A CERTAIN ERRATIC TENDENCY IN ACCOUNTANTS' INCOME PROCEDURE

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I OFFER for consideration four propositions: (1) Sound work in the mathematical theory of price economics is unlikely to be done by one whose theory of income accounting is inchoate or otherwise defective.

(2) Generalizations drawn from statistical analyses in price economics by one who is unaware of the deficiencies in prevailing income accounting procedure cannot be adequately safeguarded by the usually calculated measures of probable error.

(3) The full fruition of quantitative economic theory must wait upon the substantial betterment of both the mathematical theory and the statistical practice of income accounting.

(4) Extensive rationalization of economic conduct in the economic arts is not to be expected unless, and until, the erratic character of prevailing income accounting is remedied.

Needless to say, I shall not attempt an exhaustive, formal proof of these four propositions: I shall be content to show the mathematical character of a portion of income accounting theory, to show the statistical unreliability of the related prevailing procedure, and to suggest the influence of this unreliable procedure upon economic events.

The statistical work of income accounting consists almost wholly of treating certain kinds of time series. The procedures employed lead to many kinds of erratic fluctuations in the terms of these series.

I shall speak of only one of these erratic tendencies; one that results in violent fluctuations in the successively reported annual net income[1]

[1] I use the term "annual net income" for verbal convenience. The figure meant is a figure determined by the formula: $(C-C_p)-(D-D_p)$ = net income of the year. In this expression C means "the sum of book credits to the 'proprietary accounts' during the year." C_p means "the sum of book credits to the 'proprietary accounts' during the year arising out of proprietary contributions," (e.g., shares of stock subscribed for), D means "the sum of all book debits to the 'proprietary accounts' during the year," and D_p means "the sum of all book debits to the 'proprietary accounts' during the year arising out of distributions of assets or promises to distribute assets to those beneficially interested in the proprietorship" (e.g., dividends declared). For convenience also I include within the term "proprietary accounts" the liability accounts arising out of borrowing transactions, but not the liability accounts arising out of goods and services purchased but not paid for.

figures of enterprises. Of course no professional accountant supposes that the figure he finds for any one year represents a fact exactly provable.[2] He regards the value found as a most probable measure of a tendency; and he regards the first differences of the successive annual figures as most probable changes in tendency. But one cannot suppose, on the other hand, that accountants perceive that their procedure *itself* is erratic, or, in other words, that any material part of the error in the successive annual figures is the inevitable consequence of their erratic algebraic treatment of their primary, factual data. The erratic tendency of which I shall speak is attributable to the mode of converting certain classes of discrete money outlays into equivalent expense deductions.

Aside from negligible contributions and payments in kind, the primary time series of income statistics consist solely of the incoming and the outgoing of money. All incomings except proprietary contributions and all outgoings except distributions to those having an interest in the proprietorship are included in these primary series. Incomings are positive, outgoings negative in sign. As a measure of income, the mere algebraic sum of receipts and payments during a year is useless except as an accounting for the change between beginning and ending cash balances. The accountant's problem is to convert the time series of actual outlays and actual receipts into equivalent series of incomes and expenses, that is, into positive and negative incomes. This conversion is, in essence, a matter of leading and lagging time series and of distributing the leads and lags.

In making this conversion there are two objectives; an implied objective that the algebraic sum of receipts and outlays shall, for the entire life of the enterprise, be equal to the algebraic sum of all annual net incomes for the like period; and an expressed objective that from the positive terms in each annual summation there shall be subtracted due allowances (expenses) for all outlays made (or expected to be made) *as an incident* to acquiring that year's positive, or gross, income. All accountants attain the implied end, none, the expressed end. The objectives are proper. The full usefulness of accounting cannot be enjoyed without reaching them.

The major processes involved in reaching the objectives may, as to effect, be described as follows: (1) Each discrete dollar-receipt and dollar-outlay is distributed as a continuous variable, "dollar-years of receiving" (income) and "dollar-years of paying" (expense); (2) the time limits within which each variable is to be continuous are fixed;

[2] I have shown in my *Economics of Accountancy*, pp. 94–99 and 126–127, that the figure for the net income of an enterprise becomes a provable fact only upon the termination of the enterprise.

(3) the equations, or formulas, of the variables are selected; (4) from these formulas the amount of each variable falling between the ordinates at the limits of the year in question is calculated; and (5) the algebraic sum of all concurrent terms is taken. This latter sum is the net income for the year.

