Internal rate of return estimation methods vs. accountant's rate of return revisited, a simulation evaluation

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Internal Rate of Return Estimation Methods vs. Accountant’s Rate of Return Revisited, A Simulation Approach

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EURO XVI
16th European Conference on Operational Research
Brussels, July 12-15, 1998
Why the subject is important

- Income (and profitability) measurement is the most central question of accounting theory.

- Information for practical decision making. Loan making decisions e.g. often use:
  - Information about the value of the firm
  - Information about the earnings potential of the firm. One essential source: past profitability of the firm.
Contributions

- Facilitating and performing a comparative evaluation of four long-run profitability estimation methods against the ideal benchmark: The true profitability of the firm
- An improved, realistic simulation approach by including business cycles and irregularities
- A practical long-run profitability method choice recommendation for the business community
The methods evaluated


- **Averaged Accountant’s Rate of Return.** No individual author.
Research Problem and Methodology

Research problem in general:
- To develop an objective and operational methodology for assessing the various long-run profitability (IRR) estimation methods presented in literature
- To use this methodology for finding out which of the methods works best both in practice and in theory

Evaluation with simulated financial statements:
- Evaluations using actual financial data from firms suffer from missing an objective profitability benchmark
- Results based on an analytic deduction are valid only under strict assumptions and have arrived at conflicting conclusions
Specific Research Questions

- Are the methods sensitive to business cycles in the capital investment activities?
- Are the methods sensitive to ordinary irregularities in the capital investments?
- Are the methods sensitive to the underlying, alternative cash contribution patterns and life-span of the firm’s capital investments?
- Are the methods sensitive to disparities between the firm’s growth and profitability?
Specific Research Questions, cont.

- Are the methods sensitive to the choice of depreciation that the firm has used in producing its financial statements?
- Are the methods sensitive to major capital investment shocks (peaks in the capital investment profiles)?
- Is it possible to find, on the basis of theoretical validity, numerical accuracy, and practical applicability, a method to be recommended?
The Simulation Model

\[ g_t = g_0 (1 + k)^t \cdot \{1 + A \sin[(2\pi t/C) + \phi]\} \cdot (1 + \sigma z) \cdot (1 + \delta_{t\tau} S) \]

- \( g_0 \): initial level of capital investments
- \( g_t \): capital investments in year \( t \)
- \( k \): growth rate
- \( A \): amplitude of the business cycle
- \( C \): length of the business cycle
- \( f \): technical phase adjustment for the business cycle
- \( \sigma \): the standard deviation of the random fluctuation in the capital expenditures
- \( z \): random variable following the \((0,1)\)-normal distribution
- \( S \): capital investment shock coefficient
- \( \tau \): the year of the capital investment shock (\( \tau = \infty \) for no shock in the simulation)
- \( \delta \): Kronecker's delta, \( \delta_{t\tau} = 1 \) when \( t = \tau \), and 0 otherwise

- trend
- business cycle
- noise
- shock
Summary of the results

- The methods of Kay, Ijiri-Salamon, and average ARR are not sensitive to cycles, and not overly sensitive to noise. Ruuhela’s method is strongly affected by both because of its strict constant-growth assumption.

- The contribution pattern of the capital investments affects the methods jointly with other factors. Ijiri-Salamon and Ruuhela also depend on the quality of the life-span estimate.
Summary of the results, continued

- Disparity between growth and profitability is the main factor affecting the quality of the estimates for all the methods. There is some tendency to exaggerate high profitability.

- The firm’s choice of the depreciation method affects the methods of Kay, Ijiri-Salamon, and the average ARR jointly with the other factors. Ruuhela’s method has the advantage of being independent of the depreciation choice.
Summary of the results, continued

- The methods of Kay, Ijiri-Salamon, and the average ARR have a high tolerance to major capital investment shocks. Ruuhela’s method practically fails under such shocks.

- In Kay's and the average ARR methods the main source of error is a discrepancy between growth and profitability. The direction and size of the error can be predicted. The error of the two other methods is markedly less predictable.
Conclusion

- Kay’s and Ruuhela’s methods have the best theoretical foundations. The assumptions in Kay’s method are less restrictive.

- Numerically the average ARR mostly does as well as Kay’s method. These both outperform the two other methods. For practical long-run profitability estimation, our recommendation is to use the averaged ARR, i.e. the average of Return on Total Assets over several years.
Visualization of Simulated Observations:
Negative Binomial Contribution Distribution,
Declining Balance Depreciation, Growth 8%, IRR 12%,
Amplitude 0.50, Noise 20%, No Shock
Visualization of Simulated Observations:
Negative Binomial Contribution, Declining Balance Depreciation,
Amplitude 0.50, Shock in Year 24, No Noise, Growth 8%, IRR 12%