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A Neoclassical Measure of Profit

Robert W. Scapens

ABSTRACT: This article seeks to develop the concept of profit used in the microeconomic theory of the firm and to examine its potential as an accounting measure. Using a simple economic model, it is demonstrated that profit maximization can be the short-run analogue of long-run wealth maximization. Economic profit is compared with certain of the existing proposals for financial reporting and similar income measures are observed. Certain differences between some existing proposals are traced to a fundamental difference of opinion about the nature of a business enterprise. It is concluded that economic profit appears to have potential as an accounting measure. However, it is pointed out that empirical research will ultimately be required to determine the usefulness of the measure to financial statement users.

FROM time to time, accountants concerned with alternative methods for *ex post* reporting of business activities have turned to economic theory to provide a theoretical framework for the accounting debate. In discussions of the methods available to measure financial performance, references have been made to the concepts of income and value as they are used by economists. The definitions of income and value developed by Fisher [1930] and Hicks [1946] generally have been used. Economic value is normally defined in terms of the net present value of future net receipts and economic income as the amount which can be consumed in a period without impairing this economic value. Studies of the relationships between accounting and economic concepts of income have been made by, among others, Revsine [1970], Shwayder [1967], and Solomons [1961].

In this paper, consideration will be given to an economic concept which apparently, has been neglected in accounting debates; *i.e.*, the concept of profit as it has traditionally been used in microeconomic theory. Profit in that sense is not the same as economic income, except in certain special cases. Economic profit may be defined as the excess of benefits over costs of productive activities in each period when all relevant costs are measured in terms of their shadow prices (or opportunity costs). Economic value and income are long-run concepts, whereas economic profit is a short-run concept. Furthermore, interest on capital is treated as an expense in computing economic profit, while economic income is a measure of the return earned by that capital.

A simple model based on an assumption of certain future cash flows will be used to illustrate the concept of economic profit. Such a model facilitates the examination of the potential role of economic profit for financial reporting. However, the theory underlying the model can be extended to provide a more realistic model which deals with the un-

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certain real-world processes. Development into the uncertainty area will be deferred for the present time, until the nature of the basic model has been fully explored.

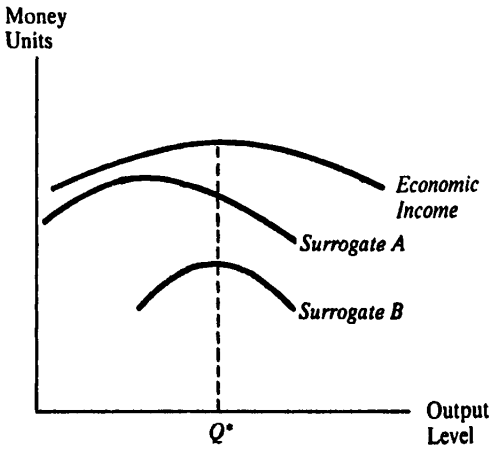
Economic Income and Profit

If the objective of a business enterprise can be assumed to be the maximization of economic wealth (*i.e.*, the net present value of future cash flows), it could be argued that a measure of economic income is potentially useful to the managers of the business, as a policy of economic income maximization in each successive period will lead to the same decisions that would follow from a policy of maximizing the wealth of the business. However, it may be impracticable to attempt to measure economic income directly because of the subjectivity of many of its components. The studies of accounting and economic concepts of income (referred to above) examined the correspondence between the concepts and evaluated accounting measures as surrogates for economic income. In general, accounting concepts do not correspond closely to economic income, particularly because accounting techniques do not measure changes in future cash flows which result from current actions. Such changes in cash flows represent a shift in wealth, and, as such, are a component of economic income.

However, it may not be necessary for the surrogate to closely approximate its principal. It is the policy implications which are important. A good surrogate will generate decisions identical to those which would have resulted from the use of the principal variable. Figure 1 illustrates the relationships in very simple terms.[1] For this illustration, it is assumed that economic income is a uni-modal function of output and that the income (and accordingly, wealth) maximizing output is at Q^*. Surrogate A is a closer approximation to economic income, than surrogate B; but it can be seen that a policy of maximizing surrogate B will lead to the wealth maximizing output of Q^*.

FIGURE 1

PRINCIPAL AND SURROGATE MEASURES



It will be demonstrated in this paper that economic profit has the characteristics of surrogate B (at least, in the circumstances of the model). For this reason, economic profit should be given careful consideration as a measure of financial performance. Wealth maximizing managers could achieve their objectives by a policy of maximizing economic profit in each period. In order to pursue such a policy, managers will form an *ex ante* view of the economic profit to be obtained from the alternative courses of action available to the business. The accounting process can assist managers in this respect by compiling budgets of the economic profit which can be earned and also by reporting the *ex post* economic profit earned by the business. This *ex post* report (which will only be useful

[1] Figure 1 is adapted from a diagram presented by Tomkins [1973].

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if the conclusions of this paper can be extended to an uncertain world) could provide an element of control and feedback for the management process. Such data is essential if managers acting in an uncertain world are to learn by experience and revise their expectations for future periods.

In this respect economic profit has the comparative advantage of being easier to measure than economic income. It is also superior to many surrogates for economic income as it has the characteristics of surrogate *B* in the above illustration; *i.e.*, it will lead to the wealth maximizing production decisions. However, as will be shown later, economic profit is similar to certain accounting alternatives already developed in the literature.

An Economic Model

To develop a measure of economic profit, use will be made of the neoclassical theory of the firm and, in particular, the version of the theory used by Jorgenson [1963, 1965 and 1967] in his theory of investment behavior. He demonstrated that on certain assumptions, wealth maximization could be achieved by maximizing profits at each point of time. The term profit is defined in such a way that profit maximization is idential to wealth maximization. In his model, Jorgenson included only single capital and labor inputs. Further, he used continuous functions to describe the relationship between outputs and inputs. Such a model is inconvenient for the development of accounting reports. Accordingly, a discrete version of the model with some additional inputs is presented below.

It is assumed that the firm is a price-taker in the market for its output and that all factor prices are exogenously determined. The stronger assumption of perfect markets for output and for all factors of production is not essential for purposes of the model. All that is necessary are exogenously determined prices with no transaction costs. However, a perfect capital market is assumed and the rate of time discount is taken to be the same for all periods. The present value of the firm can be defined as the sum of discounted net receipts over all future periods and the conventional economic objective of the firm can be expressed in the following form:

$$\text{Maximize } W = \sum_{j=o}^{\infty} \frac{R_j}{(1+r)^j}, \qquad (1)$$

where W is the wealth of the firm at time o, R_j the net receipts in period j and r the money rate of time discount.

The net receipts in period j might be written more fully as:

$$R_j = p_j\bar{Q}_j - w_jL_j - b_j\bar{X}_j - q_jI(n)_j - aI(m)_j \qquad (2)$$

$\bar{Q}_j$ represents the quantity of finished goods to be sold in period j at the selling price, p_j. The cash out-flows are represented by four variables; the hiring of labor services, L; the purchases of a homogenous raw material, $\bar{X}$; and the acquisition of additional non-monetary assets, $I(n)$, and additional monetary assets, $I(m)$.[2] The prices of these variables are w, b, q, and a respectively. It should be noted that the price of monetary assets is given by a constant; *i.e.*, the price of such assets will not change.[3] For simplicity, equation (2) will be interpreted as the cash flow of a firm consisting of a production process with a single output, single

[2] Monetary assets can be described as those assets which are defined in terms of money; for example, accounts receivable and cash at bank. Accordingly, the physical dimension of these assets, $I(m)$, will be measured in money units.

