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Volume 2 Selected Papers

Objectives of Financial Statements

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Certified Public Accountants**

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Replacement Cost Accounting: A Theoretical Foundation*

Lawrence Revsine

Our objective in this paper is to develop a foundation that supports the theoretical relevance of replacement cost accounting.¹ In order to establish this foundation, it is necessary to specify the linkages between replacement cost information and the information needed to satisfy users' decision models.

A complete analysis of the relevance of replacement cost accounting would entail a rather lengthy multi-stage research process. The various research stages can be summarized as follows:

1. A series of normative decision models for various user groups would have to be developed and the information needs of the various models isolated.
2. Empirical tests would have to be performed to determine whether the normative decision models and information needs conform to actual models and actual needs.²
3. A theoretical model would have to be developed which links the output

* The material in this paper parallels, in condensed form, certain sections of Lawrence Revsine, *Replacement Cost Accounting* (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1973). The permission of Prentice-Hall, Inc. to reproduce this material is gratefully acknowledged.

¹ The basic characteristics and computational methods underlying replacement cost accounting are developed in Edgar J. Edwards and Philip W. Bell, *The Theory and Measurement of Business Income* (Berkeley and Los Angeles: The University of California Press, 1961).

² Some authors would contend that a valid empirical specification of users' decision needs is hopelessly circular and would lead to suboptimal reporting systems. If true, this would mean that user needs would have to be normatively derived. Thus, the second stage tests described above would be unnecessary. For a development of this argument, see Robert R. Sterling, "A Statement of Basic Accounting Theory: A Review Article," *Journal of Accounting Research*, (Spring 1967), p. 106; and Sterling, "On Theory Construction and Verification," *The Accounting Review*, (July 1970), pp. 455n-456n.

generated by replacement costing to the normative information needs of users.

4. The theoretical model developed in (3) would have to be tested in actual practice.³

Obviously, a project of this magnitude is beyond the scope of the present study. Our analysis will instead be confined to stages (1) and (3), i.e., developing a linkage between the identified data needs of a single user group and the information generated by replacement costing. Furthermore, the empirical evidence required in stages (2) and (4) is currently unavailable. However, by developing a theoretical foundation for replacement cost reporting to one user group, we simultaneously provide a framework for subsequent empirical testing.

Introductory Considerations

A Basic Premise. Observation suggests that the audience for financial reports is quite diverse. One characteristic of this diversity is that there are probably differences in the objectives of various categories of users. These differences in objectives imply that there could be differences in the decision models used to achieve these disparate objectives. If the decision models vary among groups of users, then it is also possible that the information needed to satisfy the respective decision models varies among groups. That is, diversity in decision models implies (but does not necessarily guarantee) diversity in needed information. As a consequence of this potential diversity in information needs, accounting reports prepared under one measurement basis may be relevant for the information needs of one group and irrelevant to other groups.

In light of these observations, it seems reasonable to suggest that universally relevant accounting measures may not exist. Accordingly, the relevance of a particular income measure is probably best assessed by reference to the information needs of individual categories of statement users. This is the approach that will be followed in this paper. The information needs of long-term equity investors will provide the basis for analyzing the theoretical relevance of replacement cost accounting.⁴

Normative Decision Model for Long-Term Equity Investors. In the absence of an empirically specified decision model for long-term equity in-

³ Once this research process is completed, we will have some measure of the *absolute* utility of replacement cost accounting. However, in order to determine the *relative* utility of various income measures, this research process must be repeated for each alternative measure (e.g., historical cost, exit value, etc.).

⁴ A more general analysis of the relevance of replacement cost accounting would require specification of the information needs of other user groups. Once these information needs are isolated, the ability of replacement cost in generating information relevant to these needs would also have to be examined. It is possible, of course, that other user groups may have information needs similar to those of long-term equity investors. Were this the case, the generalizability of our analysis would be increased.

vestors, a normative model will be used. From this decision model, we will derive normative information needs for this user group.

With regard to investment decisions involving individual securities, one model has achieved prominence in the theoretical literature. This model suggests that expected future cash flows should govern the selection of investment securities. Given existing market prices, the strategy is to select those securities whose expected future cash flows promise the highest return at an acceptable risk level. This model can be formalized in the following fashion:⁵

$$V_c = \sum_{i=1}^n \frac{D_i \alpha_i}{(1+\beta)^i} + \frac{I_n \alpha_n}{(1+\beta)^n} - I_0$$

where:

- V_c = the subjective net present value of one equity share purchased at time (0) at price I_0
- D_i = dividend per share expected during period (i)
- α_i = certainty equivalent factor which makes an investor indifferent between D_i and a totally riskless cash flow $D_i \alpha_i$ if the investor is risk averse, $0 < \alpha_i < 1$
- β = opportunity rate for a riskless investment (assumed, for ease of exposition, to be constant over the foreseeable horizon)
- I_n = expected market price of one share at the terminal date of the planning horizon (n).

It is evident that this model requires information regarding the expected level and variability of future dividend flows, D_i . The Committee on External Reporting suggested that these dividend flows are themselves a function of several variables, such as operating profits, nonoperating profits, stockholder investments, purchases and dispositions of assets, random events, and management dividend policy.⁶ With the exception of operating profits, most of these elements are erratic and some are material only when aggregated. But operating profits—which usually comprise the bulk of total net enterprise flows—are generally considered to be more regular, and hence predictable. Thus, if an investor is able to generate tolerably accurate predictions of operating profits, then his ability to predict future dividends is greatly enhanced.⁷

Given this normative long-term investor decision model, replacement cost data would be relevant insofar as such data aid in the prediction of future operating flows and facilitate estimates of the risk associated with these

⁵ This model is adapted from a report of the Committee on External Reporting, "An Evaluation of External Reporting Practices, A Report of the 1966-68 Committee on External Reporting," *Committee Reports*, Supplement to Volume XLIV, *The Accounting Review* (1969), pp. 82-83. For simplicity, income tax effects are ignored.

