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by
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[Introductory note: Jack L. Treynor is editor of *Financial Analysts Journal.* A trustee of the Financial Analysts Research Foundation and a member of the board of the Institute for Quantitative Research in Finance, he is also a director of the American Finance Association, a member of the Investment Advisory Council to the City of New York. He is a director of eleven mutual funds and general partner in two partnership funds. He is the author of articles in *Harvard Business Review, The Journal of Business, and Financial Analysts Journal.* He is senior author of *The Financial Reality of Pension Funding Under ERISA,* published by Dow-Jones Irwin, Homewood, Illinois (1976).]

One of the most influential college physics texts of modern times is *Foundations of Physics* by Lindsay and Margenau. The book is unusual among physics texts in its emphasis on the philosophy and underlying physics -- a philosophy that was pushed ahead rapidly in the first decades of the twentieth century by Edington, Jeanes and, of course, Einstein. Lindsay and Margenau point out that every variable in physics has two definitions -- one that explains how it is measured and one that explains how it is used: "The very idea of symbolism implies ... that a symbol must represent a concept transcending the particular operation which it is used to represent."

The necessity of these two definitions is not, of course, unique to physics. Indeed, it applies wherever we use numbers to try to understand the real world. It even applies in accounting. When we attempt to apply Lindsay and Margenau's dictum to accounting, however, we immediately run into a curious problem: The people who derive accounting numbers and the people who use them are two different groups of people. According to both the Trueblood Report and the Objectives Statement of the Financial Accounting Standards Board, the primary user of accounting numbers is the outside user. Perhaps it is for this reason that the two kinds of definitions of such accounting numbers as earnings are rarely considered simultaneously.

On one hand, if you ask an accountant for the meaning of earnings, he will very likely (as I noted in "The Trouble with Earnings") tell you how an earnings number is derived from the accrual process. If, on the other hand, you ask an outside user what the earnings number means, three possible answers are available to him: (1) a rationalized proxy for cash flow, (2) the change over the accounting period in the value of the firm and (3) a proxy for the value of the firm. Many outside users seem to be subscribing to the first definition of earnings in the way they use earnings numbers. Perhaps unfairly, Hicks is usually held responsible for the second. Fischer Black has recently offered us the third.

Although Black's definition proceeds from a consideration of how professional investors use published earnings, it raises some questions. One has to do with the way in which the earnings series is generated from the bookkeeping process. How does a bookkeeping process that operated in a predictable manner on input time series that are themselves not random walks (levels of employment, output, sales, etc.) produce a random walk?

How can an outside user combine his insights and information with an accountant's estimate of value (i.e., the published earnings figure) to produce an improved estimate of value? If Black's definition of the earnings number is the correct one, then the accountant is, in effect, saying to the outside user: "Take it or leave it. Use my estimate of value or your own, but don't try to use mine to derive yours."

Before the accounting profession can move forward from the observation of the Trueblood Report and the Objectives Statement that accounting standards should reflect the needs of outside users, it must determine which of these three definitions of the earnings concept is the correct one.

A Theory of Earnings

What if the accountant producing the earnings measure wanted it to be as useful as possible to the outside user? Taking a leaf from the Objective Statement, what the outside user wants to do is predict future cash flows. If the accountant undertook to predict the entire stream of future flows x(t), such a prediction would replace both the income statement and the balance sheet. (Owen and Brief made this point in their *Financial Analysis Journal* article, "The Role of the Accountant in Investment Analysis," in the January-February 1975 issue.) Periodic accounting reports would update predictions of the cash flow stream, so that over time the outside user would accumulate a series of predictions.

$$x(t,1),$$
$$x(t,2),$$
$$\ldots$$
$$x(t,T).$$

Focusing on the series of predictions for the rate of cash flow at a particular point in future time, we observe that, if these predictions are as good as they can be (i.e., as free as possible of extraneous noise), then they will have an important statistical property. One of the most general theorems proved by Howard Raiffa and Robert Schlaifer in their famous book, *Applied Statistical Decision Theory,* was one which, translated into words, says that when you are making a series of predictions of the same future event, the best current prediction of a future prediction is your current prediction of the event. (To get technical for a moment, your forecast at any point in time of the event -- or indeed, of any future prediction of the event -- will be a probability distribution. The word "prediction" in this statement refers to the expected value associated with the probability distribution.) But this means that your current prediction of any future prediction, including the next one, will imply zero change from the current prediction, and your next prediction will imply zero change in the prediction after that and so forth. The result, of course, is what we have come to call a random walk. Any time series of such predictions that is not a random walk is either (1) not fully reflecting information as soon as it is available or (2) is mixing noise in with the information content in the time series.