[3] As $I(m)$ is measured in money units (see footnote 2) the price of such assets will always be unity (*i.e.*, $a \equiv 1$). Changes in the price of bonds or similar monetary assets will be reflected in the capital stock of such assets and not in the a parameter.

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labor input, a single raw material input, and single monetary and non-monetary capital inputs. However, it could also be interpreted as the representation of the cash flow arising from multi-input/multi-output operations, in which $\bar{Q}$, L, $\bar{X}$, $I(n)$ and $I(m)$ are quantity vectors and p, w, b, q and a the corresponding price vectors.

The ability of the firm to maximize its wealth, as expressed by equation (1) (and expanded by equation (2)) is limited by several constraints. First, the level of output, Q, is constrained by the production function, which may be expressed in the general form:

$$Q_j = F[L_j, X_j, K(n)_j, K(m)_j, S_j, S(x)_j], \quad (3)$$

where $K(n)_j$ and $K(m)_j$ are the inputs of non-monetary and monetary capital; S_j and $S(x)_j$ are the inputs of services from inventories of finished goods[4] and from raw material inventories and L_j and X_j the inputs of labor and raw materials. It will be assumed that this production function is convex and twice differentiable with positive marginal rates of substitution and non-increasing returns to scale.[5]

The units of service from inventories are assumed to be a constant proportion of the stock at the start of the period and for simplicity the proportionality is taken to be unity. Thus, two further constraints can be written as follows:

$$Q_j - \bar{Q}_j = S_{j+1} - S_j, \quad (4)$$

$$\bar{X}_j - X_j = S(x)_{j+1} - S(x)_j, \quad (5)$$

Similar assumptions can be made about the stocks and flows of capital assets. The level of accumulated stocks of capital assets is determined by the amounts of new investment[6] and the rate of physical depreciation. Monetary and non-monetary assets may be considered separately. Thus, the final two constraints can be written:

$$K(m)_{j+1} - K(m)_j = I(m)_j - D(m)K(m)_j, \quad (6)$$

$$K(n)_{j+1} - K(n)_j = I(n)_j - D(n)K(n)_j. \quad (7)$$

The only terms which require further explanation are $D(m)$ and $D(n)$. These represent the rate of physical depreciation (deterioration) of monetary and non-monetary capital assets respectively. The deterioration of monetary assets could occur in the form of bad debts (however, this is unlikely in the certainty model); or the rate of deterioration could be zero as for cash.[7] In this model, the rate of depreciation is assumed to be related to the current stock of assets; this is equivalent to the accounting method of calculating depreciation on the declining balance. The model could also be formulated in a form equivalent to the accounting straight-line method of depreciation. Whether one or another of the alternative formulations is more appropriate is an empirical question which has little impact on the fundamental nature of the profit measure derived from the model.

Equations (1) through (7) specify the model of the firm used in this paper. The solution of the system of equations gives the marginal productivity conditions for each of the productive inputs from which it is possible to derive the values of the marginal products; *i.e.*, shadow prices

[4] The inclusion of the services from finished goods inventories in the production function is not altogether satisfactory as these inventories probably assist selling rather than production. However, their inclusion in this manner simplifies the analysis and it may be argued that such inventories are a prerequisite to production as they provide a necessary buffer between sales and production.

[5] For a discussion of these assumptions see Malinvaud [1972: Chapter 3].

[6] Because of the discrete nature of the model and the normal assumptions that transactions take place at the end of each period, new investment acquired during period j will not be available for use until the start of period $j+1$.

[7] Cash may lose value in a period of inflation. However, the physical amount of cash does not change. The term $D(m)$ applies only to physical deterioration. A loss incurred from holding cash in a period of inflation will come out of the model later.

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each input. The mathematics are demonstrated in the appendix where the following shadow prices are derived:

$$p_j\frac{\partial F}{\partial L_j}=w_j=c_j^{i} \tag{8}$$

$$p_j\frac{\partial F}{\partial X_j}=b_j=c_j^{ii}, \tag{9}$$

$$p_j\frac{\partial F}{\partial K(n)_j}=(1+r)q_{j-1}-q_j[1-D(n)] =c_j^{iii} \tag{10}$$

$$p_j\frac{\partial F}{\partial K(m)_j}=(1+r)a-a[1-D(m)] =c_j^{iv} \tag{11}$$

$$p_j\frac{\partial F}{\partial S_j}=(1+r)p_{j-1}-p_j=c_j^{v} \tag{12}$$

$$p_j\frac{\partial F}{\partial S(x)_j}=(1+r)b_{j-1}-b_j=c_j^{vi} \tag{13}$$

A measure of profit can be defined with productive inputs priced at their shadow prices (in other words, at their implicit rental values). Thus, profit, P_j, can be defined as:

$$P_j = p_jQ_j - c_j^{i}L_j - c_j^{ii}X_j - c_j^{iii}K(n)_j - c_j^{iv}K(m)_j - c_j^{v}S_j - c_j^{vi}S(x)_j. \tag{14}$$

It should be noted that there is an implicit cost of carrying inventories and these enter into the calculations of profit. The shadow prices given in equations (8) through (13) can be used to replace the terms $c_j^{i}\cdots c_j^{vi}$. Thus

$$\begin{aligned}P_j=p_jQ_j-w_jL_j-b_jX_j &-\{(1+r)q_{j-1}-q_j[1-D(n)]\}K(n)_j\\ &-\{(1+r)a-a[1-D(m)]\}K(m)_j\\ &-\{(1+r)p_{j-1}-p_j\}S_j\\ &-\{(1+r)b_{j-1}-b_j\}S(x)_j\end{aligned} \tag{15}$$

This measure of profit is consistent with the assumed objectives of the firm; *i.e.*, the maximization of its wealth. If the firm maximizes these profits in the short run, it will also maximize its wealth in the long run. The first order (marginal productivity) conditions for the maximization of P_j are identical to the marginal productivity conditions for the maximization of W. These conditions are derived and compared in the appendix and a numerical example demonstrates that identical production plans are obtained from the wealth maximizing and economic profit maximizing objectives.

In developing the model, it was assumed that the money rate of time discount r is the same for all time periods. This is not critical to the results of the analysis. If r is allowed to vary over time (but within discrete intervals), the measure of profit in equation 15 will not alter; the appropriate value for r will be the money rate of time discount for period j.

The expression for profit given in equation 15 is not in a convenient form for comparison with accounting measurements. This can be remedied by a rearrangement of the terms:

$$\begin{aligned}P_j=p_j\bar{Q}_j+p_j(S_{j+1}-S_j)&\\ -[w_jL_j+b_jX_j+q_jD(n)K(n)_j&\\ +aD(m)K(m)_j]-r[q_{j-1}K(n)_j&\\ +aK(m)_j+p_{j-1}S_j+b_{j-1}S(x)_j]&\\ +(q_j-q_{j-1})K(n)_j+(p_j-p_{j-1})S_j&\\ +(b_j-b_{j-1})S(x)_j&\end{aligned} \tag{16}$$

This measure of economic profit is made up of four distinct elements. Sales and any increase in finished goods inventories valued at the current selling prices of output make up the first of these elements. Because of the discrete nature of the model, prices will change only at the discrete intervals used in the analysis; *i.e.*, at the point of time which characterizes the end of one period and the start of the next. Thus, the price p_{j-1} will be

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appropriate for the whole of period $j-1$, but will change to p_j at the start of period j. The second element of the profit calculation is the deduction of inputs used in production during the period, valued at current prices.[8] The third, a deduction for the opportunity cost of funds, is computed by applying the interest rate to the value of inputs inherited from the past. This is a measure of the interest which could have been earned had the asset stocks been sold at the end of the previous period and the fund realized invested in the capital market. Thus, it measures the "normal" return which could have been earned on the funds invested in the business at the start of the current period. The final element in the profit calculation is an adjustment for changes in the prices of the stocks of assets held by the firm. It is the price differential for each resource multiplied by its stock level at the start of the period.

