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Accounting Rates of Return: Comment

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The appropriateness of using the accounting rate of return (hereafter *ARR*) as an economic rate of return concept instead of the internal rate of return (*IRR*) has long been questioned, most recently and forcefully by Franklin Fisher and John McGowan (1983). In a recent article in this journal Gerald Salamon (1985) addresses this question. For a sample of 197 firms for the 1974–78 period he calculates a conditional internal rate of return (hereafter *CIRR*), subject to less measurement error vis-à-vis the *IRR* then the *ARR*, starting from the cash recovery rate[1] (hereafter *CRR*). *CRR* is defined as the ratio of the firm's cash recoveries in a period to the gross historical cost of investments outstanding during that period. Salamon derives the following analytical relationship between the *CRR* and *CIRR*, conditional on a number of general assumptions:

$$(1)\quad CRR = CIRR/\left[1-(1+CIRR)^{-n}\right],$$

in which n is the useful life of the assets in question in years.

The *CRR*, and given (1) the *CIRR*, is readily calculated from the published financial statements of the 197 firms, as is of course the *ARR*. Salamon then compares the use of the *CIRR* with that of the *ARR* in a typical example of an economic study in which the *ARR* is frequently used: the relation between firm size and profitability. His empirical results reveal that there is no significant effect of firm size on the *CIRR*. Salamon traces his result largely to the effect of differences in depreciation methods between firms of different size. Larger firms often choose accelerated depreciation methods, which leads to systematic errors when measuring the *ARR*.[2] Salamon's results seem to undermine a substantial body of empirical work, while at the same time suggesting a methodology for investigating the usefulness of the *ARR* in various other empirical settings.

Of course, in order to use (1) n has to be estimated. Salamon obtains an estimate $\tilde{n}$, for each year, by dividing annual depreciation expense into gross investment. Unfortunately, this, as will be shown, may lead to an underestimation of n, precisely because of the argument used above against the *ARR*. The underestimation of n in turn leads to an underestimation of the *CIRR*, as $\partial CRR/\partial CIRR > 0$ and $\partial CRR/\partial n < 0$, for the larger firms in Salamon's sample to the extent that they do indeed, as he argues, use accelerated depreciation methods. Evidently this would affect his estimation of the relation between *CIRR* and firm size.

The effect of depreciation method on $\tilde{n}$ and *CIRR* can be analyzed as follows. When g is the growth rate of gross investment, and the investment at the beginning of year $t-n$ is 1 unit of money, gross investment at the beginning of year t is

$$(2)\qquad I_t = \left[(1+g)^n - 1\right]/g.$$

Depreciation in year t is

$$(3)\quad d_t = \delta_1(1+g)^{n-1} + \delta_2(1+g)^{n-2} + \cdots + \delta_n,$$

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[1]Advocated earlier by Yuji Ijiri (1979) and Salamon (1982).

[2]It can easily be proved that, *ceteris paribus*, accelerated depreciation methods lead to a lower *ARR* when the growth rate g exceeds the *IRR*, a situation which is supposed to prevail for large mature firms (Fisher and McGowan, 1983, p. 86).

TABLE 1—DEPRECIATION METHOD (*SYD* AND *DDB*) AND BIAS IN ESTIMATED USEFUL LIFE, $\tilde{n}$, AND *CIRR* (*IRR* = .06)

n	g	CRR	$\tilde{n}_{SYD}$	$CIRR_{SYD}$	$\tilde{n}_{DDB}$	$CIRR_{DDB}$
15	.00	.10296	15	.06000	15	.06000
15	.03	.10296	14.03	.05322	14.38	.05580
15	.06	.10296	13.22	.04651	13.78	.05126
15	.09	.10296	12.55	.04010	13.22	.04651
20	.00	.08718	20	.06000	20	.06000
20	.03	.08718	18.30	.05371	18.96	.05634
20	.06	.08718	16.94	.04739	17.94	.05217
20	.09	.08718	15.87	.04135	17.01	.04775

where δ_i is the depreciation rate for an i years old asset, and $\Sigma\delta_i = 1$. Thus, assuming all assets are depreciable, $\tilde{n} = I_t/d_t$. The effect of three depreciation methods will be considered: straight line (SL), sum-of-the-years' digits (SYD) and double-declining balance (DDB).

It can easily be seen that for $g = 0$, $n = \tilde{n}_{SL} = \tilde{n}_{SYD} = \tilde{n}_{DDB}$. But when $g > 0$ this is not necessarily the case.

For SL it is still true that,

$$(4) \qquad \delta_i = 1/n \qquad (i = 1,\dots,n)$$

and

$$(5) \qquad \tilde{n}_{SL} = n.$$

However, for SYD,

$$(6) \qquad \delta_i = [2(n-i+1)]/[n(n+1)] \qquad (i = 1,\dots,n)$$

and

$$(7) \qquad \tilde{n}_{SYD} = \frac{\left((1+g)^n - 1\right)gn(n+1)}{2\left(1 + (ng-1)(1+g)^n\right)}.$$

While for DDB,

$$(8) \qquad \delta_i = (2/n)(1-2/n)^{i-1} \qquad (i < n),$$

$$(9) \qquad \delta_n = (1-2/n)^{n-1},$$

and

$$(10) \qquad \tilde{n}_{DDB} = \frac{\left((1+g)^n - 1\right)(ng+2)}{g\left[2(1+g)^n + g(n-2)(1-2/n)^{n-1}\right]}.$$

From (7) and (10) it follows that the bias in $\tilde{n}$ in these cases depends on the values of n and g. Note that, knowing g, $\tilde{n}$, and the depreciation policy of the firm, (7) or (10) could be used to determine n in empirical work.

The effect of the bias in $\tilde{n}$ can be assessed from Table 1 for an asset yielding a constant annuity with an IRR of 6 percent, using (7) or (10), and (1). Table 1 shows that the bias in $\tilde{n}$ can be severe, moreover leading to substantial differences between the IRR and the $CIRR$.[3]

Suppose, as Salamon argues, that larger firms often use more accelerated depreciation methods and that usually $g > 0$, then the way Salamon estimated useful life may be improved upon for these larger firms. Until then no firm conclusions regarding the relation between firm size and profitability measured by the $CIRR$ seem possible.

[3]Robert E. Jensen (1985) analyzes more systematically the robustness of the *CIRR* with regard to variations in n. He concludes that *CIRR* "...estimates may be highly sensitive to n-specification errors. This sensitivity is both asymmetric with the direction of the error and affected by the level of the cash recovery rate." (p. 24).

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