NOTICE

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THE SHAPE OF THE AVERAGE COST CURVE

By WILFORD J. EITEMAN and GLENN E. GUTHRIE*

I. *The Problem*

It has been argued that, when manufacturing is conducted with facilities designed by modern engineering techniques, the least cost point of a plant is located either at or near capacity output. By capacity is meant the greatest physical output possible in some relatively short period of time, such as an hour or a normal work day. The argument continues that, when modern engineers are successful, the short-run marginal cost curve for a product always lies below the average cost curve at all levels of operation short of capacity. The result is that the marginal cost curve cannot intersect the marginal revenue curve (1) if the average revenue curve is horizontal, or (2) if the average revenue curve is high and relatively elastic.[1] The foregoing thesis has been attacked from many quarters.[2]

The validity of much price analysis hinges upon the shape of the average cost curve, to which are related both the location of the least cost point and the shape of the marginal cost curve. To discover the shape of the average cost curves for actual companies is an exceedingly difficult task. Even if the shape of the curves could be ascertained, the existing controversy would continue. The reasoning of marginal price theory is valid if businessmen *believe* curves to be shaped as theorists assume, even though the curves are actually shaped as opponents contend; conversely, orthodox price theory is not valid if businessmen *believe* curves to be shaped so that their least cost points are at or near capacity, even though the curves really have the shape which conventional theorists maintain. Hence, marginal price theory stands or falls depending upon what businessmen think, because their short-run decisions to expand or to contract are based upon what they *believe* rather than upon what is actually true.

The easiest way to discover what businessmen think is to ask them.

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[1] W. J. Eiteman, "Factors Determining the Location of the Least Cost Point," *Am. Econ. Rev.*, Dec. 1947, XXXVII, 910-18.

[2] The thesis has been censured by Mr. Bishop and Mr. Haines in two communications published in the September 1948 *Review*. A rejoinder to their criticisms will be found in the December 1948 *Review*.

Accordingly, a research foundation provided the authors with a small fund with which to finance a questionnaire study of what businessmen think concerning the shape of the average cost curves. The sole purpose of this paper is to describe the methods and to report the results of this study.

II. *Description of the Study*

In order to engage the cooperation of the right individual in each company, the paragraphs which follow appeared at the beginning of the questionnaire:

Shape of the Average Cost Curve

Why This Questionnaire Is Sent to You

Economists are currently engaged in a controversy regarding the shape of industry's "average cost curve." Their dispute has great theoretical importance, and indirectly some practical importance. Interestingly the argument relates to what businessmen think about the shape of the curve and not to the actual shape of the curve. This questionnaire is an attempt to discover what businessmen think. Your aid will be appreciated.

Who Should Answer the Questionnaire

Somewhere in your organization there is an individual or a group of individuals charged with the responsibility of deciding that production in the plant will be increased or decreased *tomorrow, next week, or next month.*[3] That individual or a representative of that group is the one whom we would like to answer this questionnaire. May we solicit your aid in seeing to it that the proper individual gets this questionnaire.

What Is Meant by the Average Cost Curve

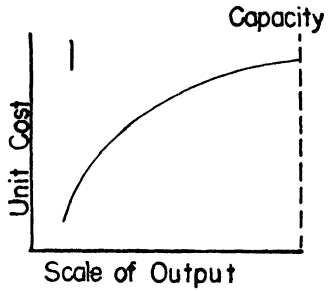
The average cost curve is a line on a graph which shows the cost per product at each possible scale of operation from the minimum to the maximum (*excluding all over-time work*). At each scale of operation the average cost is computed by dividing total costs of production allocated to a product by the quantity of the product produced. Obviously average cost varies as the scale of operations changes. The question is, How?

How to Answer the Questionnaire

Eight small graphs follow. Will you kindly indicate the one which you think comes nearest to representing the cost situation for each of

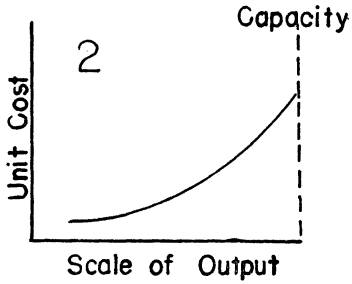
[3] The italicized phrases automatically rule out long-run considerations without confusing a businessman with technical economic phraseology. The questionnaires were taken very seriously. Several companies called meetings of top management to discuss the subject and to formulate a memorandum to accompany the returned questionnaire.