⁶ *Ibid.*, pp. 84-87.

⁷ Obviously, these estimates of future operating profits would be used in conjunction with estimates of the other flow variables in order to generate more refined dividend predictions. These other variables can often be predicted from supplementary sources, such as annual report textual disclosures.

flows.⁶ (For simplicity, we will analyze the relevance of replacement cost information to individual security decisions. Doing so allows us to avoid the complexities of portfolio theory, which are beyond the intended scope of this paper.)

Dividends and Distributable Operating Flows. Observation suggests that managers of publicly held corporations strive to avoid lowering the established dividend rate. Since, in the long run, operating flows generate the bulk of the total resource flows needed to pay dividends, this desire to maintain dividend levels immediately translates into a desire to (at least) maintain operating flow levels.⁹

Now, future operating flow levels are a function of two variables: (1) the physical level of future operations (i.e., how many machines are employed, how much inventory is used, etc.), and (2) the prices which will prevail in the future for the firm's inputs and outputs. Since future prices are usually dictated by external conditions, management's real controllable variable in striving to maintain operating flow levels is to maintain the existing physical level of operations on the presumption that future input and output prices will remain constant. Thus, while management will do better if it can, we contend that at a minimum, management strives to maintain its existing level of physical operations. If physical operations do later rise to a higher level, then the process would begin anew. That is, management would then strive to at least maintain future operations at the new, higher physical level.

Let us define "distributable operating flow" as that portion of the resources generated by operations which can be distributed to owners without

⁶ Because of space limitations, this paper will not discuss the utility of replacement costing for evaluating the risk associated with expected operating flows. This topic is explored in some depth in Revsine, *Replacement Cost Accounting*, Chapter 7. Briefly, the rationale for suggesting that replacement cost numbers may be useful for the evaluation of risk associated with individual securities relates to certain characteristics of replacement cost financial ratios. One could contend that replacement cost ratios do not inject arbitrary valuation and timing differences into the assessment of firm performance. As a consequence, a reliable basis for intertemporal and inter-firm comparisons exists. Such comparisons over time and between firms provide evidence of extraordinary profitability, its persistence, and its variability. This is precisely the type of evidence that is needed to evaluate the risk associated with future flows in an individual security setting.

In a portfolio setting, the riskiness of a security is a function of the covariance of its expected returns with those of other securities in the portfolio (this is termed "systematic risk"). Thus, traditional accounting ratios, which are thought to reflect the individualistic risk of a security, would seemingly be of little benefit for risk evaluation in a portfolio setting. On the other hand, if individualistic risk and systematic risk are themselves positively correlated, then accounting ratios may also be a surrogate for systematic risk. Indeed, this surrogate relationship is consistent with the limited evidence currently available. (See William Beaver, Paul Kettler, and Myron Scholes, "The Association Between Market Determined and Accounting Determined Risk Measures," *The Accounting Review* (October 1970), pp. 655-659.)

⁹ It should be readily apparent that, ceteris paribus, if operating flows fall, then total enterprise flows will fall, and if this condition persists, eventually dividend payments must fall.

reducing the level of future physical operations (and thus future dividends). Our final premise in this paper is that this distributable operating flow is (perhaps intuitively) monitored by management and constitutes an important element in final dividend decisions.¹⁰ Thus,

$$D_i = f(D_o, X)$$

where:

D_i = future dividends

D_o = future distributable operating flows

X = row vector of other dividend variables.

Given this dividend model, and the normative investor model introduced above, it follows that investors are interested in predicting future levels of distributable operating flow. That is, since investors are primarily interested in D_i , and since D_i is strongly influenced by D_o , then investors' estimates of D_i will be improved to the extent that their ability to predict D_o is enhanced.

Relevance of Replacement Costing

Introduction. To be relevant for the information needs of the normative long-term equity investor model described above, a reporting concept must be useful for generating predictions—preferably predictions of future distributable operating flows.

There are two general means by which accounting data regarding past events can provide users with a basis for generating predictions:¹¹

1. An accounting measurement system may impound certain external events which serve as lead indicators for future events. Accordingly, such financial statements could allow the user to discern emerging forces which are expected to affect the firm.
2. An accounting measurement system which incorporates past data regarding relevant variables could afford users a basis for extrapolating trends of such variables in order to generate desired predictions.

This first method for providing a predictive basis will be called a *lead indicator approach* while the second method will be referred to as an *extrapolation approach*.

The relevance of replacement cost information rests upon two separate and distinct arguments regarding the predictive basis which this measurement method supposedly provides to long-term investors. The first rationale suggests that *total* replacement cost income is a *lead indicator* for future distributable operating flows. The second rationale implies that the current

¹⁰ This immediately follows from our earlier observations that (1) management desires to at least maintain existing dividend levels, and that (2) physical operating level is their only controllable operating variable for achieving this end.

¹¹ An essentially similar view was adopted by a recent American Accounting Association committee of which the author was a member. See "Report of the Committee on Corporate Financial Reporting," *Committee Reports*, Supplement to Vol. XLVII, *The Accounting Review*, 1972, pp. 525-528.

operating profit component of total replacement cost income provides an *extrapolation* basis for estimating future distributable operating flows.

The theoretical foundation underlying each of these potential uses for replacement costing will be explored, individually, in the following sections.

