This review of over 100 studies concludes that diminishing returns characterize . . .

THE SHAPE OF THE ADVERTISING RESPONSE FUNCTION

Julian L. Simon and Johan Arndt

The general question before us is: What is the effect, for the firm and for society, of a larger rather than a smaller quantity of advertising? As it is stated, however, this question is extraordinarily vague. And the difficulty of putting the right questions in sufficiently precise fashion is the cause of much of the controversy and confusion about the effect of various quantities of advertising.

As passing evidence of this confusion, the entire topic is often treated under the rubric "economies Of scale in advertising," even though the situations being discussed seldom (if ever) fit into the economies.of.scale concept. This concept refers to the outcomes Of same-proportion increases in 1711 inputs: that is, the proportions of all inputs remain the same as the scale of the firm changes. But when discussing advertising quantities, writers inevitably have in mind dther an increase in advertising alone, or an increase in the total scale of the enterprise with changing proportions of inputs. And the advertising-sales ratio that is usually adduced as the relevant measurement is worthless for the purpose at hand.

There are at least five interlocking questions about the effects of various quantities of advertising. Some Of these questions affect our judgment of advertising's role in the firm's thinking, and all affect our judgment of advertising's impact on the *economy as* • whole.

(1) Can an increase in the ***physical quantify*** of advertising-the number of inches in a printed advertisement or the number"of seconds in a television or radio commercial-produce a larger-than-proportional number of units sold?

(2) Can an increase in the ***expenditure*** for advertising produce a larger-than-proportional number of units sold? Because of quantity discounts, the answer to this question could be "yes'" even if the answer to question I is "no."

Questions 1 and 2 are important on an everyday basis for business decision makers. They also enter into the social questions to come.

(3) Can a same-proportion increase in all factors

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of the enterprise-including advertising-produce a larger-than-proportional increase in a brand's sales that is traceable to costs in factory production or transportation? This is a true economies-of-scale question—that is, whether a big firm bas an advantage over a small firm due to advertising. (There is some inevitable confusion about whether the factors of production and output are measured in physical or monetary terms. But we feel that clarifying the matter is not worthwhile at this point.)

(4) Can an *increase in the number of brands of the same or related products* sold by the firm-with a same-proportion physical increase in all inputs to the enterprise —produce a Iarger-than-proportional increase in the firm's sales that is not traceable to cost functions in the factory or transportation? That is, are there economies of multibrand operations due to advertising's role?

(5) The hardest question to properly frame concerns dynamic effects and barriers to entry into the industry. Does the existence of advertising as a competitive tool lead to a smaller number of tom. petitors and higher industrial concentration than would otherwise be found if there were no advertising?

After a brief theoretical discussion of the possible shapes of the response function, we will first examine the evidence relating to the physical advertising response function, and next the findings concerning the monetary response function. The third question by itself constitutes a voluminous —but separable -question: on the other hand, there is little evidence relevant to questions 4' and 5. We shall therefore limit ourselves to a few notes on these latter three issues at the end of tbe paper.

We will review both recent and not-s o-recent evidence, but the reader who wishes more details about older studies is referred to *Simon (1%5, 1970) so as to* conserve space here. (Other reviews covering chunks of Ibis part of tbe advertising literature may be found in Schmalensee, 1972; Gensch, 1973; Ray, 1975; Asker and Myers, 1975; and L.ambin, 1976.)

What Is the Shape of the Function?

Advertising response function is here used to refer to the quantitative relationship between some *input* of advertising and some *output or effect* of presumed value for the advertiser. Input measures include size and frequency of ads as well as monetary expenditures on advertising. Output measures include saks effects as well as "intermediate" indicators such as ad recall, attitudes, or intention to buy. The advertising response function may refer to the reaction of a given individual (individual response function) or to the reaction of members of a target group (aggregate response function). (While there are important problems in moving from the individual to the group level [see Rae, 1970], these problems of aggregation are not important for the present review.)

Our survey of the literature shows that almost all writers on advertising subscribe to one ortbe other of the following two proposed shapes of the response function: (1) the concave-downward function and (2) the S-shaped logistic function. The concave function implying monotonically diminishing returns is shown in Figure la. Figure lb shows the S-shaped adver. tising response function, which first has increasing returns and then, after an inflection point, diminishing returns.

Each proposed response function implies a theory about how advertising operates. Before contrasting the theoretical rationales for the alternative shapes, let us agree that at *some* conceivabk point of very low advertising there must be increasing returns. For example, a television commercial too sboti to identify brand or advertiser can hardly have any positive results. But let us also agree that the relevant range of the function is that over which firms might seriously consider operating, given the accepted technological and commercial restraints. For example, a television commercial shorter than 10 or 15 seconds may not be within the feasible set of alternatives and need not be considered.

The theoretical root of the concave-downward curve is in the macroeconomic "law" of diminishing returns to productive inputs (see, for instance, Stigler, 1966). On an aggregate level, tbe argument is that as tbe amount of advertising is increased, the unreached prospects will have progressivel y weaker

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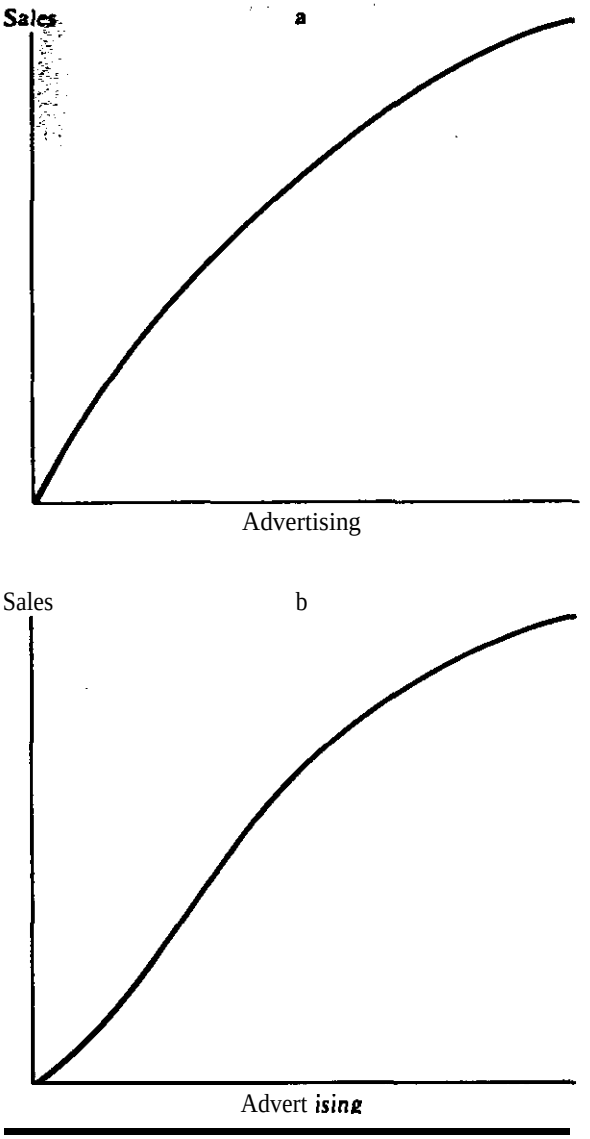
Figure I
Increasing and Decreasing Returns in Advertising Response Functions