When Jorgenson presented his model in developing a theory of investment behavior, he was criticized because of his simplifying assumptions; for instance, see Miller [1967]. The measure of profit developed in this paper is subject to some of those criticisms, principally, because it assumes away uncertainty, adjustment lags and costs and imperfections in the capital market. However, these assumptions allow us to focus on the fundamental nature of economic profit. Some comments about their implications are made later in the paper.

Equation 16 represents a measure of profit which is consistent with standard neoclassical economic analysis and which has some similarities with the measure of residual income widely discussed in the divisional performance literature, for instance see Solomons [1965] and Tomkins [1973]. The next step will be to extend this analysis to encompass one of the current issues in financial accounting.

The Price Level Adjustment

The role of a price level adjustment has been widely discussed in the financial accounting literature in recent years, but no reference was made to the effects of changes in the general level of prices in the above development of a measure of economic profit. The neoclassical theory of the firm says nothing about changes in the general price level; only relative price changes are considered. However, it is possible to modify the analysis to introduce a price-level element. Neoclassical theory is a static equilibrium analysis; *i.e.*, in each period an equilibrium position is achieved. But in moving from one equilibrium position to the next, inflation may take place. In its simplest form, the central authority may print more money. With a certainty model, the effect of such action will be foreseen. Nonetheless, the general price level will increase, and if the supply and demand conditions of individuals goods and services shift, relative prices will also change.

The measure of economic profit in equation (16) may be said to implicitly account for a price level factor. The market rate of interest is generally assumed to take some account of expected inflation. The money interest rate, r, may be assumed to be made up of two elements: (1) the real rate of time preferences, ρ, and (2) the proportional change in the general price level, g. Their relationship is normally expressed in the following terms:[9]

$$(1 + r) = (1 + \rho)(1 + g) \qquad (17)$$

[8] For reasons of clarity in presentation, the variables included in the model were kept to a minimum. However, if other inputs, such as selling and administration costs were included in the model, they would appear as a deduction in the economic profit calculation.

[9] If used in an *ex ante* sense, equation (17) implies that the market interest rate makes perfect adjustment for expected inflation. Recent empirical work, for instance Roll [1972], casts doubt on the speed of adjustment. However, this is not critical to the conclusions of this

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In a perfect capital market, there will be a unique market interest rate which can be used as the monetary rate of time discount. However, no similarly unique value for ρ, the real rate of interest, can be confidently expected. Consider the price change element, g, for any investor. Purchasing power is peculiar to the individual and it is dependent upon both inflation and the relative prices of the particular parcel of goods normally bought. Accordingly, a unique value for g cannot be expected (unless there are no relative price changes, in which case, the prices of all consumer goods and services will increase at the inflation rate). The market mechanism in a perfect capital market will ensure that in equilibrium each individual's real marginal rate of time preference is such that, when combined with the change in his personal purchasing power, the result is the unique market rate of interest. As g is not unique for all investors, ρ must vary in such a way that the combination of ρ and g in equation (17) will yield the unique r.

With this restriction on the interpretation of ρ and g, the definition of economic profit can be rearranged using equation (17), thus:

$$\begin{aligned} P_j = {} & p_j\bar{Q}_j + p_j(S_{j+1} - S_j) - [w_jL_j + b_jX_j \\ & + q_jD(n)K(n)_j + aD(m)K(m)_j] \\ & - \rho[(1+g)\{q_{j-1}K(n)_j + aK(m)_j \\ & + p_{j-1}S_j + b_{j-1}S(x)_j\}] + [q_jK(n)_j \\ & + p_jS_j + b_jS(x)_j] - (1+g)[q_{j-1}K(n)_j \\ & + p_{j-1}S_j + b_{j-1}S(x)_j] - gaK(m)_j \quad (18) \end{aligned}$$

The three separate elements of expense are still identifiable in the above definition of profit: (1) inputs valued at current prices, (2) the opportunity cost of funds and (3) adjustments for price changes. The opportunity cost of funds is now calculated in real terms by applying the real rate of time preference to the price level adjusted value of stocks (of capital assets and inventories) at the start of the period. The adjustment for changes in the prices of non-monetary assets are obtained by subtracting the price level adjusted value of capital stock brought forward from the current value of that stock. The calculation of the measure of economic profit as defined by equation (18) is summarized in Table 1.

Measuring Financial Performance

Economic profit is a short-run measure, but it is equivalent in the long run to economic income. The maximization of economic profit will lead to identical decisions within the firm as would the more conventional maximization of economic value (or income). Accordingly, as argued above, economic profit may be useful for the business manager. This was the financial statement user to whom Edwards and Bell [1961] directed their concepts of income measurement. It will be shown below that economic profit is comparable in certain circumstances to the measures suggested by Edwards and Bell, but the method of analysis is different. However, the managers within the business are not the only users of financial statements. There are a number of interested parties outside the business who may have a use for a statement of financial performance; for example, stockholders, investors in general, creditors, bankers, taxing authorities, and so on. Economic profit may possess special advantages for certain of these users.

A measure of economic profit may be particularly useful for the control of business activities by outside regulatory

paper; it will be suggested that it is undesirable to attempt to dichotomize the monetary interest rate into a real interest rate and an inflation adjustment (even if perfect adjustment actually takes place). Furthermore, the equation does provide a definition of the *ex post* real rate of time preference (*i.e.*, interest).

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TABLE 1
STATEMENT OF PROFIT FOR PERIOD j

Revenue (Quantity sold at current prices)		$p_j\bar{Q}_j$
Add Net increase in stocks of Finished goods (at current selling prices)		$p_j(S_{j+1} - S_j)$
Quantity produced (at selling prices)		xxxxx
Less Inputs valued at current prices:		
Labor	w_jL_j	
Raw materials used	b_jX_j	
Depreciation of non-monetary assets	$q_jD(n)K(n)_j$	
Deterioration of monetary assets (*e.g.* bad debts)	$aD(m)K(m)_j$	xxxxx
Outputs less Inputs (at current prices)		xxxxx
Less Opportunity cost of Funds:		
		$\rho\{(1+g)[q_{j-1}K(n)_j+aK(m)_j+p_{j-1}S_j+b_{j-1}S(x)_j]\}$
Net Operating Income		xxxxx
Add Gains arising from holding non-monetary assets:		
Capital stocks	$q_jK(n)_j-(1+g)q_{j-1}K(n)_j$	
Inventories of finished goods	$p_jS_j-(1+g)p_{j-1}S_j$	
Inventories of raw materials	$b_jS(x)_j-(1+g)b_{j-1}S(x)_j$	
	xxxxx	
Less loss from holding monetary assets	$gaK(m)_j$	
Real Holding Gain		xxxxx
	ECONOMIC PROFIT	XXXXX

authorities; for instance, by taxation or price control bodies. The choice of an income measure to be used as a basis for control depends on the objectives of the agency applying the control mechanism. That is a political question. However, it is possible that controls may be required to limit income; for instance, as part of the procedure for controlling prices. In such a case, it would be undesirable to base controls on a measure of income which will increase the possibility that output, product by product and business by business, may differ when the controls are applied from what they would have been without interference.