Within the scope allotted to this paper I shall be unable to go into the details of the various expense-spreading formulas. I can do no more here than sketch a representative resultant of the commoner procedures. For convenience, I shall consider the case of a concern whose sole important source of money receipts is collections from customers. For this concern I shall separately carry the major classes of annual income terms through the first four of the major processes referred to above.

The treatment of the positive terms is simple. Since, in our assumed example, receipts of money are restricted to customer collections, the variable, "sales less bad debt losses," may be substituted for collections. A dollar collected from a customer will be represented by a dollar of income in the year in which the sale occurred, without regard to whether the collection was made in the year prior to the sale, or during that year, or in the year following the sale. The summation of sales made during the year, adjusted for bad debt losses, becomes the sum of the year's positive terms. Annual gross income figures are therefore sensitively responsive to changes in trade conditions.

The negative terms I shall divide into two major classes, one of which will be sub-divided. One of these major classes arises out of outlays made in hand-to-mouth buying; the other, out of outlays made to procure long-lived facilities and in connection with long-term commitments.

The cycle, or turnover period, for the first class is short. Wage payments to factory workmen, to salesmen, and office staffs, payments for materials and supplies utilized in operations, hired services like transportation, etc., are representative of the class. These payments are converted into expenses of the period in which the goods resulting from the hired services and the utilization of the materials are sold.[8] Again,

[8] Superficially, these payments seem to become expenses of the year in which the materials were bought and in which the services were rendered. Purchases are charged in the income accounts as they are made, wages, as they are earned. But at the end of the year partly manufactured goods and finished, but unsold, goods will be inventoried. The figure found by the accountant as the "cost" of the inventory will become a credit to income, that is, will be minus a negative term. This inventory figure will become a negative term in the next year's summation. A like carry-over, by means of the inventory valuation, occurs for certain variables of the other major class of negative terms also. Clerically regarded, there is a primary distribution and an adjustment, or redistribution, of the leads and lags.

the date of the actual outlay is immaterial; it may precede the year in which the expense is deducted, fall in the same year, or follow in a later period. But characteristically, the interval between the time of *payment* and the time by which an expense to the full amount of the payment has become *charged*, is short. The annual summations of this class of expense, like those of the positive summations, are, therefore, sensitively responsive to changes in trade conditions. The absolute values of the successive annual summations of this class of negative terms are highly correlated positively with the concurrent positive summations.

The second major class of negative terms is usually represented as three or more coordinate, independent classes. Superficially, they appear quite unlike one another; economically and statistically, their kinship is near. With respect to the theoretical problem of income determination, they are essentially alike.

One of these sub-classes consists of the so-called "non-disbursed" expenses, depreciation and obsolescence. In reality they arise out of numerically equivalent outlays just as all other expenses do; in general, the expense terms merely continue long after the outlay has been made. The original outlay made to acquire a long-lived instrument, a leasehold, etc., gives rise to a series of expense terms that is continuous from the time the thing acquired goes into use until the last product associated with its use is sold.[4] The formula most used in distributing this expense is the "straight line" formula. That is, the annual negative terms are equal.[5] The formula next in popularity substitutes, for this arithmetic progression of common difference zero, a geometric progression with common ratio of 1 plus a small constant that is usually called a rate of interest, although it is not a rate of interest. The deduction terms according to this formula are inert and unresponsive to trade conditions.

A second sub-class of expense terms arises out of outlays that, though repetitive at short intervals, are associated with long term commitments. Monthly rental instalments on long term leases, salaries of officers, etc., suggest the type. In accounting practice, the annual expense terms are nearly equal, after end-of-the-year adjustments, to the yearly outlay. These expense terms also are inert and insensitive to trade changes.

The third sub-class I shall call, for short, service charges. These ex-

[4] For the sake of simplicity I have neglected the treatment of expected salvage value, a positive term. In practice, the difference between cost and salvage value is distributed—a procedure which, in effect, distributes the items simultaneously and in like proportions.

[5] But see note (3) above, concerning redistributions.

penses arise out of outlays incurred for repairs and upkeep, for general property taxes, for insurance premiums, and the like. The amount deductible annually is initially equal to the liabilities for payment incurred during the year; some of these deductions are adjusted in the inventory account. The annual summation of this class is, to a slight degree only, responsive to trade conditions. For example, machine repairs fluctuate with amount of work done, but such outlays are also a function of the age-distribution of the machines. There is often a spurious appearance of dependence; large programs of repair are often deferred until increasing operations supply the ready funds to pay for them. This is notoriously the case with many American railroads. As a whole this sub-class fluctuates little from year to year and the absolute correlation with the concurrent positive terms is small.