buying predispositions (Ozga, 1960). At the level of the individual buyer, the reasoning is that a given message conveys less and less information with each additional exposure (*Stigler, 1%1). Along this* line, Krugman (1972) argues for the special importance of the two or three exposures. He claims that exposure number 1 creates curiosity, number 2 brings recognition, while number 3 clinches a decision; further exposures are said to have little value. This sort of reasoning leads to the hypothesis that there are decreasing returns to both "frequency" and "reach" for advertising.

Furthermore, the most important cause of increasing returns in manufacturing-indivisibilities of capital goods and organization-is not present to the same extent in advertising. It is true that the minimum of network television time that can be bought is not small in absolute terms, and there are discounts. Advertisers, however, can arrange advertising schedules by purchasing from individual television stations and using regional or local editions of print media in such a fashion that there are no discontinuous jumps from one level of advertising to the next, even in consumer-package-goods advertising.

Despite the above arguments for the concave response function, the great majority of persons interested in advertising-advertising practitioners, media salesmen, economists, and laymen-seem to believe that the advertising response function has an inflection point and is S-shaped. Economists such as Dean (19> 1). Chamberlain (1%2), Comanor and Wilson (1974), and Porter (1976) claim that there are initial increasing returns to scale for advertising. Similarly, some marketing researchers and operations analysts assert that the advertising response curve is S-shaped (Zentler and Ryde, 1956: Vidale and Wolfe. 1957; Rae, 1970).

Psychological arguments are often adduced for the S curve. Sometimes the logistic function is referred to as the "'curve of learning."' But experimental psychologists have found *support* for both forms of the curve. Acquisition of complex skills usually can best be described by a concave curve, whereas S-shaped curves have been observed in classical conditioning and in memorizing as well as in the development of skills (Berel son and Steiner, 1964).

Some psychological speculations in favor of the S-shaped response function arc based on the notion of a threshold effect. In Chamberlin's (1%2) language: "Control of the buyer's consciousness must be gained. and while it is being gained additional expenditure yields increasing returns."' Another argument is that "constant repetition would ingrain a stimulus in the mind and eventually lead to a desired effect" (Greenberg and Suttoni, 1973). In the imagery of the advertising-space salesman, the argument is that "You've got to keep dripping the water onto the rock until it cracks.'"

Krugman's (1965) concept of low-involvement learning may be interpreted as implying an initial threshold for advertising effects. Krugman suggests that consumer response to ads, particularly television ads. may be characterized as passive learning, because much advertising content *is learned the "same way as* is meaningless material. There need not be measurable immediate behavioral or attitudinal effects. Instead, "Stimulus repetition . . . build[s]

a potential for allegation in *perceptual* structure of advertised brands, i.e., a gradual development of the ability to see the brand differently without being specifically aware of any change'" (Krugman, 1966-1%7).

By now it should be clear that there is an abundance of *theory. conventional* wisdom, and speculation, both economic and psychological, to support a judgment in favor of either an S-shaped or a constant-concave advertising response function. It seems to us that it is not worthwhile to elaborate these theoretical speculations, because inevitably their sum will be inconclusive. Instead wc must turn to the data.

The Physical Advertising Response Function

fn deciding which empirical studies to review in this and the following section, a key criterion has been whether there are reasonable controls for extraneous and potentially confounding effects. This review distinguishes among three main groups of studies: laboratory experiments, field experiments, and ex post facto studies.

Ideally, a review first presents a representative early bench-mark study in detail and then considers extensions and methodological improvements in subsequent work. On this topic, however, there is little cumulative research. Instead there is little cross referencing, and the literature is fragmented, which constitutes a difficulty for reviewing.

Laboratory Experiments fn a laboratory experiment the researcher can isolate the impact of the advertising variable by manipulating the independent variable and controlling for confounding influences. Yet laboratory experiments have the drawback that the stimulus, response, and setting are far different from market conditions. Also, the use of intermediate variables as measures of effect is questionable because there is little evidence on how such indicators reflect sales or sales opportunities. Therefore, laboratory studies are always weak on external validity, generalization of the results to advertising-sales relationships in the world outside the laboratory.

We shall consider the evidence using this (xnd subsequent) methods, first with respect to increasing *size* of advertisements and then with regard to increasing *repetition*.

Size. Laboratory experiments are unanimous in finding diminishing returns to size (print advertisements) and length (television commercials). The bench-mark study is still that of Strong (1914). Using a dummy magazine, Strong found that recall did not increase proportionately with the increase in size. The relative recall value for a quarter-page advertisement was 1.0, a half page 1.5, and a full page 2.2. Similar results were found for advertisements that were shown once, twice, and four times at monthly intervals. There is need for new studies using Strong's technique to replicate his results in a wide variety of conditions.

For television commercials tanging from 20 to 60 seconds, Wheatley (1968), Capitman *(Media/Scope, 1964),* Schwetin's theater-lottery methnd (Hoffman, 1963), and Lodish (1971), reanal yzing Rohloff "s [1966) data, all found evidence of sharpl y diminishing returns. There might, however, be a threshold effect if the time interval in which advertisements are shown is too shon for human perception. But in Schwartz's (1975) tachistoscope experiment, the proponion of subjects correctly identifying the brand name rose most at the shortest exposure interval. This suggests that though there *may* be a perception threshold for a given individual, individuals differ sufficiently so that there is no such threshold effect in a *group.*

Repetition. An important ancestor of later experimental advertising repetition studies was Ebbinghaus (1885), who used nonsense syllables as test stimuli, with himself as his only subject. His "acquisition curve"' showed that recall increased at a decreasing rate with number of repetitions. A landmark study of advertising in the Ebbinghaus tradition was the well-done experiment by Adams (1916), who worked with dummy magazines containing one, two, or four insertions of the same advertisement. When the same advertisement appeared, there were diminishing returns with repetition. But when different advertisements for the same brands appeared, there were *increasing returns. Since* additional (and different) advertisements may contain new information, it is not implausible that repetition with variation may show initial increasing returns. But more rigorous evidence than the Adams data is needed to test such a hypothesis.