If the control is to be applied without altering the allocation of resources in the economic entities subject to the control, intuitively, it would seem desirable to apply the control procedures to the variable which managers seek to optimize by productive operations. In the conventional management accounting and finance literature, it is assumed that management attempts to maximize the wealth which the owners have invested in the business. However, the economic concept of wealth can be very difficult to measure, and accordingly, it may not be possible to control it directly. Thus, it may be appropriate to use a proxy measure.

For control purposes, a useful proxy should possess similar attributes to the concept of wealth. Economic profit, *a priori*, appears to possess suitable characteristics. A manager who seeks to maximize such a measure of profit will simultaneously maximize the wealth of the owners of the business. Thus, if a regulatory agency wishes to influence business

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activities by the control of a variable which can be used by rational management in the pursuit of its maximizing policies, economic profit merits serious consideration. However, in the circumstances of the certainty model presented in this paper, the control of wealth directly does not present any problems. But when the certainty assumption is dropped, the measurement of wealth becomes difficult. Further research is required to analyse the role of economic profit in such circumstances. This paper suggests that further work of that nature could be worthwhile.

Another potential user of economic profit is the investor. Revsine [1973] used an interesting approach to examine the usefulness for investors of accounting measures of income. He suggested that economic income might be regarded as an ideal measure, but pointed out that it is very difficult to compute in pactice. As economic profit and economic income lead to identical decisions (within the firm), it may be suspected that economic profit would also be useful for investors. However, as Revsine suggested, more empirical research is required to establish the information needs of individual investors when the assumption of certainty of future cash flows is relaxed and to determine the role of accounting data in meeting these needs.

In his book, Revsine attempted to construct an analytical bridge between replacement cost accounting and the economic concepts of value and income. He demonstrated that "in a perfectly competitive economy, the current operating profit component of replacement cost income is equal to the distributable operating flow component of economic income . . . (and) . . . the realizable cost savings component of replacement cost income is equal to the unexpected income component of economic income." [1973: pp. 99–100]. When the condition of perfect competition was removed, Revsine indicated that replacement cost income becomes only an approximation of economic income. The strength of the approximation depends on the relationship between the prices of assets and their future operating flows. Revsine, quite rightly, suggested that empirical research is required to determine the extent of market imperfections which create a divergence between the price of an asset and its future operating flows.

In this paper, also, consideration is given to the correspondence between the economic concept of value (together with its related concept of income) and accounting measures, such as replacement cost income as described by Revsine. However, the approach is different. Here the correspondence between accounting measures and the economic concept of value is examined in relation to the impact on production decisions. Revsine initially examined the direct relationship between accounting measures, in particular, replacement cost income and the economic concepts of income and value. He then proceeded to explore the role of replacement cost accounting as an indicator of those economic concepts.

Comparison with Some Other Proposals

The measure of economic profit illustrated in Table 1 may be compared with profit as measured by accountants. However, this particular representation of economic profit is valid only under the special conditions assumed in the economic model. Until further research gives an insight into the effects of relaxing many of the assumptions, care must be exercised in recommending economic profit for use in published accounting reports. Nonetheless, the present model does provide a framework for a compari-

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son of accounting and economic measures of profit. Two alternative approaches to current value accounting will be considered. The two alternatives are:

1. the calculation of income by valuing inputs and outputs in terms of current values, with capital maintained in terms of the purchasing power to the stockholders of contributed capital;
2. the calculation of income, also, by valuing inputs and outputs in terms of current values, but with capital maintained in terms of the operating potential of the firm.[10]

The main difference between these two alternative proposals arises from their concepts of capital maintenance. Both methods use current values for asset valuation.[11] The first proposal refers to stockholder-contributed capital which could be measured by the consumer purchasing power of the individual stockholders investment, whereas the second refers to the cost of maintaining the operating assets of the firm which will be affected by changes in prices of productive assets normally purchased. This dichotomy is expressed in alternative views of the nature of the firm. The proprietory view holds that the firm is an extension of its stockholders but the entity view maintains that the firm is an entity separate and distinct from its stockholders.[12]

One difference between economic profit and the above accounting income measures is the treatment of imputed interest. The opportunity cost of funds is treated as an expense in the calculation of economic profit whereas only interest paid is deducted in most accounting measures. It may be argued that an investor or manager interpreting an accounting measure of income will compare the outcome for the period with the normal return to be earned on the funds invested. In this way, inputed interest may be implicit in the interpretation of accounting profit numbers.

If the proprietory view is adopted, capital maintenance will be expressed in terms of the purchasing power of capital contributed by stockholders and any change in purchasing power, in theory, will be related to each individual stockholder. When g is interpreted in this way as a measure of stockholder purchasing power, economic profit takes on the appearance of the accounting measures proposed by the advocates of alternative 1. above. In particular, the economic measure is similar to the concept of business profit suggested by Edwards and Bell [1961]. The inputs into the production process are valued at current prices, while capital is maintained in terms of stockholder purchasing power. Any excess of the increase in the current value of non-monetary capital over the amount required to maintain the stockholders purchasing power invested in such capital is treated as a holding gain and included in profit for the period. For example, the term $p_jS_j-(1+g)p_{j-1}S_j$ in Table 1 represents the effects of changing prices on the finished goods inventories inherited from the previous period. The adjustment for the general price level change is equivalent to the separation of the real and "fictional" elements of the increase in the current value of assets, as was suggested by Edwards and Bell.

[10] Within each of these two categories, there are several proposals varying in detail. In this paper, only the general nature of the proposals is examined.

[11] In the accounting literature, there are alternative concepts of current value; for instance, replacement cost and net realizable value. Because of the particular assumptions adopted in the economic model, the various concepts of current value are not distinguished in this paper.

[12] For a discussion of these alternative views and their origins, see Gynther [1967].

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This interpretation of economic profit is also similar to the proposals of other advocates of alternative 1. such as Baxter [1967], Chambers [1965 and 1967],[13] and Sprouse and Moonitz [1963]. But as is usual in accounting measurement, these writers do not consider the opportunity cost of funds. If imputed interest is included in these proposals, the accounting measures would be the same as economic profit, with the exception that most of the advocates of alternative 1. suggest that there is some average value for g which is appropriate to all investors (*e.g.* a consumer price index), whereas, if the above argument about the improbability of a unique measure of stockholder purchasing power for every individual stockholder is accepted, a separate measure of economic profit would be required for each investor. The final profit number, P_j, would be the same in every case, but the separate components of g and ρ for each individual would differ, with the combination of these two variables satisfying equation (17) and the unique market determined value for r.

It may be observed from these comments that it is the dichotomy of r into g and ρ elements which gives rise to an indeterminate profit measure. Accordingly, it would appear wise to include the monetary market interest rate, r, in the economic profit calculation, as in equation 16 rather than to split the g and ρ elements in equation (18). But, if imputed interest is to be ignored on the grounds that a user of the profit measure can take implicit account of the interest cost, it would seem logical to ignore both elements of r; *i.e.*, both the real interest charge and the purchasing power adjustment. However, if accounting alternative 1. is eventually selected it should be recognized that the purchasing power adjustment represent only an average adjustment and may not be appropriate for every investor.

Not all writers in the accounting literature on this subject would agree that g can be approximated by some average change in purchasing power. Some would argue that the general level of prices may be of interest to some "average" investor, but as the firm is a separate entity, consideration should be given to the purchasing power of the business. This interpretation accords with the entity view of the firm.

