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Jeffrey E. Jarrett
University of Rhode Island, jejarrett133@gmail.com

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A NOTE ON INVESTMENT CRITERIA AND THE ESTIMATION PROBLEM IN FINANCIAL ACCOUNTING

Jeffrey E. Jarrett*

In previous papers, the allocation problem in financial problems was restructured to place it in context of a general estimation problem for both the single and multi-asset case (1, 2, 3, 5). The aim of this effort was to create a new emphasis and direction in the various accounting methods concerning the jointness of costs and revenues over time. This new direction permitted an examination of the similarity of the "matching" principle and the "realization" postulate (4). Also, the estimation problem permitted an understanding of the bias resulting from adjusting asset values for changes in the general price level for goods and services (6).

In another paper the author explored both the conceptual problem and the effects of using accounting information to estimate the cost of capital for the division of a firm (7). The conclusion was that the allocation of costs will affect the estimate of the cost of capital. The purpose of this note is to show in the absence of perfect capital markets the usefulness of accounting data in project evaluation. In particular, there is concentration on the criteria of *net present value* and *net future value* in project evaluation. Furthermore, this note is consistent with the notions of Pazner and Raxin who concluded that these criteria do not necessarily lead to identical results (8).

Estimation Model-Imperfect Capital Markets

In the presence of perfect capital markets, it does not matter from the viewpoint of project evaluation whether the investor is guided by the net present value criterion or net future value criterion. Both selection criteria obviously lead to identical rankings or projects. However, in the absence of perfect capital markets (or if the discount rate is uncertain), the equivalence of the two criteria no longer holds.

In determining the effect on estimating internal rates by accounting (book) rates, it is useful to define these two criteria. Consider a standard asset (project) purchase model where the cost of the asset, C, is the expected or net present value of cash flows denoted by r_t, $t = 1,2,\ldots$. T is the terminal date of the asset. If the discount rate (cost-of-capital), d, used in the discount of x_t, cash flow is random, the cost of the asset by the net (expected) present value (EPV) criterion is

$$C = E \sum_{t=1}^{T} \prod_{i=1}^{t} \frac{1}{1+d_i} X_t \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

*The author is Professor in the Department of Management Science at the University of Rhode Island. *(Paper received April 1979)*

and d is the expectation of d_i. Using the net (expected) future value (EFV) criterion, the cost of an asset will be

$$C = E \sum_{t=1}^{T} \prod_{i=1}^{t} (1+d_i) \; x_t \quad \ldots \ldots \ldots \ldots \quad (2)$$

According to either the net present value or net future value criteria, the asset is purchased whenever the purchase price of the asset is no more than either the expected present value or the expected future value respectively. In the deterministic setting there is an equivalence between the two criteria, that is, a project is worth undertaking under either criterion, if and only if, it is worthwhile undertaking under the other. In other words, the present and future value criteria leads to identical rankings of investment projects. In the face of uncertainty, i.e. the discount rate (cost-of-capital), this equivalence no longer holds and the two criteria may lead to inconsistent rankings.

Since the two criteria are equally plausible on a priori grounds and as they provide different ranking of investment prospects, the questions arise as to what is a proper criterion. Our purpose here is not to solve the problem of which criterion is more appropriate, but to indicate how accounting information can be used to aid in the solution of decision problems using either criteria. Thus, the solution can now be found for the allocation scheme p_i depending on whether the firm uses EPV or EFV as the project (asset) purchase criterion under the assumptions of imperfect capital markets and an uncertain future.