Among the studies on *repetition, that* of Ray and Sawyer (1971) is the current bench mark because it is the most *careful* and best controlled. Subjects were told that they were panicipating in a study of future shopping arrangements via cable *television. Then a stream* of product, advertisements was presented on a screen, with various numbers of exposures for various brands and products. Dependent measures were unaided recall, attitudes toward brands, and purchase intentions. The results showed diminishing returns across numbers of exposure from O to 6, a "deviation front a linear trend toward the modified exponential curve of repetition effect

on recall . . . very much like the negatively accelmated curve . . . often found for nonsense syllables learning'" (Ray and Sawyer, 1971). The results for the categories of "'convenience'" and "'shopping" goods are shown in Figures 2a and 2b. The smooth curves have been fitted by us to their data points.

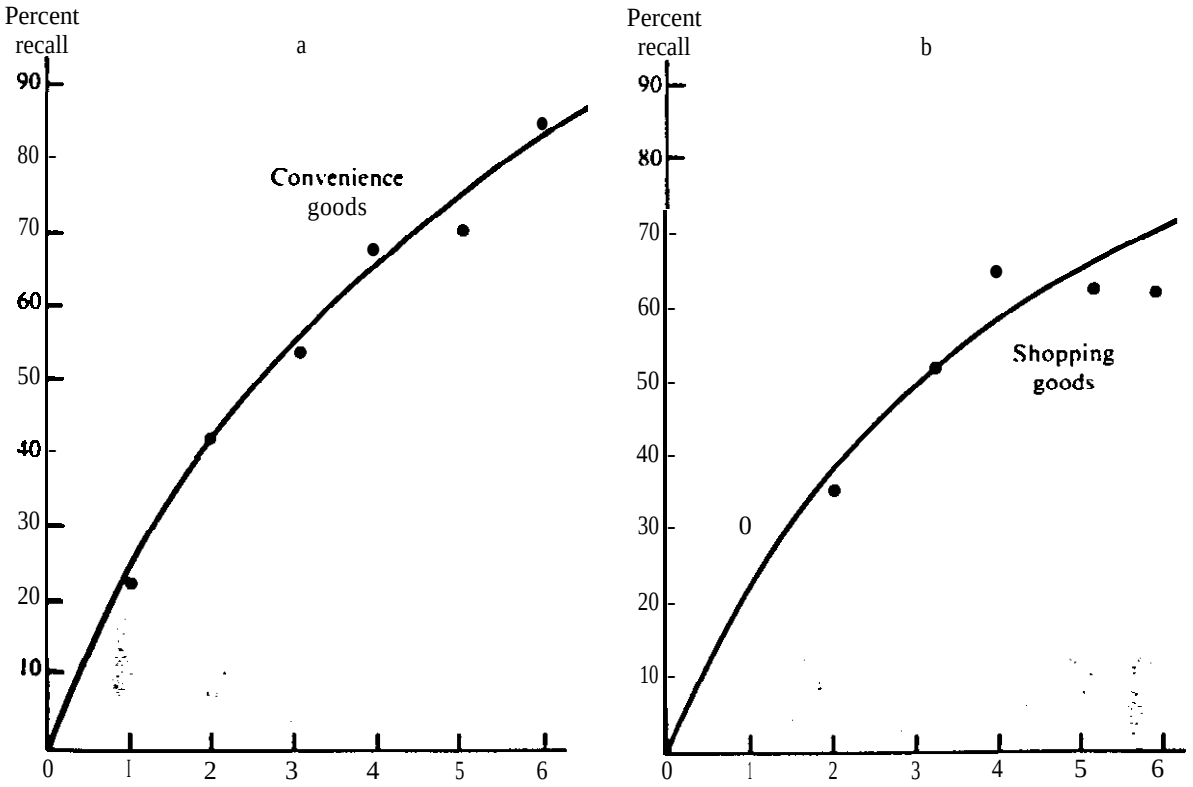
Politz's (1960) method of leaving magazines at homes on "Monday and Wednesday, then checking reed on" Friday, showed conflicting results on var. ious recall measures. Some measures indicated increasing returns, and others indicated decreasing returns. There was a major loophole in this ingenious design, however. Those who received only one magazine received it on Monday, rather than half on Monday and half on Wednesday. Those who received two magazines got them Monday and Wednesday. This meant a longer average time lag between exposure and measurement for the one-magazine group. This study deserves to be repeated with better controls, because it COUM produce valuable data.

Studies of repetition in the laboratory using as the dependent variable recall (surveyed by Sawyer, 1974) and intention to buy (Wells and Chinsky, 1965) also do not show increasing returns.

interesting because of its pb ysiological response measure is Krugman's study (1%7), which used an optiscan to record eye movements of a subject exposed to the test ad for 10 seconds in three successive weeks. The results showed that scanning (defined as the proportion of the total ad surface upon which the eye fixated) increased fmm the first to the second exposure and leveled off with the third exposure. It is not clear what the implications of this finding are for the shape of the advertising response function, but further research could clarify the connection.

In sbon, laboratory experiments with repetition

Figure 2
Relationship between Recall of Advertisement and Number of Exposures for '. Convenience"" and 'Shopping" Goods



126 responses per condition

Source: Ray and Sawyer (1971).

do not give evidence of increasing returns.

Field Experiments. Let us now turn to actual market experiments conducted under realistic conditions. Again, we will distinguish between studies beating on the effects of size and on the effects of repetition (which will include a few experiments that varied the physical quantity of advertising).