If, as holders of the entity view suggest, it is the change in the firm's purchasing power that is important, g should measure the proportional change in the prices of assets purchased by the firm. The adjustment for price changes included in economic profit, expressed by equation (18), may be rewritten as:

$$\begin{aligned}&\text{Adjustment for price changes}\\&=[q_jK(n)_j+aK(m)_j+p_jS_j+b_jS(x)_j]\\&\quad-[q_{j-1}K(n)_j+aK(m)_j+p_{j-1}S_j\\&\quad+b_{j-1}S(x)_j]-g[q_{j-1}K(n)_j+aK(m)_j\\&\quad+p_{j-1}S_j+b_{j-1}S(x)_j]\end{aligned}\tag{19}$$

If g is interpreted as the change in the prices of assets purchased by the firm, this adjustment for price changes will be zero. This follows from the discrete nature of the model; *i.e.*, price changes occur only at the beginning of each period. The first line of equation (19) represents the market value of assets held by the firm during the current period. The second line of the equation represents the market value of inherited assets at the end of the previous period and line three, a purchasing power adjustment applied to the value of those inherited assets. The assets used in the current period are those assets inherited from

[13] Chambers favors net realizable value, whereas the other references prefer current replacement costs.

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the previous period. Accordingly, equation (19) comprises a change in value arising from movements in the market prices of assets inherited from the previous period (line 1 less line 2) and a purchasing power adjustment applied to those inherited assets. If the purchasing power factor, g, reflects the change in the prices of all the assets held by the business, line 1 less line 2 will equal line 3 and the adjustment for price changes will be zero.[14] The remaining terms in equation (18) suggest a measure of profit which is similar to the "current value" profit—alternatve 2.—advocated by writers such as Mathews [1965 and 1967], Ross [1969] and others, who claim that profit should be calculated by comparing current values of inputs and outputs without the inclusion of holding gains.

It can be seen from the above that the concept of economic profit developed in this paper may be argued to be consistent with two alternative approaches to current value accounting. It can further be seen that the fundamental difference between those two accounting approaches flows from their underlying assumptions about the nature of the business enterprise; that is, according to whether the proprietory or entity viewpoint is accepted.

The distinction between these alternative interpretations of economic profit can be demonstrated by means of a numerical illustration.

Illustration

At the end of the previous period, *C* Incorporated held capital assets with a then-current value of $2000 and an inventory of raw materials of $500. All production is sold immediately on completion, and accordingly, there are no inventories of finished items. During the current period, the market rate of interest was 15½ percent and the prices of assets purchased by the company increased by 10 percent while the index of consumer prices rose by only 5 percent.

Table 2 illustrates the alternative interpretations of economic profit. During the period the sales at current prices amounted to $8800 and the current cost of the variable inputs (labor and raw materials) used in production was $4400. The company used up half its stock of capital assets during the period and maintained its physical inventory of raw materials. As prices of these assets increased by 10 percent, the current depreciation charge is ½ of $2000 (1+.10) =$1100. Current operating profit (*i.e.*, the difference between the sales proceeds and the productive input costs—$3300) is the same for each alternative.

The economic profit in column (1), computed from equation (16), is in accordance with the standard neoclassical theory. The total monetary holding gain is 10 percent of the capital assets and inventory inherited from the previous period: $2500 × 10 percent = $250. The current market interest rate of 15½ percent is used to compute the opportunity costs of funds: $2500 × 15½ percent = $387.50, and an economic profit of $3162.50 is reported for the period.

If all markets in which a firm is operating are perfect, the neoclassical economic model would suggest that the economic profit should be zero. The company would only be able to earn the normal market rate of return on its assets and such a return is included as a cost in

[14] If monetary assets are not included in the weighting of price changes in the calculation of g, a loss on monetary assets may remain in the profit calculation. But this loss will not be calculated in terms of the general price level; it will be measured by reference to the change in the business's purchasing power. This treatment of losses on monetary assets was supported by Gynther [1966].

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TABLE 2

C INCORPORATED—ALTERNATIVE MEASURES OF ECONOMIC PROFIT

	Economic Profit (Equation 16)		*Economic Profit (Equation 18)* *Proprietory View*		*Entity View*	
	(1)		(2)		(3)	
Sales		$8800.0		$8800.0		$8800.0
Less Variable inputs	$4400		$4400		$4400	
Depreciation	1100	5500.0	1100	5500.0	1100	5500.0
CURRENT OPERATING PROFIT		3300.0		3300.0		3300.0
Add Holding gain		250.0		125.0		—
ACCOUNTING PROFIT		3550.0		3425.0		3300.0
Less Opportunity cost of funds		387.5 (15½%)		262.5 (10%)		137.5 (5%)
ECONOMIC PROFIT		$3162.5		$3162.5		$3162.5

computing economic profit. However, in the economic model presented earlier in this paper the assumption of perfection in all markets was not made. The firm was assumed to be a price-taker in the market for its output and all factor prices were assumed exogenously determined. These assumptions do not rule out completely all barriers to market perfection and the possibility of monopoly rents. Accordingly, it is possible that a business, such as *C* Incorporated, operating under such a regime may earn a positive economic profit.

It will be observed that profit is identical in each of the three measures—only the components of the measures differ. The two alternative interpretations of the measure of economic profit defined in equation (18) (columns 2 and 3) follow from the extension of the neoclassical theory which was introduced in this paper. The market rate of interest is divided as in equation (17). If the proprietory view is accepted, there is strictly a different value of g (and hence ρ) for each stockholder. However, if it is accepted that the consumer price index may provide an approximate purchasing power adjustment for stockholders 5 percent can be used for g and from equation (17), 10 percent for ρ. The holding gain in column (2) of Table 2 (the proprietory view) is computed by deducting the purchasing power adjustment from the monetary holding gain—*i.e.* \$250 − (\$2500 × 5 percent) = \$125. The opportunity cost of funds is computed by applying the 10 percent interest rate to the price level adjusted value of assets inherited from the previous period—*i.e.* 10 percent × \$2500 (1 + .05) = \$262.50.

If the entity view is adopted, the market rate of interest must be divided in a different way. The purchasing power adjustment will relate to the goods and services normally purchased by the firm (in this case 10 percent, and the real cost of capital, ρ, will be 5 percent. As demonstrated earlier, there will now be no holding gains. The assets inherited from the previous period were valued at \$2500 and a monetary holding gain of \$250 arose, but this gain will be offset by the purchasing power adjustment of 10 percent × \$2500 = \$250. The opportunity cost of funds in real terms is now calculated on the revised value of inherited

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assets, 5 percent $\times$\$2500 (1+.10)= \$137.50.

Reporting Economic Profit

The above illustration demonstrates that no matter which interpretation of economic profit is adopted, the final profit number will be the same in each case. Accordingly, if a measure of economic profit is to be reported, it would appear most satisfactory to avoid the difficulties of spliting the market interest rate into the purchasing power and real interest rate elements by reporting the measure of economic profit defined in equation (16) and illustrated in column (1) of Table 2. Such a measure is consistent with neoclassical economic theory and does not depend on the extension introduced in this paper. However, that extension does provide some insights into the relationship of economic profit and accounting measures.