Total Replacement Cost Income as a Lead Indicator. The contention that replacement cost income is a lead indicator for future distributable operating flows rests on the ability of replacement cost income to approximate economic income.¹² It can be shown that, under certain circumstances, replacement cost income is a surrogate for economic income. Since economic income directly incorporates future expectations, if replacement cost income is indeed a surrogate for economic income, then replacement cost income would also incorporate future expectations. Insofar as expectations provide an accurate predictive basis, the resultant replacement cost measures would be useful to those interested in forecasting future events. The relationships which underlie this position will be discussed in the sections which follow.¹³

Replacement Cost as a Lead Indicator in Perfectly Competitive Environments. The correspondence between replacement cost income and economic income will first be developed for a perfectly competitive economy.¹⁴ In this type of environment perfect resource mobility exists, and the price of net assets at the beginning of the i^{th} period (P_i) is equal to the discounted present value of the net cash flows which, at the beginning of the i^{th} period, are expected to be generated by asset operations (V_i); that is,

$$(1) \quad P_i = V_i.$$

Now the total economic income figure which results from comparing the change in the value of an enterprise between two points in time can be separated into two components: (1) expected income and (2) unexpected income.¹⁵ The expected income (Y_e) component of total economic income is

¹² The definition of economic income which is used in this study is a comparative statics income concept. That is, income for a period is computed by comparing the end of period net assets of a firm with beginning of the period net assets. At any moment in time, the value of the net assets of a firm consists of two components. The first component is the discounted present value of the future net cash flows expected to be generated by the productive assets of the firm. The second component consists of the value of the net liquid assets on hand. Thus, economic income for a period incorporates *both* changes in *realized* liquid assets and changes in the cash generating *potential* of the firm.

¹³ These relationships were first developed in Lawrence Revsine, "On the Correspondence Between Replacement Cost Income and Economic Income," *The Accounting Review*, (July 1970), pp. 513-523; the discussion and development is amplified in Revsine, *Replacement Cost Accounting*, Chapter 4.

¹⁴ For a discussion of the characteristics of such economies, see, for example, Kalman J. Cohen and Richard M. Cyert, *Theory of the Firm: Resource Allocation in a Market Economy* (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1965), pp. 49-51.

¹⁵ See, for example, Norton Bedford, *Income Determination Theory: An Accounting Framework* (Reading, Mass.: Addison-Wesley Publishing Company, Inc., 1966), pp. 25-27.

the product of the market rate of return (r) and the beginning of the period present value of net assets (V_1). Thus:

$$(2)^{16} \quad Y_e = rV_1$$

The other component of economic income, i.e., unexpected income, is equal to the discounted present value of the change in expectations concerning the amount and timing of future operating flows.

In similar fashion, replacement cost income can also be fragmented into two components: (1) an operating profit segment, and (2) a price change segment. These components are typically referred to as current operating profit and realizable cost savings, respectively.¹⁷ (Current operating profit is the difference between realized revenues and expired current replacement costs. Realizable cost savings are measured as the change in the market prices of owned assets.) If replacement cost income is computed using economic depreciation (i.e., a concept which measures the periodic decline in the discounted earning power of an asset) the resulting actual operating rate of return on net assets is given by

$$(3) \quad r_a = \frac{C_i}{P_i}$$

In (3), r_a represents the actual operating rate of return, C_i is the current operating profit, and P_i as before, denotes the market price of net assets. Given a perfectly competitive environment, the following relationship should hold in equilibrium:

$$(4) \quad r_a = r$$

Substituting V_1 for P_i and r for r_a in equation (3) and rearranging gives:

$$(5) \quad C_i = rV_1$$

A comparison of equations (5) and (2) indicates that:

$$(6) \quad C_i = Y_e$$

Thus, in a perfectly competitive economy, the current operating profit component of replacement cost income is equal to the expected income component of economic income.¹⁸

¹⁶ This relationship is easily demonstrated. See Revsine, "Replacement Cost Income and Economic Income," p. 516.

¹⁷ See Edwards and Bell, *Business Income*, pp. 88-97.

¹⁸ Note that the conditions under which this relationship holds are rather limited. First, this relationship is valid only for economies in which all characteristics of perfect competition are satisfied and, because of equation (4), only in equilibrium. Second, equation (6) is valid only if the specific depreciation concept used in the replacement cost model is that of economic depreciation. However, Edwards and Bell (*Measurement of Business Income*, pp. 178-180) exclude economic depreciation from their model on both theoretical and practical grounds. Therefore, current operating profit as computed by Edwards and Bell need not necessarily equal expected income. Finally, a change in the composition or level of ending inventory of processed goods can destroy the equation (6) relationship. (See Edwards and Bell, *Measurement of Business Income*, pp. 105-108.) This is the case since the entry value replacement cost concept promulgated by Edwards and Bell specifically excludes value added by production.

In similar fashion the second component of replacement cost income—realizable cost savings—is a direct counterpart to the second component of economic income—unexpected income. Realizable cost savings are equal to the change in the market price of assets held during the period. Unexpected income consists of the discounted value of the changes in the amount of future flows expected from operating owned assets. In a perfectly competitive economy, such changes in cash flow expectations are directly translated into changes in asset market value [equation (1)]; therefore, the realizable cost savings component of replacement cost income is equal to the unexpected income component of economic income.¹⁹ Since each component of replacement cost income is equal to its counterpart component of economic income, it is apparent that total replacement cost income would equal total economic income in a perfectly competitive economy.

Expected Income and Distributable Operating Flow. It is easily demonstrated that a firm could distribute the entire amount of expected income as a dividend in each period and—provided all original expectations were met and there are no changes in future prices—still maintain physical operations and future dividends at their existing levels.²⁰ In other words, expected income is akin to the concept of distributable operating flow introduced above. It represents one measure of the maximum amount of resources which the firm can distribute to owners and still maintain operating and dividend levels.

Given this relationship, the theoretical relevance of replacement cost income for predictive purposes immediately follows. Since replacement cost income is equal to economic income in a perfectly competitive environment, the equity value shown on a replacement cost balance sheet would be equal to the net present value of the firm (equation 1). Multiplying this net present value by the market rate of return (equation 2) allows one to generate an estimate of expected income, which is equivalent to future distributable operating flow.