Size. The most impressive evidence on the physical advertising-saies relationship comes from experimentation with mail-order safes. Mail-order data are as nearly perfect as economic data can be. the relationship between advertising and sales being completely measurable with the key that is in every advertisement that reveals the source of each sale that is made. The experiments are well controlled. The modern split-run test (in which every odd msg. tine in each stack carries advertisement A and every even magazine carries advertisement B) is the most reliable, largest-sample experiment ever carried out in any science. And mail-order tests are realistic because they are real. No links in the logical relationship need to be estimated with judgment, as is the case, say, when one uses readership data to gauge the ultimate sales payoff. Furthermore, in the mail-order business there are no other merchandising efforts that work jointly with advertising—as in the case of deafer-sold products—and that may obscure the effect of advertising. The only reason not to rel y completely on mail-order evidence for a judgment about the shape of the advertising response function is that nonmail-order advertising may be different from advertising for store-sold and salesman-sold goods and services.

Shryer (1912) provided the earliest and most extensive body of mail-order data-a book-length array of data that is impressive even when compared to any modern study of any type of advertising. These data came from a business that Shryer himself owned and ran, and hence the results of his study affected bis own pocketbook. He found conclusively that returns diminish sharply with size. All other reports concur. The onfy reason for not devoting more space here to these mail-order data is that they are well documented in earlier reviews (Simon, 1%5, 1970).

Keyed coupon tests in print advertisements, which are one step further away from realism than are mail-order advertisements, also show diminishing returns (Starch, 1959a). Readership studies, which are not true experiments, also show diminishing returns with size (Rudolph, 1936; Starch, 1966). Engel, BlackwelL and Kollat (1978) have proposed that readership tends to increase in proportion to the square root of the increase in space.

Repetition. Mail-order data from many sources all confirm Shryer-s conclusion, based on thousands of keyed advertisements, that 'The first insertion of a tried piece of copY in a new medium will pay better, in every way, than any subsequent insertion of the same copy in the same magazine"' (Shryer, 1912). In other words, returns decrease with repetition.

Pomerance and Zielske <1958; and especially Zielske, 1959) invented an important new design for comparing the effects of various numbers of advertisements for store-sold products. They mailed 1 to 13 advertisements, at weekly or monthly intervals, to women who were tested for recall of the advertising after the last advertisement had arrived. Reanalysis of the raw data (Simon, 1979) shows that when spread over a longer time period, a given amount of advertising has a larger total impact, measured in recall-weeks. This implies diminishing returns to advertising.

Stewart (1964) used an exposure design similar to that of Zielske (1959) in a massive field-study comparison of the effects of advertising for a bleach and for a food product in four matched quarters of Fort Wayne, Indiana. Stewart concluded that his data showed mixed results with respect to increasing m decreasing returns. But reanalysis of his data suggests that on balance the data arc strong evidence *against* increasing returns (Simon, 1970). Similar findings emerge from other recall and coupon studies of repetition (Starch, 1959b; Alfred Politz Research, 1964, 1%5). A particularly interesting variation iS that of Miller (1976). who studied the response to a poster admonishing readers to contribute to a campaign for the reduction of foreign aid. His subjects (undergraduate college students residing in a dormitory building) were randomly assigned to four treatment conditions: no exposure (pretest), moderate exposure (30 posters), overexposure (170 posters), exposure removal (delayed posttest). Data were collected from a questionnaire. While the design did not provide adequate controls (for instance, contamination in the form of communication among the experimental groups might have occurred), the results showed diminishing returns both for an attitudinal and a behavioral measure (percent volunteering for a campaign). Another study that deserves mention for its novelty of method is that of De Fleur, who dropped a study by De Fleur in leaflets from the air onto eight similar towns in the United States. 'fbe number of leaflets dropped per head of population varied over a wide range, being doubled in successive towns. The leaflets requested the finder to note and to pass on a given message. The proportion of the population knowing the message was measured by surveys. Broadbent and Segrtit (1972) reanalyzed the data and found that the relationship between number of leaflets dropped per head to

proportion knowing the message could be described by a constant-concave geometric response function.

Ex Post Facto Studies. Ex post facto studies try to measure the impact of advertising by comparing subjects' states on indicators of effect by respondents receiving different levels of exposure. Such an ex post facto design is vulnerable to confounding effects by nonadvertising variables because it assumes that subjects can reaUy serve as their own control on nonmeasured potential influences. The design also raises problems as to the direction of causality.

Roberts's (19471 bench-mark study of proprietary-drugs advertising used purchase data over six months on two competing pharmaceutical products forapanel of 2,000 households, who also reported on receipt of advertisement-bearing issues of magazines. Holding constant the effect of important demographic variables, Roberts concluded that "the resulting curve shows plainly the effect of diminishing returns" at all points of the curve. However. Robens's study suffered from the absence of a measure of prior sales in addition to other difficulties with the cross-sectional approach.

The lack of prior sales data from which Robens's design suffered was made good by Cerha (1%7), who used a panel design to isolate the effect on Swedish gasoline buying behavior of the Esso Tiger campaign, which used a heavy newspaper advertising schedule. Effects of the campaign upon knowledge, attitudes, and behavior (visits togas stations) were measured as differences (by before and after campaign measures) within strata defined by differences in exposure (defined by opponunity to see the ads, as in the Roberts study). The results showed that the massive campaign, though apparently reaching all members of the target group, failed to sell more Esso gas. Furthermore, Cerha reported that neither knowledge nor attitude changes varied with ad exposure. Yet a remaining unsolved problem in this as well as in an otherwise sound study. the Roberts dmg study. is the use of opportunities to see, rather than adircct measure of exposure.

There is a long line of attempts to determine the effect of repetition by measuring the advertising recall by people who have been exposed to different numbers of advertisements in magazines or other media (e.g., lhe 'readership studies" discussed by Britt, 1956; Starch, 1959c; Politz, 1%4). But these studies are irreparably flawed by a variety of methodological difficulties.

More recent ex post facto studies using a variety of techniques include an investigation of the effects of movie commercials (Broadbent and Segnit, 1972). a study of airline advertising (Broadbent and Scgnit. *1972), a report* by McDonald on the relations between reported purchase diary y data and media data (Krugman, 1972), and the MorriU study (McGraw-Hill. 1971) of the effect of industrial advrxdsing. They all suggest diminishing returns to advertising, as do three studies cited by Engel, Blackwell, and Kollat (1978): the NBC Hofstra study of television advertising recall, the T yrex study of product awareness, and a brand-mention study of *Post* magazine readers. The only exception is a German study reponed by Geiger and Ernst (1971), who found support for an S-shaped curve for the relationship between reported exposure to magazine advenising and brand awareness. None of these studies seems to us to be sufficiently solid methodologically to be worth examining indcpth.