An array of successive predictions of the future cash flow stream is an awesome thing to contemplate. Every prediction in the series contains subpredictions for every future point in time. A new set of such predictions is issued at the end of each accounting period. After a while, the outside user has accumulated an embarrassment of riches. Fortunately for both the outside user and the reporting accountant, such predictions are largely redundant information. There is an important class of transformations on the cash flow series that are essentially costless, reversible and capable of being undertaken at any time at the option of management. These are, of course, exchanges of cash flow across time executed at market interest rates. Because management can achieve such transformations so readily (and so costlessly) that they cannot be predicted, a prediction of the future cash flow stream purports to contain a great deal more information than it really can.

Attention has traditionally focused on one particular member of this transformation class -- namely, that cash flow series that concentrates all its value at time zero. Since all the members of the class contain equal information about the future of the company, a fortiori, this member -- the so-called "present value" -- contains all the useful information in the entire cash flow series. No matter what capital market

transformations management way have elected, the present value of the cash flow stream will be the same. Raiffa and Schlaifer might be tempted to call it a "sufficient statistic" on the future cash flow stream.

Since the present value of the cash flow stream depends linearly on the individual cash flows, predictions of future present values of the stream will have the same property as predictions of the individual cash flows -- namely, the random walk property.

It follows from these considerations that if the accountant is attempting to report information about the future cash flow stream as soon as possible and adulterated with as little noise as possible, he has little choice but to report the present value of the stream. (He could, of course, report the implied value five or ten years hence, but the choice of time horizon would introduce unnecessarily arbitrary elements into the reporting scheme.) This begins to sound a lot like Black's concept. It also sounds a lot like "permanent earnings" as described, for example, in Bill Beaver's new book. But this is getting ahead of the story.

The accountant's objective in recognizing individual transactions that he *predicts* will have no present value impact on the firm will be to prevent them from doing so. He must acknowledge simultaneously all ultimate cash flow implications of such transactions. Such present value preserving acknowledgements are, of course, called accrual accounting. The purpose of accrual accounting is to prevent transactions from introducing spurious information into the accountant's predictions.(1)

In practice, of course, accrual accounting goes further than that. It treats transactions that by themselves are ambiguous -- that may or may not contain information -- as if they had none. The accountant waits until he has in hand all the transactions in a cycle to see whether in the aggregate they have present-value consequences, and then makes a once-and-for-all present value adjustment. Transactions -- and only transactions -- acknowledged by the accountant to contain new information are permitted to alter the present value of the cash flow stream. Others are treated as if they were precisely the kind of present-value- preserving transformations just discussed.(2)

If the completed cycle has present value implications, however, then the accountant must acknowledge those implications. At this point accrual accounting introduces two sophisitications: 1) it makes present value adjustments for the last transactions in the cycle, whether or not they have any net present value effect; 2) it makes these adjustments, whether or not their net effect was expected. Taken together, these sophistications enable the accountant to accumulate all sales revenue and all expense for a period.

The second sophistication would clash with the basic rule that only unexpected cash flow is reflected in present value adjustments, were it not for the fact that at the same time the accountant records actual revenues and expenses he makes a contrary present value adjustment to remove the expected effect.

Let's recapitulate in more familiar terms: The present value of the firm's net cash flow is its *equity.* The net effect on present value over the accounting period of the transactions I have been describing is, of course, *income.* Transactions containing (potential) information are *revenue* and *expense* transactions. The adjustment to remove from present value the expected contribution of current-period transactions is accomplished by depreciation (which, as we shall see, also accomplishes something else).(3)

We have already noted that transactions in inefficient markets are virtually certain to result in gains or losses. What is less clear is whether it is rational to *expect* a gain (or loss) from such transactions in the future -- i.e., to expect to be able to gain consistently from trading in such markets. Nor is it clear that if the firm's employees have this ability they won't charge the firm for it. If they do not, then the only source of expected contributions to net present value is economic rents. Indeed, we can define an asset as something whose services arc sufficiently scarce to justify an expectation of future rents -- hence to contribute to present value. Obviously, an asset doesn't have to be tangible. Given this definition, expected future cash flows will derive entirely from scarcity rents on the firm's assets.