Replacement Cost as a Lead Indicator in Imperfectly Competitive Economies. In contrast with perfectly competitive economies, there are numerous frictions and other market imperfections in imperfectly competitive economies. These imperfections transform the equalities in (1) and (4) to mere

¹⁹ This correspondence between realizable cost savings and unexpected income is precise only if replacement cost depreciation is measured as the periodic decline in the earning power of an asset (economic depreciation). Only then will the difference between the book values of assets and ending market values correspond to the unexpected income component of economic income. If replacement cost depreciation is computed on a basis other than economic depreciation, realizable cost savings will vary from unexpected income by the amount of the divergence between economic depreciation and replacement cost depreciation as actually computed.

²⁰ To demonstrate, assume that a firm has a single asset with a three-year life and no salvage value. The asset costs \$299.55 and is expected to generate annual net cash inflows of \$110. The internal rate of return, given these facts, is 5 per cent. If the firm distributes all of its expected income as a dividend in each year—and if original expectations are realized—then the income pattern would appear as follows: [Fn. 20 continued on page 186]

approximations. Substituting these approximations back into (3) similarly makes the equation (5) relationship an approximate one. That is,

$$(5) \quad C_i \cong rV_i$$

Thus, current operating profit is merely an approximation for expected income in an imperfectly competitive economy.

A similar surrogate relationship might also be said to exist between realizable cost savings and unexpected income in imperfectly competitive environments. That is, it seems reasonable to suggest that asset prices will approximate the net present value of asset revenue generating potential even in imperfectly competitive economies. It follows that perceived changes in this revenue generating potential should theoretically precipitate appropriate changes in asset prices. Thus, realizable cost savings—measured by reference to market price changes over a period—should approximate unexpected income—measured by reference to perceived changes in asset revenue generating potential over the same period.

[²⁰ Cont.]

	Year			Total
	1	2	3	
Book value and market value of asset at beginning of period, V_{11} (Book value and market value are presumed equal since economic depreciation is used.)	\$299.55	\$204.53	\$104.76	—
Undistributed cash flow, V_{12} :				
From year 1		95.02		—
From years 1 & 2 (\$95.02 + 99.77)			194.79	—
Total Assets	<u>\$299.55</u>	<u>\$299.55</u>	<u>\$299.55</u>	
Net cash inflow:				
From asset operation	\$110.00	\$110.00	\$110.00	\$330.00
From reinvestment of undistributed cash flows of previous periods	0.00	4.75	9.74	14.49
Total cash inflow	<u>110.00</u>	<u>114.75</u>	<u>119.74</u>	<u>344.49</u>
Expected Income:				
From asset operation (rV_{11})	14.98	10.23	5.24	30.45
From reinvestment of undistributed cash flows (rV_{12})	0.00	4.75	9.74	14.49
Total expected income (equals dividend paid)	<u>14.98</u>	<u>14.98</u>	<u>14.98</u>	<u>44.94</u>
Undistributed cash flow (equals economic depreciation)	<u>\$ 95.02</u>	<u>\$ 99.77</u>	<u>\$104.76</u>	<u>\$299.55</u>

We see that if the firm distributes the total amount of expected income as a dividend at the end of each period, the following consequences result. First, the accumulated undistributed cash flow at the end of the third year (\$299.55) is precisely the amount needed to buy a replacement asset *and thus maintain physical operations at their existing level*. Second, when the dividend distribution is equal to the amount of expected income, then future expected income (and thus future dividends) remains constant. Thus, expected income is definitionally equivalent to distributable operating flow. Assuming stable prices, it is the maximum amount which the firm can distribute as a dividend and still maintain physical operations and future dividends at their existing levels.

In summary, the argument can be made that replacement cost income is a surrogate for economic income even in more realistic, imperfectly competitive environments. The basis for this contention would rest on two sub-correspondences: (1) that current operating profit is a surrogate for expected income, and (2) that realizable cost savings are a surrogate for unexpected income.

Goodwill. Imperfect competition introduces the possibility that there may be persistent differences in the rates of return earned by firms. The ability to earn these extraordinary profits, which ability we will call goodwill, would seemingly lessen the predictive ability of replacement cost statements. Because of the existence of goodwill, the equity value shown on a replacement cost statement might diverge significantly from the present value of the firm. Accordingly, estimates of distributable operating flows (which must use the equity value of the firm as a base) might be adversely affected.

While this problem is very real, there is reason to believe that it may not be as serious as it first appears. The explanation is that, were replacement costing adopted for external reporting purposes, users might be better able to discern the existence of goodwill and perhaps even estimate its magnitude.²¹

The existence of goodwill might be seen more easily because replacement costing facilitates valid interfirm comparisons. That is, the use of a market-based accounting measure reduces the number of possibilities for artificial accounting-induced differences between firms' reported results. Firms with basically similar net assets and operating performance would be more likely to reflect similar financial statement asset values and income figures on a replacement cost basis. There are two reasons for this:

1. The use of market valuations obviates the need for certain arbitrary allocations (e.g., Lifo versus Fifo) that, in traditional accounting, could cause two firms with identical assets to report different asset valuations and income figures. Such differences are less likely to occur on a replacement cost basis.²²
2. The use of market valuations reduces the distortion caused by differences in the timing of asset purchases. For example, two firms that bought an

²¹ This statement assumes that it is not the intended purpose of accounting to directly provide users with estimates of internally generated goodwill. Instead, estimates of extraordinary earnings potential should be derived by users themselves from available financial data. Existing reporting standards are in conformity with this notion regarding the responsibility for goodwill estimates. As a practical matter, however, traditional, historical cost reports provide users with little basis for developing their own estimates of internally generated goodwill. Some of the reasons for this are explored below, along with a brief discussion of why replacement costing does provide information which makes user estimates of goodwill feasible.