Summary and Conclusion about the Physical Advertising Response Function. The review of the studies on the physical advertising response function bas revealed a fragmented and noncumulative research effort. The design and results of the studies reviewed in this section are summarized in Table 1. The independent variable-advertising input—may be size of print advertisement, length of commercial, or number of exposures. The dependent variable may be sales or some "intermediate" effect measure that is conative (e.g., intentions to buy), affective or attitudinal, cognitive (e.g., product awareness or recall of advertisement), or even physiological.

The extreme right-hand column of Table 1 summarizes the findings, indicating whether the studyin question showed monotonically decreasing returns over the range covered or increasing returns. Taken together, these studies of the effects of size, repetition, and quantity of advertising show no conclusive evidence of increasing returns in the physical advertising response function. Rather, the evidence massively shows diminishing returns over the ranges studied. In drawing this conclusion, we put special weight on the imaginative and well-controlled experiment of Ray and Sawyer (1971). and on the mail-order data because of their reliability. Geiger and Ernst (1971) claimed to have documented an S-shaped curve, but we find the basis for their conclusion not solid enough to temper our conclusion that the shape of the physical advertising response tinetion is concave downward.

The Monetary Advertising Response Function

Even if there are no increasing returns in the physical advertising response function, there could be increasing returns in the relationship between *expenditure on* advertising and sales in physical or

Table 1

Summary of Design and Findings of Studies of the Physical Advertising Response Function

Research design	Study	Dependent measure: Sales	Conative	Affective	Cognitive	Physiological	Findings
(1) Laboratory experiments							
(a) Size	Strong (1914)				x		Decreasing returns
	Wheatley (1968)			x	x		Decreasing returns
	Capitman (1%4)				x		Decreasing returns
	Hoffman (1%3)		,	x			Decreasing returns
	Lodish (1971)		,				Decreasing returns
	Schwartz (1975)				x		Decreasing returns
(b) Repetition	Adams (1916)				x		Decreasing returns
	Ray and Sawyer (1971)		x	x	x		Decreasing returns
	Politz (1960)				,		In two cases decreasing returns. and i. two cases increasing returns
	sawyer (1974)				x		Decreasing returns
	Wells and Chinsky (1%5)		,				Decreasing returns
	Krugman (1%7)					x	Decreasing returns
(2) Market experiments							
(a) Size	Shryer (1912)	x					Decreasing returns
	Simon (1965, 1970)	x					Decreasing returns
	Starch (1959a)		x				Decreasing returns
	Rudolph (1936)				x		Decreasing returns
	Starch (1966)				x		Decreasing returns
lb) Repetition	Shryer (19121	x					Decreasing ret.rm
	Zielske (1959)				,		Decreasing returns
	Stewart (1964)	x	x	“	x		Decreasing returns
	Starch (195%)		x				Decreasing returns
	Politz (1964)				x		Decreasing returns
	Politz (1%5)		x	,	x		Decreasing returns
	Miller (1976)		x	x			Decreasing returns
	Broadbent and Segnit (1972)				n		Decreasing returns
(3) Ex post facto studies	Broadbent and Segnit (1972)				x		Decreasing returns
	Broadbent and Segnit (1972)				x		Decreasing returns
	Krugman (19721				x		Decreasing returns
	Morrill (1971)	x		,			Decreasing returns
	Engel, Blackwell, and Kollat (1978)				x		Decreasing returns
	Geiger and Ernst (1971)				x		First increasing, then decreasing returns
	Roberts (1947)	1.					Decreasing returns
	Cerha (1967)	x		x	x		No relationship for awareness and attitudes. Linear relationship for behavior.

money units, because of quantity discounts. And for the enterprise and for society, the monetary relationship is the more relevant.

Quantity discounts are often large in advertising and might lead to increasing returns to advertising. So might these other factors Chamberlain (1%2) adduced:

> 1. . . . Improvement in the organization of the expenditure as its total amount is increased . . . the employment of more resources means greater specialization in their use.
>
> 2 . . . . The most effective media may be those whose use requires a large outlay. As expenditure increases, then, a shift may take place to continually more effective media, so that a tendency to increasing returns is imparted to the cost curve.
>
> 3. . . . The most effective choice of media may involve the use of several in combination. .

Let us consider the evidence.

Experimental Studies. For our purposes here, experimental evidence has the large advantage over nonexperimental data in that all other selling conditions can be satisfactorily controlled in an experiment, whereas it is very difficult to do so econometrically. A bench mark is du Font's 12-market test with amounts of advertising for Teflon corresponding to levels of $1 million, $500,000, and zero (McNiven, 1%9). The advertising level was varied in fall and winter so that the results of various combinations of advertising could be seen. The data seem to show that there arc *increasing returns. That is, the $1-million level* did much better than the $500,000 level, while the latter did only slightky better than no advertising at all. This set of data constitutes the strongest available evidence for increasing returns, though the generality of the finding is limited by the short range of observations—only three levels of advertising-in the study.

We have found only one near-replication of the du Pont study: Eskin"s (1975) test of a new food product with 60 stores in four test markets over six months, which also introduced new methodological twists. There were three price treatments and two advertising *treatments allowing tests* of interaction effects. Data were collected on various measures of potentially important extraneous factors that could inlfuence the outcome. The proportion of total expenditures allocated to each media class was kept constant. The principal dependent measure was unit sales of the product per store per month.

Advertising had most impact at the lowest price level. At each price level, the proportional increase in sales (adjusted for differences in the covariates) *was smaller* than the relative increase in advertising. which suggests diminishing returns. It would be valuable if studies such as the present one and the du Pent experiment were extended so as to include more levels of advertising.

Two other high-quality experiments deserve mention. The American Dairy Association (in'. cooperation with the Department of Agriculture) tan a weU-controlled experiment on the effect of several levels of promotional expenditure upon fluid-milk sales. Over the range of this experiment, there were diminishing marginal returns (Clement, Henderson, and Eley, 1%5). And Doyle and Fenwick (1975) conducted an experiment with 32 stores of a company in England which had not advet-dsed in the preceding two years. They subjected stores to three different levels of advertising, plus no advertising for a control group for a six-month period. Doyle and Fenwick concluded "The advertising response function as developed from the experiment appears to exhibit the classical pattern of diminishing returns."

And last. OHerIihy ([977, 1978a) has described in general terms several large-scale field experiments for British products that he says all show the con. cave-downward curve rather than the S-curve, though only one of these —for Andrex toilet tissue— has been published in reasonable detail (Branton, 1978).