Curves

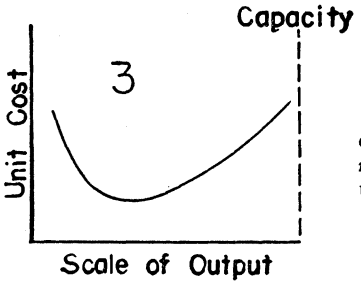


Interpretation

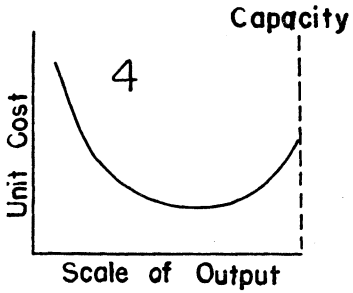
1. If you choose this curve you believe that your lowest cost point is at minimum output and that unit costs increase rapidly at a decreasing rate as output expands.



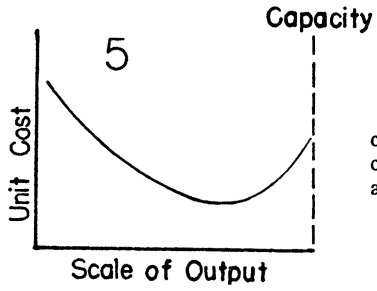
2. If you choose this curve you believe that your lowest cost point is at minimum output and that unit costs increase slowly at an increasing rate as output expands.



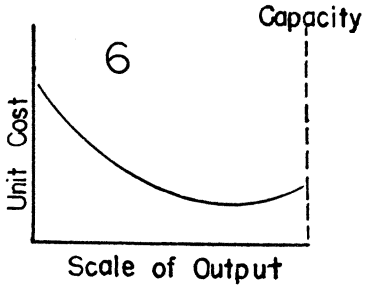
3. If you choose this curve you believe that unit costs are high at minimum output, that they decline *rapidly* to a least-cost point, and then that they rise until capacity output is reached.



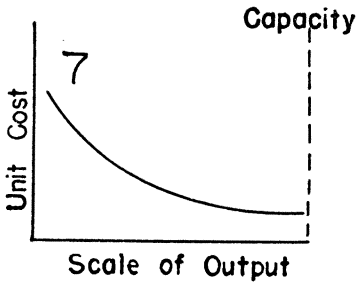
4. If you choose this curve you believe that unit costs are high at minimum output, that they decline to a least-cost point located about midway between minimum and maximum output and then rise.



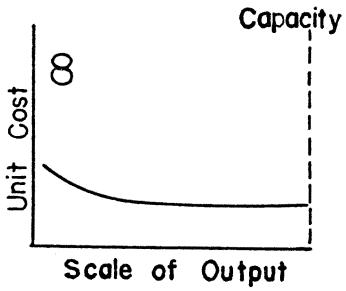
5. If you choose this curve you believe that unit costs are high at minimum output, that they decline *gradually* to a least-cost point *near* capacity, after which they rise sharply.



6. If you choose this curve you believe that unit costs are high at minimum output, that they decline gradually to a least-cost point near capacity, after which they rise slightly.



7. If you choose this curve you believe that unit costs are high at minimum output, and that they decline gradually to capacity at which point they are lowest.



8. If you choose this curve you believe that unit costs are the same at all scales of operation.

your principal products. Do not make a statistical or accounting investigation before indicating your answer because, as was previously explained, we are interested in what you think rather than in the actual shape of the curve.

The eight graphs mentioned above were so placed that all eight were visible without necessitating a turning of the page. The curves and the explanations which appeared beside them are on pages 834-35.

Questionnaires were sent to one thousand manufacturing companies located in forty-seven states. The companies chosen were manufacturers having more than 500 but less than 5,000 employees. It is important to note that the questionnaires were sent by mail. Personal interviews would have permitted the bias of the researcher to influence the thinking of the one being interviewed.

III. *Results of the Study*

Of the one thousand questionnaires sent, 366 replies were received from companies in thirty-two states.[5] Table I indicates the positions in the firms of the persons who provided the requested data.