We can put these concepts into perspective by examining the economic content of Hick's definition of earnings -- considering how time and changing expectation interact in altering the present value of the firm. Let x(t,u) be the cash flow series, t being equal to or greater than zero and less than infinity. This stream will have a present value at each future point in time, T, of:

$$PV(u,T) = \int_{T}^{\infty} e^{-r(t-T)}x(t,u)dt.$$

It has, of course, rates of change with respect to u and T. For the change with respect to u we have:

$$\frac{2PV}{2u} = \int_{T}^{\infty} e^{-rt} \frac{2x}{2u} dt.$$

Since T appears in both the lower limit and the integrand we have:

$$\frac{2}{2T} PV(u,T) = -e^{-r(T-T)} x(T,u) + r \int_{T}^{\infty} x(t,u) e^{-r(t-T)}dt.$$

At future time T, of course, the second expression has the value -x(T,u), since the discount factor equals one.

$$\frac{2}{2T} PV = r\, PV(u,T) - x(u,T).$$

Using the expressions for the two partial derivatives, we can write the total differential:

$$d(PV) = \frac{2}{2u}(PV)\, du + [r\, PV(u,t) - x(u,T)]\, dt.$$

This is the total differential of the remaining cash flow stream. As real time elapses, of course, the future cash stream is being realized, converted into actual cash and (presumably) invested at the market. Thus the way in which the present value of the firm will change over time, starting from now, involves a term that is missing from this total differential -- namely, the cash flows already realized. As noted, the accountant focuses on present value surprise by treating the stream as the expected cash stream and the contribution to the present value of the firm that this expression leaves out as the *actual* cash flow. Let us now write an augmented expression for the total differential of the present value of the firm including the actual contribution of cash currently involved.

In the expression

$$d(PV) = x_{\text{actual}}\, dt + \frac{2}{2u}(PV)du + [r(PV) - x_{\text{expected}}(u,T)]\, dt.$$

X(u,T) is the expected rent at T -- i.e., the expected difference between sales income and cost of sales. Thus the total expression breaks down into *operating income*

$$x_{\text{actual}}(u,T) - [x_{\text{expected}}(u,T) - r(PV)]$$

and the *change in expectations*

$$\frac{2}{2u}(PV)\,du.$$

The subexpression

$$r(PV) - x(u,T)_{\text{expected}}$$

is depreciation -- i.e., the expected decline in value of the assets. Depreciation acknowledges that, with elapsing real time, the present value of the remaining cash flow future stream 1) Appreciates at the market rate and 2) depreciates at the instantaneous cash flow rate. Under this view, operating profit is market return plus surprise in realized rents. Surprise in rents doesn't necessarily imply either a) market inefficiency or b) contributions (good or bad) by management.(4) Market return is a capital market phenomenon. It has to do with return investors require based on liquidity, risk and tax considerations (aside from luck, the sole cause of rapidly rising PV).

Operating income deals entirely with the past; the change in expectations deals with the future. The rules governing the accrual process relate entirely to the first element. The second element is judgmental, constrained only by what the accountant can do with reserves, etc., under GAAP.

The key point is that "operating income" and "adjustment for changing expectations" are mutually exclusive. Any logical connections between a surprise in operation income and altered expectations about the driving variables that collectively make up "n" are entirely outside the accounting process. Any disciplines in "measurement" and manipulations of measured numbers accountants impose on accounting for operating income constrain these connections not at all.

One is tempted to suspect, simply because accounting provides no formal apparatus for changing expectations, that accountants employ none. If so, then accountants who can define earnings in terms of the first kind of definition ("It's what you get when you take the journal entries, etc., etc.") but not the second are navigating without any compass whatever. Estimating the value of this second term cannot realistically be described in such terms as "measuring" or "reporting."

What the Evidence Tells Us

Although it ignores the effect of changing expectations, conventional bookkeeping is loosely consistent with the Hicksian notion of income, though not with Black-Beaver: Operating income is an element in the change in permanent income, rather than in permanent income itself.

Variability in value is far less than variability in change in value. (The latter has an almost infinite coefficient of variation.) Thus the adjustments to reserves required to report value are far less than those required to report change in value; then, too, the resulting time series is "smoother." Thus accountants' desire to smooth the reputed series is a powerful force toward reporting value and away from reporting changes in value.