The admixture of evidence from field experiments requires some judgment. Our evaluation takes note that only one among several studies shows evidence of increasing returns, and that one—fike the others-is not repot-ted in sufficient detail for thorough analysis. Hence we are inclined to consider that it is anomalous for any one of many reasons that we do not know. Our reluctance m rely heavily on a single study is reinforced by a recent remark by Corkindale and Kennedy that, in their considerable experience, fully 19 of 20 field studies of advertising expenditures fail to produce valuable information because of a variety of confounding factors and researcher inept. itudes (OHerlihy, 1978b).

In brief, then. we arc satisfied that the field experiments as a group show no solid evidence for *increas*ing returns over operating ranges.

Nonexperimental Studies. Ideally, nonexperimental studies of the advertising response function should include the following elements (for a more comprehensive and detailed discussion see Parsons and Schultz, 1976):

(1) marketing-mix interaction effects -i.e., sales impact of other elements of the marketing mix;
(2) competitive effects —i.e., impact of competitors' activities;
(3) cam yover effects —i.e., explicit consideration of

lagged responses;

(4) simultaneous relationships (which may Be necessary to solve problems of identification or direction of causality Is advertising causing sales, or are advertising expenditures determined by sales?).

The studies to be reviewed fafl far short of this ideal, partly due to limitations in the data available. A purist might exclude cross-sectional and time-series data from this review. But to exclude these econometric studies would mean throwing away much realistic evidence that describes actual buying in response to actual marketing mixes in real-life settings.

We distinguish between time-series and cross-sectional studies, but because some of the studies have pooled these two types of data, the classification of studies into each of the two groups is not neat.

Time-Series Studies. From the earliest days of national advertising for patent medicines, advertisers have striven to relate current advertising expenses to current safes, but without avail because of the lagged effect of advertising. An unusual example of a current-data study that did not suffer fatally from this is that of Buzzell and Baker (1972), wbo took advantage of the "natural experiment" created by the General Motors strike, which caused firms in the automotive industry to alter their advenising budgets. As maybe expected, advertising alone explained only a small proportion of the variation in safes. Finding some support for a logarithmic function, however, the authors concluded that "there appeared to be a diminishing returns phenomenon operating. "

An early attempt to allow for competitive effects was reported by Weinberg (1956). who investigated tbe market effort-sales relationship for a glass-container manufacturer. His data base consisted of observations, over seven years, of annual changes in market share and in the "'exchange rate"" for marketing expenditures (the firm's marketing expenditures per dollar of sales divided by the corresponding ratio for its compactors). Hence, competitors' activities were to some extent included. A remarkably close fit (r' = .996) was repotted for a logarithmic function. evidence against *economies* of scale, but the data were described only at a high level of abstraction.

Weiss (1968, 1%9) extended the Weinberg study by developing a multiplicative formulation to explain changes in market shares of three national brands of a low-cost consumer food item. The influence of competitive factors was represented with relative advertising and price measures. The estimation resuited in near-zero advertising elasticities. casting some doubt on Weinberg's excellent fit.

Johansson (1973) made a diligent effort to fit a variety of functions, including semi-log, double-log, and sigmoid. to monthly observations over 13 months of market shares and advertising expenditures in four media for an unidentified product group, but ignored competitive effects. He concluded that "the effect of advertising "on market share is best depicted by a curve which is everywhere concave to the origin.'"

The next group of studies to be reviewed include the effects of lagged advertising in their designs. We concentrate on the single-equation models because most studies using simultaneous-equation models have not explicitly reported investigations of various forms of the response function, For other reviews and discussions of methodological aspects of lagged models, see Clarke (1976), Parsons and Schultz (1976), and Dhalla (1978).

The landmark study that took into account the crucial lagged effect of advertising was that of Telser (]962), wbo thoroughly investigated the relationship of safes to advertising for the three largest cigarette brands before World War 11. He tested several different models, included both competitive effects and price as variables, and concluded that "the level of advertising was high enough to place the companies at the point where there were diminishing returns to advertising."'

Telser's conclusion is interesting more as a confirmation than as a discovery, however; one would hardly expect the largest advertisers to stop advertising al a point of increasing returns, if such a point exists. Nor does this finding about the largest brands tell us whether they are operating at a lower per-unit cost than is possible at greatly lower levels of advenising expenditure. This difficulty afilicts all such time-series studies as evidence for or against increas. ing returns. Once firms have accumulated some knowledge of their response functions, they would never knowingly operate in the region of increasing returns. Hence, the fact that such a region is not *observed in these studies* is not strong evidence tftat such a region does not *exist.* This caveat also applies to other time-series studies reviewed below, though not to the same degree in most cases.

Tlte best-known single-equation study is that of PaIda (1964) on Lydia Pinkham's Vegetable Compound from 1908 to 1960. The product had no known close substitutes. thereby eliminating the complications caused by competitive effects. Palda found that a distributed-lag model with the logarithm of advertising as an independent variable gave the best predictions. This result 'tends to confirm the operation of decreasing returns to a variable factor.'" A

large number of studies in the Telser-Palda tradition have confirmed this finding of diminishing returns: analyses of M brands of liquor by Simon (1%9), of a Swedish drug product by Lohmander and Tufvesson (1975), and of a variety of U.K. products by Cowling *et al.* (1975). Other relevant references are Buzzell (1964), Kttehn, McGuire, and Weiss (1966). Frank and Massy (1967), Lam bin (1969, 1970a, 1970b), Sexton (1970, 1972), Hamilton (1972), Montgomery and Silk (1972), Narodick (1972), Schmalensee (1972), Motiarity (1975), and Parsons (1975).

Lambin's exhaustive study (1976) must now be considered the centerpiece single-equation time-series study of the advertising-sales relationship. (The following material on Lambin's work has been drawn from a forthcoming article by *Simon [1980].) The econometric* techniques are wisely chosen and well used, and the sample covers 107 brands of 16 product classes in 8 countries of western Europe (though all were consumer goods). We shall discuss this study in depth partly because of its comprehensiveness and partly because it produced findings that apparently (but do not really) differ from the general pattern.

Each individual response function that Lambin estimated was best described by a concave-downward diminishing.returns equation. From this, Lambin concluded that "since semilogarithmic (in the advertising variable) and double-log regressions invariably performed better than linear forms, this is evidence that the shape of the advertising response curve is concave downward, i.e., that there is no S-curve and no increasing returns in advertising a given brand by a given firm."