²² While this is true on the balance sheet for all items valued by reference to actual market prices, certain arbitrary allocations will often be necessary for valuing fixed assets when there is no active market for used assets.

identical asset in the same market at two different points in time could, in traditional accounting, report different asset valuations if the price at the time of each purchase differed. If these assets have identical service potential, and if both firms buy these assets in the same market, they would be valued similarly on a replacement cost basis.²³

Since similar asset positions and operating performance are likely to generate similar results on replacement cost statements, the replacement cost operating rate of return measure (i.e., r_a in equation 3) constitutes a valid basis for estimating the *relative* earning power of a firm. By definition, goodwill represents the ability to earn extraordinary profits. A simple comparison of replacement cost rates of return across firms will disclose the existence of this extraordinary profitability. This provides a far better gauge than traditional, historical cost rate of return measures because of the absence of previously mentioned artificial allocation and timing differences.

Once the existence of goodwill has been determined, a user must next try to estimate its magnitude. By observing the amount of the extraordinary return and movements in this rate over past periods, some estimate of the persistence of goodwill and its rate of decay is gained. Armed with this data, a user has a basis for developing an estimate of the magnitude of goodwill. This figure, when added to the replacement cost equity value, provides the figure needed to generate estimates of future distributable operating flow.²⁴

Covariance Between Price Changes and Changes in Operating Flow Potential. While the need to estimate goodwill may be troublesome, the major difficulty with this lead indicator hypothesis in imperfectly competitive economies lies elsewhere. Specifically, if replacement cost income is to be a lead indicator for future distributable operating flow, then there must be positive covariance between changes in asset prices and changes in an asset's operating flow potential *for the individual firm*. Only if this is true will realizable cost savings equal unexpected income for the period, thus maintaining the hypothesized lead indicator relationship.

For the economy as a whole, this covariance between changes in asset prices and changes in the operating flow potential of assets must hold. But

²³ If the two firms buy these assets in different markets, then different valuations could result if the current replacement cost in each market differs. This gives recognition to the fact that, while each firm's physical asset may be identical, their economic positions are not similar; that is, one is situated in a generally higher cost market.

²⁴ This approach presumes that the sum of original replacement cost equity plus goodwill is multiplied by the prevailing normal rate of return for firms of similar riskiness. In this fashion, an estimate of distributable operating flow is generated.

A totally equivalent procedure that avoids the need for explicit goodwill estimates is also available. Following this approach, the firm's observed past replacement cost operating rate of return (r_a) is multiplied by replacement cost equity (ignoring goodwill) in order to develop an estimate of distributable operating flow. Obviously, both approaches will yield the same operating flow estimate.

due to market frictions, there is seemingly no necessary relationship between changes in specific asset prices and changes in the operating flow potential of these assets to any individual firm.

At the individual firm level, three possible relationships between changes in prices and changes in flows theoretically exist:

- A. Future flows expected from asset operation could change in the same direction as the price change.
- B. Future flows expected from asset operation could remain constant, despite the price change.
- C. Future flows expected from asset operations could change in the opposite direction.

It is easy to demonstrate that Type B and Type C asset price changes can destroy the correspondence between replacement cost income and economic income and thus negate the reputed lead indicator advantage of replacement costing.²⁵

Given the normative investor model introduced above, it follows that investors are concerned with changes in firms' operating flow potential, since such changes may be expected to lead to changes in future dividend flows. To be useful for such information needs, an income concept reported to investors should ideally vary in the same direction and by the same magnitude as variations in operating flow potential. But if a replacement cost report includes Type B and Type C price changes, it is possible for reported income to be moving in a direction exactly *opposite* to movements in operating flow potential. This would cause errors in estimates of the present value of the firm and, as a consequence, affect forecasts of future distributable operating flows.²⁶

There is currently no empirical evidence regarding the extent and frequency of Types B and C price changes. Such evidence is absolutely necessary for an evaluation of the validity of the theoretical lead indicator advantages of replacement costing. If Type A changes are found to predominate in the real world, then the reputed predictive ability of total replacement cost income would be affirmed. However, if significant Types B and C changes

²⁵ Revsine, *Replacement Cost Accounting*, Chapter 4.

²⁶ To illustrate the importance of this problem, assume that the distributable operating flow estimate is made using the second approach outlined in footnote 24. That is, a firm's December 31, 19X1 replacement cost equity (ignoring goodwill) is multiplied by the firm's observed past replacement cost operating rate of return during 19X1 (r_a) in order to generate an estimate of distributable operating flow for 19X2 and subsequent years. This approach implicitly assumes that future r_a will exactly equal observed, past r_a . But if a Type C price increase has occurred, say during December of 19X1, future years' r_a will be lower than 19X1's r_a . Since the level of this future r_a is not yet known at the end of 19X1, past r_a must be used to generate the estimate. That is, the new higher 19X1 equity value (which includes the Type C price increase) is multiplied by the existing r_a , rather than by the unknown, but lower, future r_a . As a consequence, the distributable operating flow estimate is overstated. This prediction error is, of course, caused by the Type C price change.

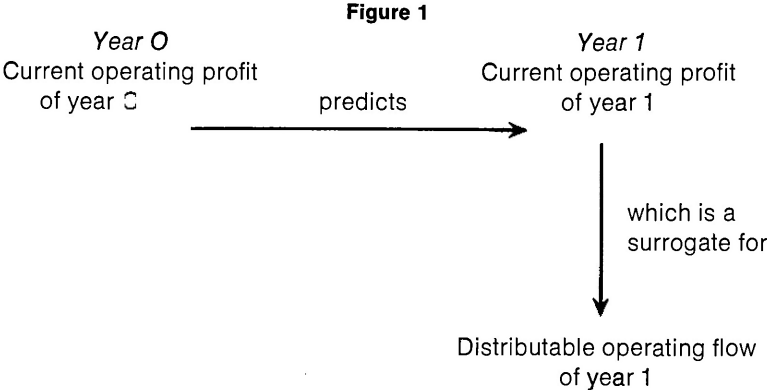
frequently occur, then the purported lead indicator advantages of replacement cost income would be seriously undermined.

The Extrapolation Approach

In addition to the lead indicator approach, there is another—totally independent—reason for ascribing predictive ability to replacement costing. This view, which we will identify as the extrapolation approach, involves only the current operating profit component of total replacement income. This second approach suggests that replacement cost current operating profit can be extrapolated in order to generate an estimate of succeeding years' distributable operating flows.