Considered as one major class, these three sub-classes of negative terms associated with long-lived facilities and long-term commitments, exhibit in the annual summations large absolute amounts and a very small coefficient of variation.

Let us take stock of our three major series, one positive, the other two negative. The positive terms fluctuate in response to trade conditions. One class of the negatives is highly correlated absolutely with the concurrent terms of the positive series. Hence the annual differences of the first two exhibit a coefficient of variation not greatly differing from that of either the minuend or the subtrahend series. But when we deduct from these fluctuating difference terms, the concurrent terms of a large, nearly constant series, we reach a final series of net annual income figures whose relative fluctuations are so violent as to suggest the term "freakish," rather than the milder term, "erratic" behavior.

This violent fluctuation is not a new phenomenon to those who have had to deal with income statistics in income studies, in business cycle analyses, in income taxation problems, and the like. It is possible, however, that many may not hitherto have marked the degree to which mere accounting procedure, rather than real economic events, has brought about this behavior of income series.

I propose certain questions for consideration: Does the amplitude of fluctuation in annual net income series arise chiefly by reason of events that have a real existence rather than by reason of the arbitrary mode of accounting for the events? Is there, in economic reality, any such fluctuation in real net earnings as is exhibited in the accountants' *figures* for earnings? Is there, in economic fact, a large class of fixed expenses, that is, of annual expenses that are independent of the annual volume of operations? I shall answer each of those questions in the negative. The large net income figures found by the accountants in

years of large volume of output are characteristically grossly overstated; the red ink that appears in the income balances of low-volume years,—because of the arbitrary treatment of "fixed" expenses—is, more often than not, just ink. There is no kind of expense that is, unconditionally, and in economic reality, a fixed expense with respect to annual operating income; there are only arbitrarily fixed *allocations* of certain expenses.

Before I attempt to support my negative answers let me recall the accountants' expressed objective: to deduct from each year's gross income the expenses incurred in *getting* that gross income. The gross income in question should be not money nor collections, but should be a measure of the *coming-in* of money (at some time or other) by reason of operations *brought to a certain stage* (sales), *during the specific year*. The expense in question should not be money or payments, but should be a measure of the *going-out* of money (at some time, past or future) made necessary by these same operations that have been *brought to this stage during the year*.

The accomplishment of this highly desirable objective amounts to solving the problem of how much of any given dollar of outlay is spent to obtain any particular dollar of receipt. I shall not attempt to answer this question specifically myself; I shall show that the accountants' answers are needlessly wide of the mark because of their treatment of the second major class of negative terms. I shall also indicate the mathematical character of this portion of income accounting theory.

This class includes some of the so-called fixed charges and all of the so-called fixed expenses. In certain senses they are really fixed. If $1,000 is paid for a machine the outlay is fixed in the sense that it is an unalterable number of dollars of negative sign. It creates a fixed *total* of expense, that is, of charges against income. That expense total is a fixed expense of the total time within which the machine's use enhances sales. But the expense is not fixed in the sense that any particular portion of it is unconditionally a negative term in the income summation to be charged to any particular year within the time limits of use. The latter is a matter of distribution and is entirely at the disposal of the accountant. The accountant can have no option as to the total ultimate expense charge; he cannot control the time within which all of a set of services will have been utilized, but he can distribute the fixed total in the actual time of use in any manner that recommends itself to his judgment.

Exactly the same propositions can be made about each and every one of the series in my second major class of negative terms. The contracting to pay $10,000 yearly rental for 50 years for a parcel of land is not evidence of a judgment that the land's services will be of ex-

actly equal effect in enhancing sales in each year. It is not evidence of any judgment at all except that the use of the land for *fifty* years will be worth as much, in producing revenues, as the capital value of an annuity of $10,000 a year for 50 years. Beyond this judgment the bargain merely indicates that the parties prefer the annuity method of settlement. Again, $500,000, the outlay, is the fixed distribuendum, 50 years is the fixed period, but the distribution is again at the disposal of the accountant.

If during the life of a machine it will pay to spend $500 on repairs, and if $500 is thus spent, the $500 must be distributed during the use-life of the machine, but it can be distributed at will within that time.