Then Lambin changed course radically and ex*amined* the relationship of each brand's advertising share to its market share. This is conceptually related 10 the relationship between the advertising-sales ratio and the size of the firm, the. major difference being the use of brand rather than firm data. The results showed that brands with relatively small market shares had advertising shares larger than their market shares. This Lambin interpreted as indicating that there is a threshold for advertising effectiveness below which advertising expenditures have no effect. Such a threshold constitutes an inflection point, the lower boundary of a region of increasing returns. fn the words of Lambin: 'Therefore, to reach the level of communication effectiveness, small brands have to keep their advertising shares higher than their market shares. "

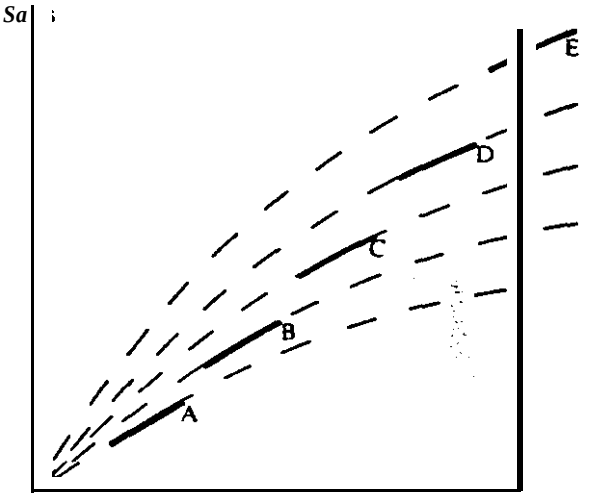
It is important that we examine this conclusion of Lambin's in detail, because it is susceptible of being cited for many years by those in the advertising business who have a stake in the existence of increasing returns.

Let us be clear. Lambin's overall interpretation must be that there *is an S curve* of increasing returns, though he writes: "Our results present strong evidence that decreasing returns to the advertising factor is the general rule . . . there is no S-curve and no increasing returns." This interpretation is based on the interbrand advertising and market-share relationships. Our task is to go deeper into the meaning of these data to see what interpretation they best support.

Let us first assume with Lambin that smaller brands have higher advertising-sales ratios (advertising shares in the context of his data) than brands with larger market shares. If so, the observed data might be explained as shown in Figure 3. There we see that firms that advertise more have higher response functions. That is, firm E, which is presently advertising at level E, has an extrapolated function that produces more sales at any given level of advertising than does the response function for firm D, and so on down the line to firm A. (The observed data cover only the range of the solid lines in Figure 3.)

These data need not indicate a threshold, however, as we shall now explain. It is first important to notice that each separate advertising function shows the returns to advertising with all other (empirically controllable) factors *held constant.* But the comparison of the response functions *from one brand to another* is made with *nothing held constant. That is,* it is reasonable and likely that firm E has a much more extensive distribution network and a larger

Figure 3
Alternative [n terpretation of Lambin's Data



sales force than does firm A. That would explain a logarithmic or double-logarithmic form, which im-
both why firm E has a higher response function *and* plies diminishing returns to advertising. But this
why it advertises more in total than does firm A. form seems to have been chosen by assumption
And, depending on the particular slopes of the func- either because the researchers believe it is most
tions, the advertising-sales ratio could well be lower realistic or for reasons of mathematical convenience
for the larger firm for this reason alone. Or the or both. The choice does not, however, throw any
advertising response function might be lower for the light on the shape of the advertising response func-
larger firm in this situation because it finds that it is tion. If these studies were to compare various func-
best suited with a strategy of a relatively high in- tion forms, they could make a contribution.
vestment in distribution compared to advertising.

So the logic of Figure 3 is consistent with the observed data without any need of a threshold argument. And if Figure 3 is a sound representation of Lambin's data, then it suggests, plain and simple, that there is no inflection point and no increasing returns, because the response function of the *small-* ● sf firm, A, is concave downward.

There arc also additional reasons not to interpret Lambin's data as showing a threshold effect. Lambin used an entirely different son of argument to explain an inverse relationship between the advertising-sales ratio and market share among the largest firms done, "because large firms perceive the existence of diminishing returns and therefore set their advertising appropriation at a level where the marginal sales effectiveness of advertising monies is sufficiently high." But the same argument would also apply to small firms. And the resort to several such ad hoc arguments for the same phenomenon under different conditions weakens them all.

Even if Lambin's interpretation of his data as of showing a threshold were correct-and we have every reason to think that it is not correct—one would still have m conclude against a threshold being empirically observed. The reason is that in the universe of firms as a whole—in contrast to Lambin"s convenience sample of 107 brands in 16 product classes -Simon and Crain (1966) found no association between size of firm, as measured by asset value, and the advertising-sales ratio in the various industries (using IRS data on all firms submitting tax returns in 109 industries). Lambin's data are more appropriate than are Simon and Crain's because they are at the brand level. But if the relationship really holds, one would expect to see it at the firm level as well, where it does not appear. This is additional evidence against Lambin's interpretation of his data as showing a threshold effect (and therefore increasing returns at low levels of advertising).

On the multiple-equation studies, these studies (e.g., Bass, 1%% Bass and Parsons, 1%9; Samuels, 1970-1971; Lambin, 1970a, 1972; Schultz, 1971; Beckwith, 1972; Clarke, 1973; Comanor and Wilson, 1974; Parsons, 1974; Cowling *et* al., 1975; and Wildt, 1974) typically work with tbe advertising variable in

Cross-sectional Studies. Some of the difficulties with cross-sectional studies were mentioned earlier. An additional problem with cross-sectional studies of that measure purchases is that they often fail to control for other marketing variables.

Worth mentioning here because its findings run contrary to most of the other studies reported in this paper, Rao and Miller (1975) obtained bimonthly safes observations of five Lever products in 15 sales districts. For each brand in each district, the coefficients were first estimated for a lagged model relating market share to advertising and various promotional activities. Hence, total incremental sales for each $1 advertising were estimated for each district. Next, the functional relationship between total incremental sales and level of advertising expenditure was established by cross-sectional analysis for the 15 districts. The results indicated "that the relationship of sales to advertising expenditure is approximated by a family of S-shaped curves.'" Unfortunately, Rao and Miller present only a small part of their data, most it in graphs which seem to have been smoothed, and they have not responded to requests for the raw data. In light of these factors, together with the fact that no allowance was made for differences in market potential, we arc uncertain about how much weight shotdd be placed on this publication.