The logic which supports this position can be summarized as follows:

- 1. In the absence of contrary evidence, the actual current operating profit figure for any given year constitutes the best estimate of the current operating profit which will be realized in the succeeding year.
- 2. This estimate of the succeeding year's current operating profit is the best ex ante measure of that succeeding year's distributable operating flow.



These relationships, which are depicted in Figure 1, can be explained in the following fashion:

1. *Estimating the succeeding year's current operating profit.* We suggested earlier that future operating profit levels are a function of two variables: first the physical level of future operations, and second, the future prices for the firm's inputs and outputs. In an environment in which technological processes, consumer preferences, and input supplies are constantly changing, it is difficult to forecast the amount of future operating profits. In the absence of a better predictive basis, one approach is to extrapolate the current level of physical operations on the assumption that no further changes in input or output prices will occur. If the succeeding period's unit operating

margin is stable,²⁷ and if volume is constant,²⁸ then the succeeding period's current operating profit will indeed equal the base period's current operating profit. Furthermore, even if price changes do occur, unless such changes represent a shift in the trend of past price changes, then in a relative sense, current operating profit provides the best basis for predicting itself in future periods.

2. *Future current operating profit as a measure of future distributable operating flows.* We have already demonstrated that where asset prices and asset values are identical, current operating profit is equal to expected income [see equation (6), above]. Since expected income is definitionally equivalent to distributable operating flow, it follows that, where asset prices and values are identical, current operating profit is a precise measure of distributable operating flow. In more realistic environments, where the correspondence between prices and discounted present values is only approximate, it seems reasonable to suggest that current operating profit is a surrogate for distributable operating flow.

Thus, there are two distinct reasons for suggesting that replacement cost information might provide a predictive basis to long-term equity investors: (1) the lead indicator approach discussed earlier in the paper, and (2) the extrapolation approach. The former method employs total replacement cost equity as a basis for generating predictions, while the latter bases its predictions only on the current operating profit component of replacement cost income.

Notice that, in generating estimates of future distributable operating flows, the extrapolation approach takes no cognizance of realizable cost savings. In contrast, the lead indicator approach presumes that there is covariance between asset price changes (realizable cost savings) and the flow generating potential of assets. Since future distributable operating flows will be higher when the expected operating flow changes occur, lead indicator estimates of future distributable operating flows accordingly include the cost savings element in replacement cost equity and, thus, in the resultant forecast.

There are two conceivable means for explaining why the cost savings element is ignored in the extrapolation approach. One alternative is that proponents of the predictive ability of current operating profit may reject the validity of the assumed correspondence between changes in asset prices and asset flows. They may believe that Types A, B, and C price changes are each

²⁷ This will obviously occur if there are no price changes in the ensuing period. Alternatively, operating margins will be stable if, say, input price increases are exactly offset proportionately by output price increases.

²⁸ Obviously, this constant volume assumption is used only for ease of exposition. Often, a user may have good reason to anticipate a certain volume change. Insofar as replacement cost income statement items are segregated by degree of variability, these anticipated volume changes can easily be built into the extrapolation.

equally likely and that no one type predominates. If true, this would mean that there is no necessary relationship between changes in asset prices and operating flows. Accordingly, cost savings could be ignored in generating distributable operating flow estimates. The other alternative is that advocates of this extrapolation method do believe that Type A changes predominate, but they feel that the operating flow effect of such price changes is so rapid that it is already reflected in the current period's operating profit figure. Since the operating flow effect has already been incorporated, simple extrapolations of current operating profit would suffice. This makes the realizable cost savings data superfluous.

Empirical evidence regarding the nature and rapidity of prevailing price changes is necessary to settle the issue. Such knowledge would provide indirect evidence needed to support either the inclusion or exclusion of realizable cost savings data in generating estimates of future distributable operating flows.

Technological Change

An important theoretical concern in the computation of replacement cost income relates to the treatment of technological changes. Normally, firms using older assets will replace these assets with technologically improved models only when the present value of the savings to be generated exceeds the net cost of replacement. Accordingly, many firms continue to use assets which have been superseded in the marketplace by improved models. This raises the issue of how replacement cost should be defined under such circumstances. Is the cost to be matched against revenues the current cost of replacing the older asset actually used in production? Or, alternatively, is replacement cost governed by the current cost of obtaining the *equivalent services* in the most economical manner, i.e., by buying the technologically improved asset?

Edwards and Bell have suggested that replacement cost be defined by reference to the actual assets used in production. Such information is necessary, they contend, to evaluate the efficiency of existing operations; furthermore, it does not necessitate implicit forecasts of a firm's future investment actions.²⁹ Their position has been attacked because it seemingly ignores technological change.³⁰ Of course, this issue cannot be solved by appeals to the intuitive "correctness" of one or another income construct. Income is a totally artificial concept. One measure can be defended as preferable to another only by reference to some well-defined information needs which the concept satisfies.

By avoiding the need to estimate a firm's future investment actions, the Edwards and Bell approach implicitly adopts objectivity as an important

²⁹ Edwards and Bell, *Measurement of Business Income*, p. 186n.

³⁰ See, for example, Kenneth W. Lemke, "Asset Valuation and Income Theory," *The Accounting Review*, (January 1966), p. 38.

criterion to be possessed by the resultant measure. Since we have no quarrel with this criterion, a method which possesses this attribute will be deemed superior to one which does not, provided that this method simultaneously generates information relevant to the normatively derived predictive needs of equity investors. Thus, the crucial question is whether an income concept which defines replacement cost by reference to the actual assets used in production can generate useful information for predicting distributable operating flows for a nonadopter during a period of technological change.