The obvious test of whether *reported* income is permanent income or the change in permanent income is the role of changing expectations. In 1965, Paul Samuelson published a paper entitled "Proof that Property Anticipated Prices Fluctuate Randomly." In a rational market, share value will fluctuate randomly. And if value fluctuates randomly, then the second definition -- the change in value over the accounting period -- cannot fluctuate randomly. The first difference of a random walk is not a random walk. The difference between the time series character of a random walk and its first difference is very large -- virtually impossible to overlook in the statistical evidence. (See Appendix B)

Will anyone deny that price is a superb surrogate for permanent income, or that change in price is a

surrogate for change in permanent income? No? Then we have merely to examine behavior of income time series in relation to share price time series to answer, once and for all, whether reported income attempts to reflect permanent income or change in permanent income. Price change approximates a random walk. Do changes in reported income approximate a random walk? If so, do they correlate with price changes? If the answers to these questions are "yes," then reported earnings is an attempt to capture permanent earnings, rather than its first difference.

There is an abundance of evidence on the time series properties of earnings. In England, Little and Raynor, and in the United States, Lintner and Glauber, have found that changes in earnings approximate a random walk. One of the most exhaustive examinations of the evidence is that of Beaver. I quote from his "concluding remarks" to Chapter 5:

> "Earnings changes and price changes show a significant, positive correlation. Obviously, value (permanent earnings) and change in value should have no correlation.
>
> Although significant, the relationship is not simply one-to-one. This occurs in part because prices act as if earnings are perceived to contain a transitory component." (*Financial Reporting : An Accounting Revolution*, Englewood Cliffs, NJ, Prentice-Hall, 1981).

One possible source of a "transitory component" in reported earnings is operating income that constrains companies from reporting what they want to report -- namely, permanent earnings. In view of the fact that operating income is an element in the change in permanent earnings, rather than in permanent earnings, it wouldn't be surprising if companies encountered such constraints.

