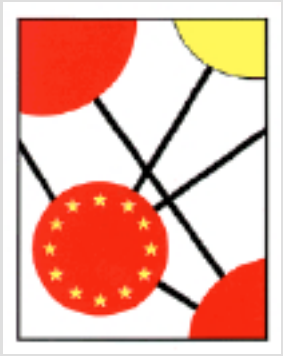

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Internal rate of return estimation methods vs. accountant's rate of return revisited, a simulation evaluation

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

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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 bench-mark: *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

- **Kay**, J.A. (1976), Accountants, too, could be happy in a golden age: the accountants rate of profit and the internal rate of return, Oxford Economic Papers (New Series) 28:3, 447-460.
- **Ijiri**, Y. (1979), Convergence of cash recovery rate, in: Quantitative Planning and Controlling. Essays in Honor of William Wager Cooper on the Occasion of His 65th Birthday (ed. Y. Ijiri and A.B. Whinston). Academic Press, New York, N.Y.

  Salamon, G.L. (1982), Cash recovery rates and measures of firm profitability, Accounting Review 57:2, 292-302.
- **Ruuhela**, R. (1972), Yrityksen kasvu ja kannattavuus (in Finnish, English summary: A capital investment model of the growth and profitability of the firm), Acta Academiae Helsingiensis, Series A:8, Helsinki.

  Salmi, T. (1982), Estimating the internal rate of return from published financial statements, Journal of Business Finance and Accounting 9:1, 63-74.
- **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

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

trend *business cycle* *noise* *shock*

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

σ = 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

τ = the year of the capital investment shock ($\tau = \infty$ for no shock in the simulation)

δ = Kronecker's delta, $\delta_{t\tau} = 1$ when $t = \tau$, and 0 otherwise

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

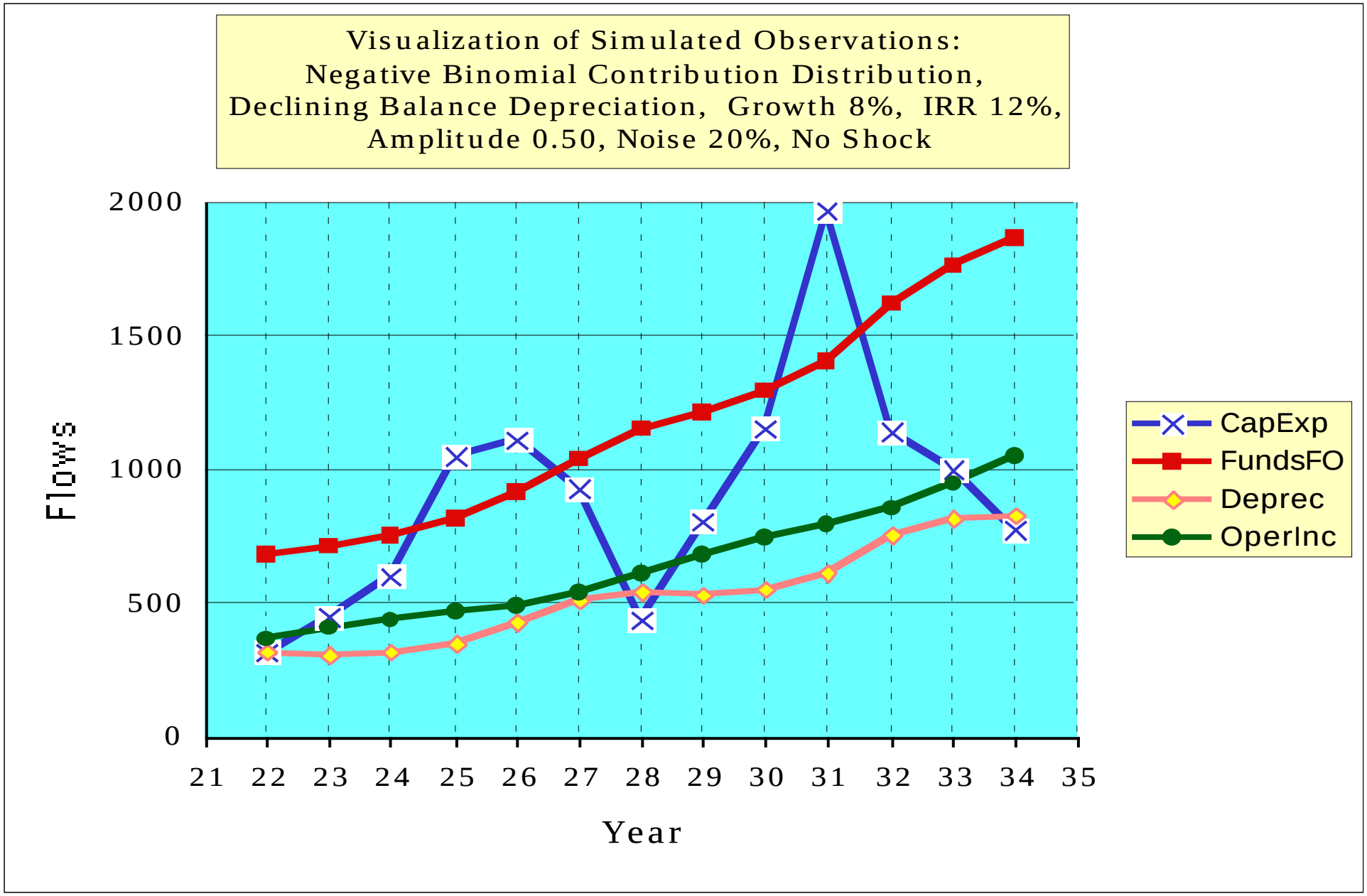
- Disparity between growth and profitability is the main factor affecting the quality of the estimates for all the methods. There is some tendency to exaggerate high profitability.
- The firm's choice of the depreciation method affects the methods of Kay, Ijiri-Salamon, and the average ARR jointly with the other factors. Ruuhela's method has the advantage of being independent of the depreciation choice.