It may be argued that the interest element of the profit calculation is not necessary for an *ex post* financial report because the user can make his own adjustment. The above illustration suggests that the nature of the interest adjustment will depend on the particular profit measure reported and, accordingly, misunderstanding might arise if adjustments are left to individual users. As already suggested, if interest is omitted, it would seem logical also to omit purchasing power adjustments. Thus, an accounting measure which comprises current operating profit and monetary holding gains would appear to merit serious consideration, *i.e.*, \$3550 in the above illustration.[15] The statement user then could make an adjustment for the cost of funds at the market interest rate which could be split in any manner consistent with his perceptions of the business. But this still presents the problem that the user may not make proper adjustment.

Market Values as Opportunity Costs

The model presented in this paper started with the objective of the firm traditionally assumed in the finance literature, *i.e.*, the maximization of the present value of future net receipts. It is demonstrated in the appendix that profit maximization can be consistent with such an objective. However, a number of simplifying assumptions were made.

There was no restriction in the model on the firm's ability to move to the optimum level of production, thus, the firm could move instantaneously and costlessly to any output/input plan. The only costs which will be incurred are the market prices for the inputs. Furthermore, the firm can sell any surplus stocks of inputs at the prevailing market price. The result of these assumptions is that market values are appropriate measures of opportunity costs which decompose the multiperiod wealth maximization problem into a series of single period profit maximization problems. However, if a firm experiences adjustment lags or is required to pay adjustment costs, such as training costs for new personnel or installation costs for new machines, the market values of inputs may not be appropriate for the measurement of economic profit. In such circumstances, the opportunity costs would have to be determined and the appropriate values used in the calculation of economic profit. If it is desired to continue to use only market values, the measurement periods cannot be regarded as independent and the traditional wealth maximization model must be used.

The alternative accounting measures of profit discussed above also use market values and are open to the same criticism,

[15] This proposal avoids the practical difficulties of splitting a market interest rate as indicated in footnote 9 above.

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i.e., market value may not be a good measure of opportunity cost. Whether market values are appropriate in such circumstances is an empirical question which is yet to be answered. The development of a measure of economic profit, which includes such opportunity costs, will be an extensive task, but research in that direction would appear essential to the understanding of the nature of profit. Furthermore, such research may be considered worthwhile in view of the general nature of the measure of economic profit developed in this paper.

When the certainty assumption is relaxed it will be necessary to form expectations about the net receipts to be received in all future periods in any calculation of economic wealth or income. (In practice, it would be sufficient to look to some planning horizon of, say, 10 to 20 years). But to measure economic profit, expectations need only be formed about the forthcoming period, provided the interdependences between periods are not too great and the depreciation rate for capital assets is known. In pursuing a profit maximization policy, a manager will not need the detailed information about the future which would be required for wealth maximization. Hence, it would appear that economic profit will be a useful concept in an uncertain world. But to explore this extension, the model must be developed to include explicit recognition of uncertainty.

Conclusions

At the level of analysis adopted in this paper, the concept of economic profit appears to provide a potential measure for reporting business performance. As suggested in the paper, there are several potential uses for such a measure: for the business manager, for the investor, and for the regulatory agency. The purpose of the paper was to introduce the concept of economic profit and to explore its possible role in accounting debates.

It has been demonstrated that some accounting measures of income have similar characteristics to economic profit, at least in this simple model. Furthermore, it has been suggested that differences between the two accounting approaches to current value accounting, which were discussed, may be the result of different capital maintenance concepts which arise because of some disagreement about the nature of the business enterprise. A measure of financial performance similar to the proposals advanced by Edwards and Bell was derived. However, a change in the capital maintenance concept led to similarities with alternative accounting measures.

This preliminary exploration of the concept of economic profit indicates that its measurement is likely to be an easier task in the assumed setting than attempting to measure economic income. Thus, further research of the concept of economic profit is likely to be a worthwhile exercise. However, the value of this or any measure of financial performance will ultimately depend upon the usefulness of the measure in satisfying the information needs of user groups. In the last resort, that is an empirical question which must be researched. This paper has presented some steps along the path towards such research.

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Appendix

The Marginal Productivity Conditions for Maximization of Net Worth

The model of the firm used in this paper can be written as follows:

$$\text{Maximize} \quad W = \sum_{j=0}^{\infty} \frac{R_j}{(1+r)^j} \tag{A.1}$$

Subject to:

$$R_j = p_j\bar{Q}_j - w_jL_j - b_j\bar{X}_j - q_jI(n)_j - aI(m)_j, \tag{A.2}$$

$$Q_j = F[L_j, X_j, K(n)_j, K(m)_j, S_j, S(x)_j] \tag{A.3}$$

$$Q_j - \bar{Q}_j = S_{j+1} - S_j, \tag{A.4}$$

$$\bar{X}_j - X_j = S(x)_{j+1} - S(x)_j, \tag{A.5}$$

$$K(m)_{j+1} - K(m)_j = I(m)_j - D(m)K(m)_j, \tag{A.6}$$

$$K(n)_{j+1} - K(n)_j = I(n)_j - D(n)K(n)_j. \tag{A.7}$$

It is assumed that all receipts and payments occur at the end of the period in which they arise. Equation (A.1) can be expanded in the following way:

$$W = R_0 + \frac{R_1}{(1+r)} + \frac{R_2}{(1+r)^2} + \cdots \frac{R_{j-1}}{(1+r)^{j-1}} + \frac{R_j}{(1+r)^j} + \cdots \tag{A.8}$$

Two terms from the expansion can be selected, say R_{j-1} and R_j, and if we multiply through by $(1+r)^j$ we find that:

$$W(1+r)^j = \cdots + (1+r)R_{j-1} + R_j + \cdots \tag{A.9}$$

Equations (A.2) through (A.7) can be used to replace the terms in R in this expression, for instance:

$$\begin{aligned} R_j = {} & p_jF[L_j, X_j, K(n)_j, K(m)_j, S_j, S(x)_j] - p_j[S_{j+1} - S_j] - w_jL_j \\ & - b_j[X_j + S(x)_{j+1} - S(x)_j] - q_j[K(n)_{j+1} - K(n)_j + D(n)K(n)_j] \\ & - a[K(m)_{j+1} - K(m)_j + D(m)K(m)_j]. \end{aligned} \tag{A.10}$$

Using this expression we can substitute for both R_{j-1} and R_j in equation (A.9). Thus:

$$\begin{aligned} W(1+r)^j = {} & \cdots + (1+r)\{p_{j-1}F[L_{j-1}, X_{j-1}, K(n)_{j-1}, K(m)_{j-1}, S_{j-1}, S(x)_{j-1}] \\ & - p_{j-1}[S_j - S_{j-1}] - w_{j-1}L_{j-1} - b_{j-1}[X_{j-1} + S(x)_j - S(x)_{j-1}] \\ & - q_{j-1}[K(n)_j - K(n)_{j-1} + D(n)K(n)_{j-1}] - a[K(m)_j - K(m)_{j-1} \\ & + D(m)K(m)_{j-1}]\} \\ & + p_jF[L_j, X_j, K(n)_j, K(m)_j, S_j, S(x)_j] - p_j[S_{j+1} - S_j] - w_jL_j \\ & - b_j[X_j + S(x)_{j+1} - S(x)_j] - q_j[Kn)_{j+1} - K(n)_j + D(n)K(n)_j] \\ & - a[K(m)_{j+1} - K(m)_j + D(m)K(m)_j] + \cdots \end{aligned} \tag{A.11}$$

To maximize this expression the partial derivatives with respect to each of the operational variables must be set equal to zero; thus, we shall take partial derivatives with respect to L_j, X_j, $K(n)_j$, $K(m)_j$, S_j and $S(x)_j$. It can be seen by inspection that only the

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part of the expansion given in equation (A.11) will contain these terms. Consider first the labor input variable, L_j.

$$\frac{\partial W(1+r)^j}{\partial L_j} = p_j \frac{\partial F}{\partial L_j} - w_j = 0, \tag{A.12}$$

i.e., the marginal product of labor can be expressed as:

$$\frac{\partial F}{\partial L_j} = \frac{w_j}{p_j} \tag{A.13}$$

and the value of the marginal product of labor, which can be called c^i,

$$p_j \frac{\partial F}{\partial L_j} = w_j = c_j^i. \tag{A.14}$$

(This is shown as equation (8) in the paper). The marginal product is multiplied by the selling price of output because the firm is assumed to be a price-taker and cannot by its own action influence the market price of its output.