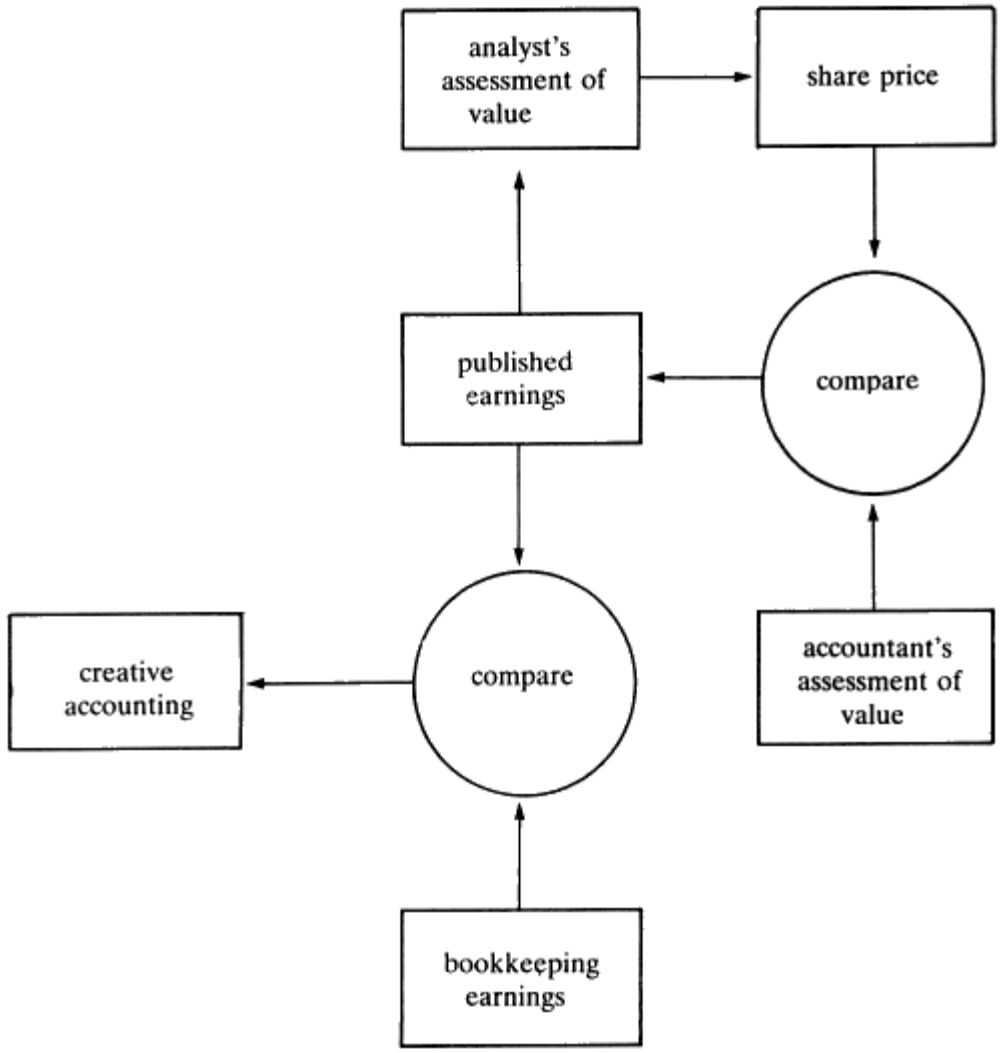
Enter Creative Accounting

Illustration 1 is a picture of what the evidence seems to me to imply about the total accounting process. Let's start with the estimates of your prototypical security analyst. He or she makes some estimate of value and, as a result, clients buy and sell and price is affected. The accountant makes his own judgment about what the value of the firm should be and compares that estimate with price. Based on that comparison, he says, "That price is too low or too high." He determines an earnings number he hopes will guide analysts in the proper directions. And that earnings number then feeds back into the thinking of the analyst. At the same time, the bookkeeper is going through the double entry bookkeeping process, estimating changes in value that have nothing whatever to do with what the accountant is trying to provide the analyst. Inevitably, when you compare the changes in value that come out of the bookkeeping process with the value-related numbers the accountant is feeding the analyst, you get differentials -- sometimes large differentials.

These differentials require creative accounting. Accountants write off assets, create reserves for future losses, shift from pooling to purchase, shift from LIFO to FIFO, shift from 30 year depreciation lives to 15 year depreciation lives -- whatever it takes to make certain that the earnings number that's fed back to the analyst is the Fischer Black type of number rather than the double entry bookkeeping number.

The number contributed by creative accounting is a residual. The bookkeeping inputs consequently have no effect whatever on the earnings number that's fed to the analyst. If it did, the earnings number couldn't behave the way the evidence shows it does behave-namely, as a random walk. All the bookkeeping number does is determine the residual contribution that has to be made in closing entires in order for the earnings number to satisfy Fischer Black prescription -- namely, an estimate (to a constant factor) of value.

ILLUSTRATION 1



The Dynamics of Creative Accounting

Let's consider for a moment the human dynamics of this process. One way the process can operate is the one I cited initially. The accountant forms his own opinion about value and then changes the inputs feeding back to the analyst every time he sees the analyst gets off the track. This is clearly what the Accounting Principles Board did when they prohibited the pooling treatment of business combinations. They decided stock prices of conglomerates were entirely too high. They were going to do something about the stock prices by changing the earnings numbers fed to the analysts and they did it by prohibiting an accounting practice that resulted in high earnings. The same thing can happen at the level of the individual company in the closing transactions of the company's accountant.

Another way this process can operate is to buy credibility for the accountant. The accountant can look at the actual current market price of the company shares and feed back an earnings number that accords with that price. When he does that investors will say, "Gee, that company must be reporting their earnings pretty accurately."

Because accountants' value to a reporting firm depends on their credibility with the outside user, it wouldn't be surprising if they behaved this way most of the time. But it would be surprising if they behaved this way all the time, because then, of course, they'd never have the opportunity to cash in on that credibility. So the third way in which this process can operate is for the firm to tell its accountant what value the accountant ought to be encouraging outside users to arrive at, independently of what the accountant thinks the value ought to be. I think that happens too from time to time.

To summarize: Outsiders use earnings to improve their estimates of value. But value deals entirely with the future. Numbers that alter users' view of the future are not objective (for example) merely because they are based on the past. There is no other basis for *any* numbers affecting judgments about the future. ("I know not what my future foot steps may be guided by, except the lantern of the past." -- Patrick Henry.)

No meaningful theory of accounting can be erected on a consideration of how accounting deals with the past. To understand accounting -- and its principal product, the earnings number -- we must consider how it deals with the future. The central problem in accounting is not how to measure but how to forecast. Thus the question posed at the beginning of this paper is sterile and unproductive. The earnings number doesn't "measure" anything.

