average cost curve. So at that point, average costs are at their lowest point, marginal cost equals average cost and average revenue and price, and there are no profits. This situation is shown in the upper left-hand section of Figure 47.

But under imperfect competition, the average and marginal revenue curves have some negative slope, and they do not coincide. The marginal revenue curve lies below the average revenue curve; and the steeper the slope of the average revenue curve, the farther does the marginal revenue curve lie below the average revenue curve. The marginal cost curve therefore intersects the marginal revenue curve some distance to the left of the point where the two would intersect under perfect competition. This is shown in the upper right-hand section of Figure 47.

The effect is more pronounced if the degree of monopoly is greater and the slope of the average revenue curve steeper, as shown in the

lower left-hand section of Figure 47. Here it is evident that production is much reduced, and prices are considerably higher than under free competition. Production stops short of the point of lowest possible cost, by a wide margin. This situation may or may not be accompanied by high profits to the monopolist. In Figure 47 it is not. But if (a) the cost curve were lower, or the average revenue curve were higher, and (b) entry into the field were difficult, profits would be high.

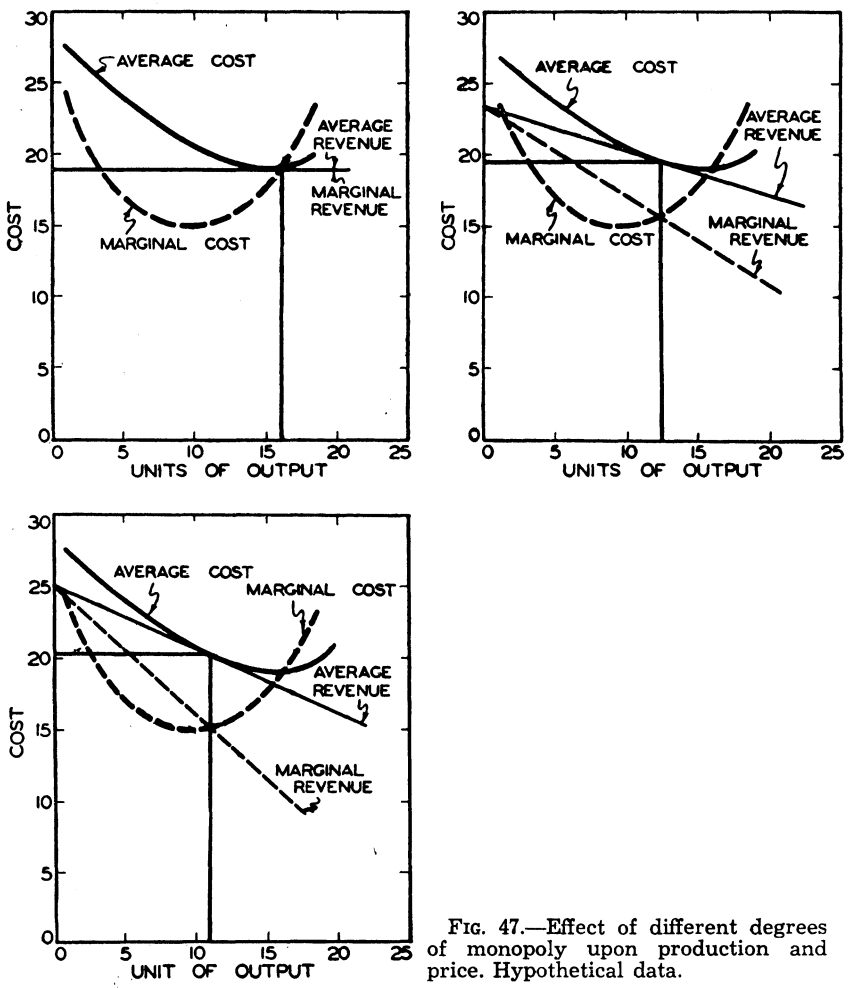

FIG. 47.—Effect of different degrees of monopoly upon production and price. Hypothetical data.

While production will be smaller and prices higher under imperfect competition than under perfect competition, an important point should be made clear here that is not always emphasized in the literature of imperfect competition. If free competition were enforced in the automobile industry, for example, by breaking the industry up into a large number of small producers, each producer's scale of production would be smaller. The scale of production might be so small that unit costs and prices might be higher, and total production less, than at present. When the statement is made that under imperfect competition production is less and price higher than under perfect competition, what is really meant is that under imperfect competition total production is less and prices are higher than if competitive conditions were enforced among the existing few large producers.