The value of the marginal product of the raw material input, c_j^{ii} is similarly determined, thus:

$$p_j \frac{\partial F}{\partial X_j} = b_j = c_j^{ii} \tag{A.15}$$

(Equation nine in the paper.)

The calculation of the marginal product of non-monetary capital assets is only slightly more complex. Taking the partial derivative of equation (A.11) with respect to $K(n)_j$, it follows that:

$$\frac{\partial W(1+r)^j}{\partial K(n)_j} = -(1+r)q_{j-1} + p_j \frac{\partial F}{\partial K(n)_j} + q_j - q_j D(n) = 0. \tag{A.16}$$

The marginal product of non-monetary capital can be determined by a rearrangement of this expression:

$$\frac{\partial F}{\partial K(n)_j} = \frac{1}{p_j}\{(1+r)q_{j-1} - q_j[1 - D(n)]\} \tag{A.17}$$

The value of the marginal products of non-monetary capital service, c_j^{iii} (Equation (10) in the paper) is given as:

$$p_j \frac{\partial F}{\partial K(n)_j} = (1+r)q_{j-1} - q_j[1 - D(n)] = c_j^{iii} \tag{A.18}$$

The values of the marginal products of the remaining operational variables are determined in the same way. Hence,

$$p_j \frac{\partial F}{\partial K(m)_j} = (1+r)a - a[1 - D(m)] = c_j^{iv} \tag{A.19}$$

$$p_j \frac{\partial F}{\partial S_j} = (1+r)p_{j-1} - p_j = c_j^{v} \tag{A.20}$$

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$$p_j \frac{\partial F}{\partial S(x)_j} = (1 + r)b_{j-1} - b_j = c_j^{vi} \tag{A.21}$$

(These terms are given in equations (11) through (13) in the paper.)

Numerical Illustration

The nature of the wealth maximization problem can be illustrated by means of a numerical example in which the figures have been kept as simple as possible. It is assumed that no inventories are maintained and no monetary assets are required. The non-monetary capital assets needed for the first period's operations must be acquired prior to the commencement of the period. Accordingly, an outlay of q_0K_1 will be deemed to have occurred at time 0. (The n notation used earlier to distinguish non-monetary from monetary capital assets will be dropped for the purpose of this illustration). In this simplified model the wealth of the business can be expressed as follows:

$$W = -q_0K_1 + \frac{p_1Q_1 - w_1L_1 - q_1(K_2 - K_1 + DK_1)}{(1+r)} + \frac{p_2Q_2 - w_2L_2 - q_2(K_3 - K_2 + DK_2)}{(1+r)^2}$$
$$+ \frac{p_3Q_3 - w_3L_3 - q_3(K_4 - K_3 + DK_3)}{(1+r)^3} + \cdots. \tag{A.22}$$

For purposes of this model the L_j's and K_j's represent the choice variables. The price variables are given exogenously and set out in Table 3.

TABLE 3

PRICE VARIABLES

j =	0	1	2	3
	$	$	$	$
p_j		10	14	12
w_j		5	5	6
q_j	90.91	100	100	120

The money rate of time discount, r, will be assumed to be 10 percent per period and the rate of depreciation 25 percent. A very simple production function of the form $Q_j = 10L_j^{\frac{1}{2}} + 10K_j^{\frac{1}{2}}$ will be assumed.[16]

The objective of the business may now be expressed as follows:

$$\text{Maximize } W = -90.91K_1 + \frac{10(10L_1^{\frac{1}{2}} + 10K_1^{\frac{1}{2}}) - 5L_1 - 100(K_2 - K_1 + .25K_1)}{1.1}$$
$$+ \frac{14(10L_2^{\frac{1}{2}} + 10K_2^{\frac{1}{2}}) - 5L_2 - 100(K_3 - K_2 + .25K_2)}{(1.1)^2}$$
$$+ \frac{12(10L_3^{\frac{1}{2}} + 10K_3^{\frac{1}{2}}) - 6L_3 - 120(K_4 - K_3 + .25K_3)}{(1{\cdot}1)^3} + \cdots.$$

[16] This very simple and probably unrealistic production function has been used to simplify presentation. However, any production functions which meets the criteria set out in this paper could be used.

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This decision problem can be solved sequentially by examining each of the choice variables in turn. Starting with period 1, the optimal values for L_1 and K_1 can be selected by the procedure outlined above.

$$\frac{\partial W}{\partial L_1} = 1.1^{-1}(50L_1^{-\frac{1}{2}} - 5) = 0,$$

$$\text{i.e., } L_1^{\frac{1}{2}} = 10 \quad \text{and} \quad \underline{L_1 = 100}$$

$$\frac{\partial W}{\partial K_1} = -90.91 + 1.1^{-1}(50K_1^{-\frac{1}{2}} + 100 - 25) = 0$$

$$\text{i.e., } K_1^{\frac{1}{2}} = 2 \quad \text{and} \quad \underline{K_1 = 4}$$

Thus, in period 1, 100 units of labor and 4 units of non-monetary capital assets should be used. This will yield an output (and sales) of $10(100^{\frac{1}{2}}+4^{\frac{1}{2}})=120$ units and a sales revenue of $\$10 \times 120 = \$1200$.

The output for period 2 can be computed as follows:

$$\frac{\partial W}{\partial L_2} = 1.1^{-2}(70L_2^{-\frac{1}{2}} - 5) = 0,$$

$$\text{i.e., } L_2^{\frac{1}{2}} = 14 \quad \text{and} \quad \underline{L_2 = 196}$$

$$\frac{\partial W}{\partial K_2} = -(1.1)^{-1}100 + 1.1^{-2}(70K_2^{-\frac{1}{2}} + 100 - 25) = 0,$$

$$\text{i.e., } K_2^{\frac{1}{2}} = 2 \quad \text{and} \quad \underline{K_2 = 4}$$

These 196 units of labor and 4 units of capital will yield an output of $10(196^{\frac{1}{2}}+4^{\frac{1}{2}})=160$ units and sales revenue of $160 \times \$14 = \$2240$.

The labor and capital for Period 3 can be similarly determined to be 100 units and 9 units respectively. This represents output of 130 units and sales revenue of $1560. The model could be continued into future periods and the production plans determined for each and every period.