Summary and Conclusion about the Monetary Advertising Response Function. Of the monetary-variable studies reviewed, almost all show diminishing returns for advertising over tkte ranges covered. One exception is the experimental study by McNiven (1%9); another exception is the Rao and Miller (1975) study. Taken together, these studies support the conclusion from the previous section on the physical advertising response function: there is little evidence for increasing returns to advertising, and considerable evidence for monotonically decreasing returns to advertising over the normal operating range.

Advertising and Economies of Sffe

Even if there are no physical or monetary increasing returns, advertising could give an advantage to

the big spender over the small spender for advertising. This could happen if there is an interaction among various levels of advertising and various other factors of production-for example, in a multiplicative fashion. This leads to the concept of economies of scale.

It is "not easy to make sense of the concept of economies of scale with respect to advertising, however. The difficulty is that the concept of economies of stalk refers to differences in just that the scale of the enterprise with all factors taken together, including their interaction. The concept was not designed to throw light on the operation of a single factor alone.

Because of the conceptual complexity as well as the complexity of interpretation of the advertising-sales ratio, which is the dependent variable in most studies that aim to analyze economies of scale in advertising (and which we regard as useless for this and most other work on advertising; see Simon and Crain, 1966), it would take much space to try to make sense of the matter. We will be happy to supply upon request a longer draft which discusses the matter and concludes that there has never been a satisfactory test of whether advertising is implicated in any economies of scale that operate in any industry. Nor do we find that the question has ever been formulated in a fashion that suggests how it may be answered meaningfully.

Another tricky issue is that of multibrand economies of size stemming from advertising. Such economics are logically similar to geographical economies. One might speculate that a merger of two related-product brands or the development of a related-product brand by a going firm might produce both volume discounts in advertising and communication economies such as the use of a common trademark. And the increase in the number of advertised brands in a majority of consumer categories (Simon, 1970) is consistent with this speculation. (This afso represents lessened industrial concentration at the brand level, by the way, rut important phenomenon in its own right.)

But a trend toward a larger number of brands sold per tit-m might afso stem from economies of distribution, production, and purchasing (e.g.. packaging materials). Hence, this is certainly not strong evidence for multibrand economies of size flowing from advertising. Nor is there other relevant evidence. And it is difficult to think of a sound design to test for this effect.

Advertising might be used as a barrier against potential entrants into the market, just as "stay-out pricing"" might be used. The latter has been discussed under the title of "limit pricing,'" analyzed in a static manner by Bain (1956), Modigliani (1958), and Sylos-Labini (1%2), and in a more dynamic context by Gaskins (1971); for a recent review see Mop (1979).

To our knowledge the dynamic theory of advertising barrier effects has not been spelled out very thoroughly, though for a start see Schupak (1972). And it is not immediately obvious how one would formalize for a mature market the ideas vaguely expressed by the literary concept. For a new product, it seems rather straightforward that a firm making high profits from an innovation might buy advertising beyond what a monopolist would in order to bind customers more closely for the future. And in this way, as well as by simply lowering the prospective profits because of advertising expenditures, a firm with a new product might render entry less attractive. That is, more advertising in period t might mean relatively fewer sales in period $t + 1$ for a potential entrant with given levels of price and advertising.

Working in the other direction is advertising's role as a competitive tool that makes it easier for potential entrants to enter successfully. If one could not advertise, it would be much harder for a potential entrant with a product improvement—a ball-point pen or a rotary engine-or even a potential entrant without a product improvement, to enter the market. In this way advertising has a procompetitive dynamic effect.

Unfortunately. we could find no body of empirical work for us to determine whether the net outcome of advertising is to increase or decrease the rate of market entrance. And it will not be an easy task to design sound research to answer this question.

How May the Basic Questions Finaffy Be Resolved?

No one study can be considered nearly conclusive on either the physical or monetary response functions. Each of the studies (even Lambin's) offers results for a limited set of conditions, and all have methodological drawbacks of one kind or another. But the near-unanimity of these very different sorts of studies is impressive. If there were increasing returns. some of these studies should show it. Yet one hopes that a more comprehensive study will be undertaken.

If one were able to design a study to settle the question once and for all, how should it be done? Of course no study really can answer the question for all products, all media, and all sorts of advertisements, but perhaps a coordinated every-other-house

design employing both cable-television and newspaper advertisements would seem to come closest. Using the soil of system available at the Milwaukee Advertising Laboratory and elsewhere, it is possible to give different advertising schedules to even-numbered and odd-numbered houses. An even better design would vary the schedules by blocks. in which case it is easier also to vary the advertising schedules in the newspapers these homes receive. This design makes possible all combinations of schedules of various quantities of advertising.

Purchase diary would likely be the basic mode of effect measurement. But it would be worthwhile 10 measure product knowledge and attitude at various intervals as well. Experiments should be made with a wide variety of product types to ensure that the findings are not product specific. Wide ranges of amounts of advertising also should be employed to ensure that the results can be very general.

Conclusions and Summary

After completing our review, we agree with Bass (1%9) that "there is no more difficult, complex, or controversial problem in marketing than measuring the influence of advertising on sales." In view of the inherent complexities of the subject matter, it is no wonder that no single study can come reasonably close m being definitive.

Despite the methodological problems of the individual studies, the main thrust of the evidence is clear—across product categories, geographical settings, media, methodologies, and researchers. Our findings are as follows.

(I) Studies of the response function linking physical measures of sales impact to physical amounts of advertising consistently indicate diminishing returns to advertising over the ranges of investigation in laboratory experiments and over the normal range of advertising budgets for operating firms. To put it differently, increasing returns have not been reliably observed in the laboratory or in the field.

(2) Studies of the function relating sales in dollars to dollars of advertising, which reflect the role of discounts, also show diminishing returns to advertising, with the exceptions of the McNiven du Pent study (1%9) and the Rao and Miller (1975) study.

(3) Taken together, the studies using physical and monetary variables add up to the conclusion that there are not increasing returns to advertising—that is, no S-sbapcd response function-over the normal operating range.

(4) We hope that a broad concerted attack upon this question is mounted, perhaps by an industry group and perhaps along the lines of the design we have suggested above. Such a piece of work intended primarily to throw light on this subject will provide a more persuasive answer than does the heterogeneous collection of studies upon which we rely for our conclusions.

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