Consider the conditions that give rise to the primary outlays of this class. Concurrent selling prices and quantities sold are, from a static viewpoint, negatively correlated. But we all know, that for brief periods,—say during a business cycle—correlations may become positive and large. It is this latter, short run condition that makes economical the provision of plant capacity in excess of that most economical for the expected minimum rate of production. And it is this decision to create, to maintain, and to operate (when advantageous), a plant of some particular capacity that fixes the aggregate of these so-called fixed expenses. The totals are capacity functions; only indirectly are they rate of operation functions.

If it is true, as I believe, that capacity in excess of requirements for minimum rates of operation can legitimately be provided only in order to take advantage of favorable markets, then the test of whether or not the provision of a given excess capacity has been profitable may be stated thus: Suppose the quantities produced in unit time to have been graduated by increments between minimum expected rates and maximum possible rates. Under this supposition, have the sales receipts from operation at maximum capacity been great enough to absorb (1) all deductions *per dollar of sales* appropriate to production at the next lower capacity increment plus (2) the entire differential outlay necessary to providing this uppermost capacity increment together with interest on the outlay for this differential capacity at a rate acceptable to the management? To be sure, the question, "has the excess capacity actually provided been profitable," sounds academic, but an answer to it is indispensable to answering the further vital question, will it probably pay to increase an existing capacity? For that is a continuing question that must be answered if an enterprise is to attempt to maximize the present worth of its gains. The answers to the questions just asked come within the scope of the accountants' expressed objective in income and expense distribution. If their procedure is to supply data for answers, customary methods of distribution must be altered.

The form of the questions just put suggests the character of the contemplated changes in procedure. It suggests the finding of a standard, or base charge, a negative magnitude k that is to be modified yearly[6] in accordance with some index of quantities produced and some index of selling prices. The properties desirable in the formula may be described as follows. The standard charge, k, should be a magnitude such that: (1) were a plant built of capacity best suited to constant quantity production at an expected mean rate (as measured by an index number of quantities) and were the plant operated constantly at that rate, $\sum k$ during the life of the plant, would equal the sum of the outlays incurred[7] in obtaining the services of the fixed facilities; and (2) were all sales to be made at some mean of expected selling prices (as measured by some index number of selling prices) the sales receipts would imply a return on the investment at the minimum rate acceptable to the management.

Then, for the plant actually built, k would become the charge against income in those years in which both the price index and the quantity index were equal to the values employed in determining k. In years in which either the price index or the quantity index was different the charge should become $k[1+f(p, q)]$ in which $f(p, q)$ is a function of selling prices and of quantities sold having the following properties: (1) it will be zero when the index of prices p, and the index of quantities q are both equal to the index values used in solving for k (as above); (2) it will equal -1 in periods during which operation is barely preferable to non-operation; (3) it will be less than -1 if operations will not pay;[8] (4) it will reach some value h in the least favorable market in which it would pay best to operate at full normal capacity;[9] and

[6] By "year" I shall mean "unit time."

[7] Both these sums are, of course, negative.

[8] This special case is interesting. It means this: if for an interval of time it will not pay to operate a plant, but, after the interval, it will pay to resume operations, the plant has a value, upon resuming operations, greater than its value when operations were interrupted. This suggests another property of the formula, viz.,

$$k[1+f(p, q)] \gtrless -siV_0$$

in which V_0 means "the sum of outlays (and of commitments) incurred for fixed facilities that, at the beginning of the idle time, had not been charged against income," i is "interest on 1 for unit time at the rate used in computing k," and s is the "shut-down time."

[9] If the value rises above h the condition of plant "overload" occurs. The meaning of values in excess of h is also interesting economically. It is the temporary condition under which it will pay best to operate at unit costs in excess of minimum possible unit costs, e.g., to avoid loss of a sale contracted at a high price, it may pay, for a short time, so to overload an electric generator that the resulting overheating greatly curtails its total ultimate economical output of energy.

(5) it can be so graduated that if future operations are as favorable as expected, (a) $\sum_{t=0}^{t=n} k[1+f(p, q)]$ will equal total outlays for fixed facility services during the enterprise life; and (b) the enterprise will have earned on its total investment the rate used in determining k[10].

I have been unable, as yet, to write $f(p, q)$ in terms of a price index and a quantity index in a form that is satisfactory to me, but I have made some approximations toward it. I think, however, that I have assigned properties to the function that are in accordance with the economic verities of the accountants' problem. I think also that a practically workable formula can be devised that would approximate the results of the theoretical function.