The Marginal Productivity Conditions for Maximization of Profit

The definition of profit, P_j, was given in the text of this paper by equation 15 as:

$$P_j = p_jQ_j - w_jL_j - b_jX_j - \{(1+r)q_{j-1} - q_j[1-D(n)]\}K(n)_j$$
$$- \{(1+r)a - a[1-D(m)]\}K(m)_j - \{(1+r)p_{j-1} - p_j\}S_j - \{(1+r)b_{j-1} - b_j\}S(x)_j \quad \text{(A.24)}$$

To maximize profit the partial derivatives with respect to each operational variable must be set equal to zero. But the maximization is constrained by the production function; thus, the maximization problem must be written:

$$\text{Maximize } P_j = p_jF[L_j, X_j, K(n)_j, K(m)_j, S_j, S(x)_j] - w_jL_j - b_jX_j$$
$$- \{(1+r)q_{j-1} - q_j[1-D(n)]\}K(n)_j - \{(1+r)a - a[1-D(m)]\}K(m)_j$$
$$- \{(1+r)p_{j-1} - p_j\}S_j - \{(1+r)b_{j-1} - b_j\}S(x)_j. \quad \text{(A.25)}$$

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The first order conditions for the maximization of this problem are identical to those derived from the earlier wealth maximization problem. For instance, taking derivatives with respect to L_j:

$$\frac{\partial P_j}{\partial L_j} = p_j \frac{\partial F}{\partial L_j} - w_j = 0$$

$$i.e., \frac{\partial F}{\partial L_j} = \frac{w_j}{p_j}. \tag{A.27}$$

This is identical to the marginal product of labor derived earlier in equation (A.13). Similarly, taking derivatives with respect to $K(n)_j$:

$$\frac{\partial P_j}{\partial K(n)_j} = p_j \frac{\partial F}{\partial K(n)_j} - \{(1 + r)q_{j-1} - q_j[1 - D(n)]\} = 0 \tag{A.28}$$

$$i.e., \frac{\partial F}{\partial K(n)_j} = \frac{1}{p_j}\{(1 + r)q_{j-1} - q_j[1 - D(n)]\} \tag{A.29}$$

This is identical to equation (A.17). The remaining first order conditions can be determined by taking partial derivatives with respect to each of the other operational variables and these can be seen to be identical to the corresponding conditions derived from the wealth maximization problem.

The numerical example presented above can be extended to illustrate the relationship between the wealth maximization and profit maximization models. The rearranged equation for economic profit (equation (16) in the text of this paper) will be used here, but in a simplified form containing only the variables needed for the example.

Thus, economic profit will be defined as:

$$P_j = p_jQ_j - w_jL_j - q_jDK_j - rq_{j-1}K_j + (q_j - q_{j-1})K_j \tag{A.30}$$

Now taking the objective of the business to be the maximization of economic profit in each period, the production plans can be derived as follows:

Period 1:

$$P_1 = 10(10L_1^{\frac{1}{2}} + 10K_1^{\frac{1}{2}}) - 5L_1 - 100(.25)K_1 - (.1)90.91K_1 + (100 - 90.91)K_1,$$

which simplifies to

$$P_1 = 100(L_1^{\frac{1}{2}} + K_1^{\frac{1}{2}}) - 5L_1 - 25K_1$$

Now,

$$\frac{\partial P_1}{\partial L_1} = 50L_1^{-\frac{1}{2}} - 5 - 0$$

$$i.e., L_1^{\frac{1}{2}} = 10 \quad \text{and} \quad \underline{L_1 = 100}$$

$$\frac{\partial P_1}{\partial K_1} = 50K_1^{-1} - 25 = 0$$

$$i.e., K_1^{\frac{1}{2}} = 2 \quad \text{and} \quad \underline{K_1 = 4}$$

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This solution is identical to the production plan determined from the wealth maximization model above.

Period 2:

$$P_2 = 14(10L_2^{\frac{1}{2}} + 10K_2^{\frac{1}{2}}) - 5L_2 - 100(.25)K_2 - (.1)100K_2 + (100 - 100)K_2$$

which simplifies to

$$P_2 = 140(L_2^{\frac{1}{2}} + K_2^{\frac{1}{2}}) - 5L_2 - 35K_3$$

Now,

$$\frac{\partial P_2}{\partial L_2} = 70L_2^{-\frac{1}{2}} - 5 = 0$$

$$\text{i.e., } L_2^{\frac{1}{2}} = 14 \quad \text{and} \quad \underline{L_2 = 196}$$

$$\frac{\partial P_1}{\partial K_2} = 70K_2^{-\frac{1}{2}} - 35 = 0,$$

$$\text{i.e., } K_2^{\frac{1}{2}} = 2 \quad \text{and} \quad \underline{K_2 = 4}$$

Once again, this production plan is identical to the plan derived earlier.

Period 3:

The same approach can be adopted in this period and a plan of 100 units of labor and 9 units of capital (as derived from the wealth maximization model) will be obtained.

The above example illustrates that in the circumstances of the model used in this paper, wealth maximizing production decisions can be obtained from a policy of maximizing economic profit in each period.

REFERENCES

Baxter, W. T., "General or Specific Index? Capital Maintenance under Changing Prices," *Journal U.E.C.* (July 1967), pp. 172–181.

Chambers, R. J., "The Price Level Problem and Some Intellectual Grooves," *Journal of Accounting Research*, (Autumn 1965), pp. 242–252.

———, "Price Variation Accounting—An Improved Representation," *Journal of Accounting Research*, (Autumn 1967), pp. 215–220.

Edwards, E. O. and P. W. Bell, *The Theory and Measurement of Business Income*, (The University of California Press, 1961).

Fisher, I., *The Theory of Interest* (Macmillan, 1930).

Gynther, R. S., "Accounting Concepts and Behavioral Hypotheses," THE ACCOUNTING REVIEW (April 1967), pp. 274–290.

———, *Accounting for Price-Level Changes: Theory and Procedures* (Pergamon, 1966).

Hicks, J. R., *Value and Capital* (Clarendon Press, 1946).

Jorgenson, D. W., "Capital Theory and Investment Behavior," *American Economic Review*, Papers and Proceedings (May 1963), pp. 247–257.

———, "Anticipation and Investment Behavior," in *The Brookings Quarterly Economic Model of the United States*, eds. J. S. Duesenberry, *et al.* (1965), pp. 35–92.

———, "Theory of Investment Behavior," in *Determinants of Investment Behavior*, Universities National Bureau Conference Series No. 18 (1967), pp. 129–155.

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Malinvaud, E., *Lectures on Microeconomic Theory* (North-Holland, 1972).
Mathews, R. L., "Price Level Changes and Useless Information," *Journal of Accounting Research*, (Spring 1965), pp. 133–155.
———, "Price-Level Controversy: A Reply," *Journal of Accounting Research* (Spring 1967), pp. 113–118.
Miller, R. F., "Theory of Investment Behavior and Comments," in *Determinants of Investment Behavior*, Universities National Conference Series No. 18 (1967), pp. 162–169.
Revsine, L., "On the Correspondence between Replacement Cost Income and Economic Income," THE ACCOUNTING REVIEW, (July 1970), pp. 513–523.
———, *Replacement Cost Accounting* (Prentice-Hall, 1973).
Roll, R., "Interest Rates on Monetary Assets and Commodity Price Index Changes," *Journal of Finance* (May 1972), pp. 251–277.
Ross, H., *Financial Statements: A Crusade for Current Values* (Pitman, 1969).
Shwayder, K., "A Critique of Economic Income as an Accounting Concept," *Abacus* (August 1967), pp. 23–35.
Solomons, D., "Economic and Accounting Concepts of Income," THE ACCOUNTING REVIEW, (1961), pp. 374–383.
———, *Divisional Performance: Measurement and Control* (Irwin, 1965).
Sprouse, R. T. and M. Moonitz, "A Tentative Set of Broad Accounting Principles for Business Enterprises," *Accounting Research Study No. 3*, American Institute of Certified Public Accountants (1963).
Tomkins, C., *Financial Planning in Divisionalized Companies* (Haymarket, 1973).

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