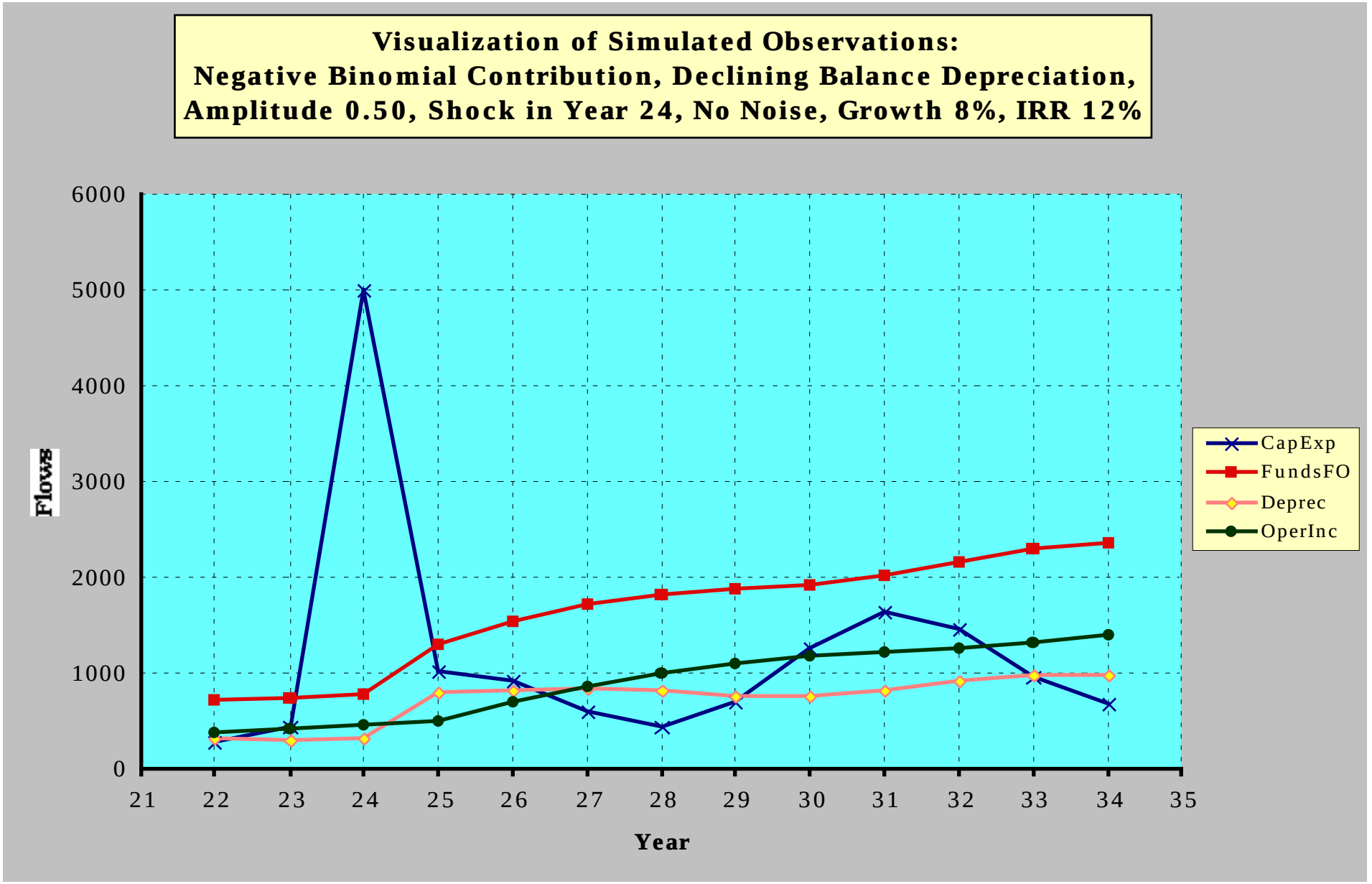
Summary of the results, continued

- 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
2000
1500
1000
500
0
Flows
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
Year
CapExp
FundsFO
Deprec
OperInc


Visualization of Simulated Observations:
Negative Binomial Contribution, Declining Balance Depreciation,
Amplitude 0.50, Shock in Year 24, No Noise, Growth 8%, IRR 12%
Flows
6000
5000
4000
3000
2000
1000
0
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
Year
CapExp
FundsFO
Deprec
OperInc