If my analysis is sound, it is clear that these so-called fixed expenses are, in economic fact, the most widely varying of all. Charges for the services of fixed facilities should fluctuate widely from year to year if trade conditions change instead of being nearly constant as accountants now distribute them. Per unit of product, or per dollar of sales, they should rise in good markets and fall in bad; the accountants' unit figures reverse the true direction of change.

Let me sum up the existing state of affairs. Superficially, the accountants' net income figures show huge net incomes in years in which plants operate to full capacity[11] and sales are made at high prices (or, what comes to the same thing, sales price minus selling expense per dollar of sales is high). In years in which plants operate at a small fraction of capacity the accountants show alarming deficits. But suppose

[10] Were such a function as $k[1+f(p, q)]$ to be employed it would be readily possible to compute a magnitude K representing the mean annual expected outlay for fixed facility services for the plant actually built. The difference,

$$\sum_{t=0}^{t=a} K - \sum_{t=0}^{t=a} k[1 + f(p, q)]$$

from the time of beginning operations to time a, would measure the accumulated margin of arrearage (if negative) from average expectations or margin of advantage experienced thus far (if the difference is positive) over original average expectations. It should be noted that both K and k are negatives. Note that K, thus defined, would be nearly equal to the accountants' "fixed expense."

[11] It should be pointed out that the net incomes found in such years could not be sustained indefinitely even if the concern could continue to operate at full capacity in an unchanged market. If the "straight line" method of charging depreciation on machinery and other facilities for which total service life is a function of the rate of exploitation is employed and if, in estimating the number of years a machine may be expected to last, allowance is made (as it usually is) for some idle time, then capacity operation will exhaust the economical life of the machine in a number of years less than the estimated number. This would necessitate, at some future time, a deduction for "depreciation arrearage." This is not the only reason, of course, why the accountants' net income figure could not be sustained under the assumed conditions.

we put the significant question, has the excess of sales receipts in the fat years of capacity production at high selling prices over the sales receipts in the lean years been large enough to pay for *all the costs of providing capacity in excess of minimum requirements* and still show a profit? Or we may put the question, were the sales receipts in the lean years smaller than the most probable expenses of getting them in an establishment for which the physical volume for that year would be an optimum? Were the incomes fat and lean or only the income figures? Toward the answering of these questions the accountants' annual figures give us exactly no help at all.

Now this periodic reversal of the microscope through which the accountants view income, would be bad enough if what they report had no repercussion upon the actual operating policy of enterprises; we should have paid for inferior statistics. But if, and to the extent that, business men *believe* what the accountants' figures seem to say, we have a pernicious state of affairs that probably to a large extent is responsible for the violence of business fluctuations in modern times.

Although I have spoken throughout my paper about certain erratic tendencies in the accountants' income data I speak of these tendencies as purely objective facts; I am not scolding the accountants. I am mindful that they might ask, what have economists and statisticians done in income statistics? What, indeed?

I have discussed in this paper only one of many erratic tendencies in income figures. A real understanding of all of them and an appreciation of the rôle they play in economic affairs is indispensable to the quantitative economic theorist. Erratic accounting does not generate business cycles, but, given an external generating impetus, belief in the accountants' figures leads to action that must increase the amplitude of the business cycle swings. The student of business cycles must miss his mark by a wide margin unless he not only knows accounting practice but also correctly values its influence in affairs. Erratic accounting does not give rise to credit inflations, but reliance by bankers on erratic accounts must often do so. The students of banking, of currency management, and of taxation, as well as the student of business cycles, have need of a like intimate knowledge of accounts.

I suggest that the betterment of income procedure is a proper task for either mathematical economists or for statistical economists. I suggest that if they attempt this task they will find it to be one that will tax their intellectual powers. I suggest also that the invention of substantial betterments that are really applicable in accounting practice will do as much to stabilize and rationalize economic behavior as anything else which economists are likely to contribute in the near future.

I venture to say in closing that economic science must defer its ma-

turity as a realistic, quantitative science that can claim a substantial degree of reliability in its analyses and predictions, until the statistical treatment of annual net income data is very greatly improved. I venture also to say that economists who continue to employ such income data as accountants now furnish, without being aware of their erratic character and without regard for the rôle that these same data play in influencing enterprise will simply repeat the fable of the blind men and the elephant.

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