Case I: EPV as the Selection Criterion

Consider the standard asset purchase model where the cost (purchase price) of the asset, C, is the EPV of cash flows. The overall (book) rate of return may now be redefined to be

$$b = \frac{\sum_{i=1}^{n} x_i - C}{\sum_{i=1}^{n} V_i} \quad \ldots \ldots \ldots \ldots \quad (3)$$

where x_i is cash flow, a random variable, C is the initial cost of an asset, and V_i is defined by

$$V_i = \sum_{i=1}^{n} x_i \; (1+d)^{-(t-i+1)} \quad \ldots \ldots \ldots \ldots \quad (4)$$

where d is the IRR or the discount rate equating C, the cost of the asset, and V_i. Also, V_i is the present discounted cash flows in period i. By applying estimation theory the book value of the asset in all periods can be redefined by the expression

$$E(V_i) \doteq C_i - \sum_{t=1}^{i=1} p_i C \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

At the beginning of period 1, $C = E(V_1)$ where $E(V_1)$ is the EPV. The interim (book) rate of return is now defined as

$$r_i \doteq \frac{x_i - p_i C}{E(V_1)} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

and is reported by the accountant.

The allocation scheme that satisfies this criterion of minimizing estimation error subject to

$\sum_{i=1}^{n} p_i = 1$ and $p_i \geqslant 0$ is

$$p_i \doteq \frac{E(x_i)}{C} - \frac{E^{-1}(1/E(V_i))}{\sum_{i=1}^{n} E^{-1}(1/E(V_i))} \sum_{i=1}^{n} \frac{E(x_i)}{C} - 1 \quad \ldots \quad (7)$$

Since $C = E(V_1)$, the allocation scheme for period 1 is

$$p_1 \doteq \frac{E(x_1)}{C} - \frac{C}{\sum_{i=1}^{n} E^{-1}(1/E(V_i))} \sum_{i=1}^{n} \frac{E(x_1)}{C} - 1 \quad \ldots \quad (8)$$

The cost of the asset, C, may now be evaluated by solving (1) as follows; for simplicity it will be assumed that the terminal date of the asset, T, is 2, hence

$$C = E(x_1)/(1+d) + E(x_2)/(1+d)^2 \quad \ldots\ldots\ldots\ldots \quad (9)$$

whenever cash is received at the beginning of the period. By substituting (9) in (7), the problem of allocating costs to period 1 is solved as follows:

$$p_1 \doteq \frac{E(x_1)}{\frac{E(x_1)}{1+d} + \frac{E(x_2)}{(1+d)^2}} - \frac{E(x_1)+E(x_2)}{\sum_{i=1}^{2} E^{-1}(1/E(V_i))} - 1 \quad (10)$$

In expectation, this allocation scheme will lead to the equating of the internal rate of return with the period and overal (book) rate from accounting data.

Case II: EFV as Selection Criterion

Using EFV as the selection criterion for purchasing assets, the cost of an asset with a two year life (T = 2) is

$$C = E(x_1)(1+d) + E(x_2)(1+d)^2 \quad \ldots\ldots\ldots\ldots \quad (11)$$

By substituting (11) in (7), the allocation scheme for period 1 is

$$p_1 \doteq \frac{E(x_1)}{E(x_1)(1+d) + E(x_2)(1+d)^2} - \frac{E(x_1) + E(x_2)}{\sum_{i=1}^{2} E^{-1}\,(1/E(V_i))} - 1 \quad \ldots \quad (12)$$

The allocation scheme defined by (12) in expectation differs from that defined by (10). The rates of return are thus different using EFV as a selection criteria rather than EPV.

Conclusions and Implications

Whenever capital markets are imperfect and the discount rate is uncertain, the estimation model will determine the allocation scheme that equates book and internal rates. In this instance, the allocation scheme depends on the particular criterion used to determine asset purchase (investment) decisions by the firm. Thus, accountants should understand that their allocation scheme determines the usefulness of information contained in interim reports.

Those who interpret and use accounting information must recognize the relationship or rates of return and criteria for ranking investment proposals. The matching of revenues and costs is dependent upon the allocation scheme resulting from implementation of the estimation model. Allocation schemes will vary depending on whether EPV or EFV is the criteria for determining asset purchase decisions. Finally, this result is both consistent with financial economic theory and estimation theory as it applies in financial accounting.

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