A theoretical answer to this question can be developed by examining the various market effects which could arise as a consequence of technological change. When a technological change occurs, any one of the following benefit distribution patterns can result:

1. The ultimate consumers of the final output could be the sole beneficiaries of the technological change.
2. The producers (or inventors, or suppliers of raw materials) of the improved asset could be the sole beneficiaries of the technological change.
3. Those manufacturers of the final product who adopt the technological change could be the sole beneficiaries of the technological change.
4. Two or more of the above groups could share the benefits in various proportions.

A reasonable presumption—that can be examined in later empirical tests—is that the market prices of older, technologically more primitive assets reflect the diminished productivity of these assets vis-à-vis more technologically advanced models. It can further be presumed that each *change* in technology causes a whole series of price *changes* for all older, somewhat obsolete assets.

Given this presumed market price structure, the predictive ability of replacement cost reports prepared for nonadopters would depend upon the circumstances surrounding the technological change. For example, consider a technological change that affects the production process used in Industry A. Assume that Firm 1 is a member of Industry A, and that Firm 1 does not adopt the change. If replacement cost statements are prepared for Firm 1 during the period of the change, the predictive ability of these statements is dependent upon which group gains the benefits of the change. If the ultimate benefit accrues to either consumers of final product or to the equipment producers who introduced the change, then replacement cost statements would provide a basis for predicting Firm 1's future operating flows. That is, a firm that continues to use older equipment in the face of a technological change would generate a replacement cost figure that tends to covary with changes in its expected future distributable operating flows. However, when all of the benefits from the technological change are captured by the users of the new equipment in Industry A, then replacement cost income would not provide a satisfactory predictive basis for nonadopters like

Firm 1. While the analysis underlying these conclusions is rather lengthy,³¹ the crucial issue is whether the rate of return earned on the new equipment equals that previously earned on the old. When this happens (e.g., cases 1 and 2, above) there will be positive covariance between total replacement cost income and expected future distributable operating flows. Furthermore, under these conditions, current operating profit would also provide a good extrapolation basis for predicting future distributable operating flows. However, if the rate of return rises, replacement cost would seemingly not perform adequately.

Realistically, the entire gain from a technological change will probably not accrue to any single group. Instead, these gains will usually be shared by equipment manufacturers, producers, and consumers. Whenever the producer's benefit share is significant, the technological change will serve to increase the industry rate of return and diminish the predictive ability of replacement costing for users of unimproved assets within the industry. Thus, to evaluate the utility of a replacement cost system which "ignores" technological change, it is important to determine the frequency with which such changes will raise the rate of return in the industry in which the change occurs.

Obviously, the precise rate of return effects of a technological change depend upon the competitive structure in both the equipment manufacturing and producing industries as well as the elasticity of demand for production equipment and for the final product. Thus, individual circumstances will determine whether rates of return will change and thus negate the utility of replacement cost statements for nonadopters. In general, however, we know that the greater is the freedom of entry into an industry, the smaller is that industry's share of the benefits from technological change. If this condition is met, then the producing industry's benefit share from a technological change will be small and the industry rate of return will change little. This constancy would appear to preserve an approximate correspondence between replacement cost income and future distributable operating flows even for those firms that do not adopt the technological change.

Required Empirical Evidence

In the preceding pages, a theoretical foundation for the relevance of replacement cost accounting to long-term investors has been presented. While an a priori basis for this foundation exists, the theory is crucially dependent on several economic relationships whose validity has yet to be tested. Hopefully, this theoretical analysis will serve to guide future empirical research efforts. Until such evidence is available, little can be said about the *absolute* utility of replacement costing. (Furthermore, until similar studies are undertaken for other measurement systems and for other user groups,

³¹ For a detailed development of these conclusions, see Revsine, *Replacement Cost Accounting*, Chapter 6.

it is impossible to evaluate the relative utility of alternative measurement systems.)

The economic evidence necessary to assess the predictive ability of replacement costing relates primarily to asset price movements. The *specific* price movement characteristics required to validate the extrapolation method differ from those required for the lead indicator method. For simplicity, our discussion of needed empirical evidence will concentrate on the lead indicator method.³²

Theoretically, in order for the lead indicator method to generate accurate forecasts, there must be perfect covariance between *aggregate* asset price changes and *aggregate* changes in an individual firm's flows from operating owned assets.³³ This condition of perfect covariance is so restrictive that one would not expect it to be met precisely in practice. Realistically, then, the research issue is to discover how well this required condition may approximate real-world conditions. If some approximate relationship between changes in prices and flows does exist, then a replacement cost system may provide a basis for generating tolerably accurate forecasts of future events. However, if the required condition is greatly at variance with observed, real-world conditions, then replacement cost data would probably not provide an accurate predictive basis. Clearly, empirical evidence is necessary in order to answer this question.

³² As discussed earlier, the price change conditions that are necessary to validate the extrapolation method are not identical to those required to validate the lead indicator method. That is, the mere prevalence of Type A changes is not sufficient for the extrapolation approach; not only must price changes be predominantly of Type A, but also the operating flow effect of the price change must occur so rapidly that it is reflected in the reported operating margin of the price-change period. Under these conditions current operating profit of one period would provide a basis for predicting current operating profit of the following period.

Of course, there is another, totally different, pattern of price changes that would also validate the extrapolation method. Specifically, if Types A, B, and C price changes are perfectly balanced, then, on average, price changes and flow changes would cancel out; under such circumstances, one period's current operating profit would provide a basis for estimating the succeeding period's current operating profit.

Thus, two different types of price change behavior are potentially in accord with the extrapolation method. Obviously, empirical evidence is needed to determine whether either of these conditions is met.

³³ Notice that for multiple-asset firms, aggregate correspondence between changes in prices and flows is sufficient. This aggregate correspondence may exist because each *individual* price change experienced is of Type A. Alternatively, aggregate correspondence may exist if Types B and C price changes are exactly offset by an opposite Type B or C price change in the same period. (For example, if one asset's price goes up while its flow potential goes down, then some other asset's price must go down as its flow potential goes up. Obviously, the amounts involved must also be equal.) Thus, what we are saying is that *for the firm as a whole*, Type A price changes must predominate. However, individual asset price changes may depart from this pattern so long as, in the aggregate, the net effect of all price changes experienced in a given period is of Type A.