TABLE I.—POSITION OF INDIVIDUALS WHO REPLIED

Position	Number of Replies
President	105
Vice-president (no function stated)	55
Treasurer or secretary-treasurer	60
Secretary	45
Controller	17
Accountant	15
Production manager	39
Miscellaneous other	30
Total	366

Some replies indicated that all the products of the company fell under one curve. Others listed numerous products but indicated that a single curve was applicable to all. Still others listed their products and indicated different curves as applicable to each. A few indicated that one curve was applicable under certain conditions but that another

[4] Immediately preceding the array of curves was the following note: "Please interpret capacity as meaning the maximum output possible without the use of overtime payments for labor."

[5] The largest number of replies came from Ohio (65), followed by Michigan (49), Massachusetts (33), Illinois (33), New York (29), Pennsylvania (26), Wisconsin (22), Connecticut (19), California (14), and Indiana (13, with lesser numbers from the other twenty-two states.

curve was more correct for the same product under other conditions. Therefore, several tabulations were necessary.

Of the 366 replies, 334 indicated one curve as applying to all the products of the company. Their choices are tabulated in Table II.

TABLE II.—CHOICE OF COST CURVE BY COMPANIES WITHOUT REFERENCE TO NUMBER OF PRODUCTS

Curve Indicated	Number of Companies
1	0
2	0
3	1
4	3
5	14
6	113
7	203
8	0
Total	334

The remaining thirty-two replies specified one curve as applying to one product and another curve as applying to another product. Table III indicates the choice of curves by products for all 366 questionnaires received. When a company did not specify products, it is included in this table as producing only one. Some products were reported under a specific curve subject to a qualification.[6] Replies of this nature are noted in the third column of the table.

Of the average cost curves included in the questionnaire, numbers 3, 4, and 5 can be taken as supporting conventional marginal price analy-

TABLE III.—COST CURVES CLASSIFIED BY PRODUCTS

Curve Number	Products Listed under Curve Indicated	Products Listed under Curve with Qualifications	Total Products Listed
1	0	0	0
2	0	1	1
3	4	1	5
4	12	3	15
5	18	24	42
6	245	136	381
7	402	234	636
8	0	2	2
Total	681	401	1,082

[6] Such as, for example, "Curve 7 provided we have two weeks notice of the step-up, otherwise curve 6."

sis. Curves 1, 2, 6, 7, and 8 do not support marginal theory. A compilation of the replies in terms of those for and those against conventional theory is given in Table IV.

TABLE IV.—COST CURVES GROUPED AS SUPPORTING OR NOT SUPPORTING MARGINAL ANALYSIS

Curves	By Companies		By Product	
	Supporting	Not Supporting	Supporting	Not Supporting
1		0		0
2		0		1
3	1		5	
4	3		15	
5	14		42	
6		113		381
7		203		636
8		0		2
Total	18	316	62	1,020

IV. *Conclusion*

The discussion above presents a factual report of the procedure applied and the results obtained from the study undertaken. The replies demonstrate a clear preference of businessmen for curves which do not offer great support to the argument of marginal theorists. If some of the personal comments of those who answered the questionnaires were to be repeated here, they would serve further to emphasize this conclusion. For example, after the questionnaires were returned, a letter was sent to each businessman explaining the reason for and the results of the study. The replies of two businessmen are given in the footnote.[7] Another operations manager reported that regardless of the shape of the curve, the least cost point is considered by him to be the capacity of his plant, since his efficiency is judged by his superiors entirely on the basis of his average costs as reported by the accounting department. Consequently, he would not under any circumstances push production beyond the least cost point.

If the beliefs of businessmen in general coincide with those included in this sample, it is obvious that short-run marginal price theory should be revised in the light of reality.

[7] "The amazing thing is that any sane economist could consider No. 3, No. 4 and No. 5 curves as representing business thinking. It looks as if some economists, assuming as a premise that business is not progressive, are trying to prove the premise by suggesting curves like Nos. 3, 4, and 5." A manufacturer of road building equipment wrote, "Even with the low efficiency and premium pay of overtime work, our unit costs would still decline with increased production since the absorption of fixed expenses would more than offset the added direct expenses incurred."