The double entry bookkeeping process actually has no impact whatever on earnings as reported to outside users. All it affects is the adjusting entries that have to be made to the results of that process in order to produce the desired earnings number which, as Black has pointed out, is a measure of value, and not change in value.

Appendix A

To prove: Depreciation of an asset with value V(t) is given by:

If

$$\frac{dV}{dt} = rV - f(t)$$

$$V = \int_t^\infty e^{-r(\tau - t)} f(\tau)\, d\tau$$

we have

$$\frac{dV}{dt} = - e^{-r(t-t)} f(t)$$

$$+ \int_t^\infty re^{-r(\tau - t)} f(\tau)\, d\tau,$$

$$= - f(t)$$

$$+ r \int_t^\infty e^{-r(\tau - t)} f(\tau)\, d\tau,$$

Q.E.D.

$$= rV - f(t).$$

Appendix B

To prove: The first difference of a random walk is not a random walk. The second difference of a random walk is the first difference of the first difference of a random walk. The question is: does the first difference of the first difference of a random walk have distinctive statistical properties of a first difference of a random walk? If not, then the first difference of a random walk is not a random walk.

Define the backward shift operator b as shifting backward one unit in time any time series to which it is applied. Consider a random -- walk series with first difference x, such that:

$$\mathbf{E\,[x\ b\ x] = o = E\,[x]}$$

and define second difference x such that

$$\begin{aligned}
&\Delta x = x - bx,\ b\Delta x = bx - b^2x \\
&\Delta x b \Delta x = (x - bx)\,(bx - b^2x), \\
&\qquad = xbx - (bx)^2 - xb^2x + bxb^2x \\
&E[\Delta x b \Delta x] = E\,[xbx] - E\,[(bx)^2] \\
&\qquad -E\,[xb^2x] + E\,[bxb^2x], \\
&\text{auto-covariance} \quad = -E\,[(bx)^2] = -E\,[x^2] = -rx^2. \qquad\qquad -Tx^2.
\end{aligned}$$

and define second difference x such that

$$\begin{aligned}
&\text{var}\,[\Delta x] = \text{var}\,[x - bx] = \text{var}\,[x] + \text{var}\,[bx] \\
&\qquad = 2\ \text{var}\,[x] = 2\,rx^2. \qquad\qquad Tx^2.
\end{aligned}$$

Note that

$$= -\frac{rx^2}{2rx^2} \qquad\qquad Tx^2 \qquad\qquad 2Tx^2$$

$$= -\frac{1}{2}.$$

FOOTNOTES

(1) No information is generated by value preserving transactions in efficient markets. Conversely, it is virtually impossible to transact in inefficient markets without altering your present value -- i.e., without gaining or losing. In treating the transactions in incomplete cycles as present -- value preserving, therefore, the accountant is implicitly assuming efficient markets -- raw materials and labor, as well as capital.

(2) Matching principle: information in cycle, but not in individual transaction. Therefore, rather than introduce noise into cash flow prediction, defer effects to end of cycle -- even though rent is actually earned at production stage of cycle. Matching ducks the problem of deciding which transaction in a related cycle caused change in NPV by acknowledging the PV effects of all transactions in the cycle simultaneously.

(3) A liability is a stream of future cash outflows: some are contractual, some are not. Algebraically speaking, liabilities and assets together clearly exhaust all possible future cash flows (excluding capital transactions). Thus we have:

$$\begin{aligned}
&\text{NPV} = \text{assets} - \text{liabilities} \\
&\text{we have} \\
&\Delta\text{NPV} = \Delta\text{assets} - \Delta\text{liabilities}, \\
&0 = \Delta\text{assets} - \Delta\text{liabilities} - \Delta\text{NPV}.
\end{aligned}$$

Debits are additions to right side of this identity; credits are subtractions. We have immediately: debits = credits.

(4) Under the traditional mercantile view, operating profit is a trading gain realized by management. Unfortunately, the mercantile interpretation leads to strained, artificial conclusions about the role of depreciation. Depreciation is a concept quite distinct from obsolescence; all assets -- tangible or intangible -- depreciate in the sense of contributing to this term in the total differential. Depreciation has nothing to do with maintaining physical, financial, or any other kind of capital.