One possible test for the prevalence of aggregate Type A price changes involves monitoring movements in replacement cost operating rate of return ratios³⁴ for individual firms over time.³⁵ When, say, asset price increases occur, the denominator of the rate of return ratio will increase. If there is positive covariance between changes in prices and flows, one would expect the numerator, current operating profit, to increase also. Thus, if the magnitude of replacement cost operating return over time was found to be relatively stable, this would be consistent with the existence of *aggregate* correspondence between changes in asset prices and changes in operating flows.³⁶

Empirical evidence of this nature is necessary to support the very foundation on which the reputed predictive ability of replacement costing rests. However, before the lead-indicator and/or extrapolation approaches are accepted, additional empirical evidence is needed. Such evidence, for

³⁴ Equation (3) denotes this operating return to be:

$$r_i = \frac{C_i}{P_i}$$

³⁵ The pattern of movements in industry-wide rates of return over time has been examined in previous studies; for example, see George J. Stigler, *Capital and Rates of Return in Manufacturing Industries* (Princeton, N. J.: Princeton University Press, 1963). While Stigler's study disclosed a large amount of short-term stability in rates of return for all industries, and long-term stability in concentrated industries, these findings are not directly relevant for assessing covariance between asset price changes and changes in operating flow potential. There are two reasons for this. First, the covariance assumption relates to *individual firms*, whereas the available evidence is on an industry-wide basis. In order to test this assumption, movements in individual firms' operating returns must be examined. Second, while Stigler adjusted for price changes, his adjustment technique used highly aggregated economy and industry-wide data. Thus, the income and asset values employed probably do not approximate the replacement cost data needed to test the covariance assumption.

³⁶ Obviously, r_a , the actual replacement cost operating rate of return, will be perfectly stable only if four conditions are met: (1) in the aggregate, price changes experienced are of Type A, (2) firms use economic depreciation for long-lived assets, (3) the time pattern of asset inflows is relatively smooth, and (4) management's operating efficiency is constant.

Since most firms do not use the economic depreciation method, we would be surprised to find absolutely stable r_a 's, even if the three other conditions were met. Thus, even if Type A changes predominate, at best this test would disclose only relative stability in rates of return. Insofar as economic depreciation is not used, irregular operating inflows can also cause the pattern of r_a 's to fluctuate from year to year, even if Type A changes predominate. Because of this problem, this test must define stability of r_a 's to mean stability of a moving average of replacement cost operating return over time. Also notice that the effects of changing efficiency would be inextricably intertwined with the types of price changes experienced. The test must, accordingly, either presume that efficiency is constant over the period examined, or recognize that there is another reason why r_a 's may fluctuate even if Type A changes predominate. These factors indicate that the suggested test represents only a coarse screening device for determining the types of price changes experienced by actual firms.

example, would deal with issues like the ability of current operating profit to predict succeeding years' current operating profit, and the conditions under which a technological change tends to raise the rate of return in those industries that employ the change.

Summary

At the start of this paper we described a four-stage research process that is necessary for a complete analysis of the relevance of replacement cost accounting. Of necessity, however, our analysis was limited to stages one and three. That is, we first selected a normative decision model for long-term equity investors and specified the information needs of this model. Given these information needs as a benchmark, we then presented a theoretical model that explained the relevance of replacement cost reports to long-term equity investors.

While this theoretical foundation specifically relates only to the information needs of long-term equity investors, it is possible that other user groups may have similar information requirements (for example, a desire to predict future cash flows). If later research discloses such commonality of needs, this finding would broaden the applicability of the theoretical foundation developed herein. (Whether this required research to discern information needs ought to be empirical or normative is currently a controversial issue.)

[³⁶ Cont.]

There is one systematic cause for instability in r_t , which could conceivably be isolated and which, if isolated, might preserve the predictive ability of replacement cost numbers. Specifically, if r —the prevailing market rate of return—changes, then theoretically, this should precipitate changes in r_a as well. If the empirical test discloses instability in individual firms' r_a 's over time, and if a large portion of this instability is found to be related to changes in r , then we can conclude that changes in r_a tend to covary with shifts in prevailing market return levels. This would suggest that there is some basic underlying association between changes in asset prices and operating flows that is obscured, on occasion, by changes in r . If, by observing the past relationship between r and r_a , one can forecast the effect on r_t of changes in r , then predictive ability might be maintained as long as shifts in r are incorporated into the operating flow forecast as soon as they are anticipated.

One additional difficulty with the proposed test must be mentioned. When capital structure is altered, intertemporal movements in an r_t may provide an inadequate means for assessing the covariance between changes in prices and changes in operating flows. For example, assume that a firm is successfully using leverage, that is, its operating rate of return exceeds its interest rate on debt. If this situation persists, and if the firm then issues additional debt during the period under analysis, one would expect r_t (the return on *net* assets) to rise even if there is perfect covariance between asset prices and operating flows. Thus, whenever capital structure has changed over the period being examined, instability can be injected into the r_a pattern. In order to test the covariance assumption when capital structure has changed, stability of the preinterest return on gross assets should be examined, rather than stability of r_a . The operating return on gross assets will not be affected by leverage changes; stability in this figure will tend to suggest—subject to the caveats introduced above—covariance between changes in asset prices and changes in operating flows.

It is evident that the developed theoretical foundation for replacement cost reporting to investors rests on several crucial assumptions regarding the economic environment. Unfortunately, empirical evidence relating to the validity of these assumptions is not yet available. Insofar as this paper provides a heretofore absent rationale for replacement cost proposals, it simultaneously provides direction for needed empirical testing. Only after relevant empirical evidence is available will it be known whether this theoretical model will perform in actual practice as a priori analysis suggests.