IRR AND MULTIPERIOD ROE

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1. Overview

Analysts examine summary measures of past performance such as ROE to assess a firm's track record. These traditional summary measures are distorted by non-recurring items and conservatism. To mitigate these problems, the spreadsheet develops the following summary measures:

- Internal rate of return (IRR): Our implementation of IRR assumes that the firm is bought at its book value at the beginning of the measurement period and is sold at its book value at the end of the measurement period. The buyer also receives the dividends during the holding period. If IRR exceeds cost of equity, the firm has generated shareholder value, and vice versa. The IRR computation assumes that had the dividends been reinvested during the measurement period, they would have continued to earn the internal rate of return.

- Multiperiod ROE: The ROE computations make the same assumptions as those for the IRR except that the ROE assumes that dividends reinvested in the firm during the measurement period earn the cost of equity instead of earning the IRR. Therefore, IRR equals ROE if and only if IRR equals cost of equity.

The IRR computation does not require an external specification of the cost of equity, but the ROE computation does. However, the latter is more realistic because of two reasons. First, firms presumably exploit all positive NPV projects before paying dividends. Thus, any marginal projects that the firm can undertake earn only the cost of equity. Second, in a competitive market, if the shareholders reinvest dividends in other shares of comparable risk, they would earn only the cost of equity.

The multiperiod ROE has the following advantages over a single-period ROE:

- Instead of using annual earnings in the numerator, the multiperiod ROE effectively uses the sum of earnings over multiple years in the numerator. This smoothes out the effect of non-recurring items.

- It also adds back earnings foregone on dividends paid during the measurement period to the numerator.

- It is a geometric average rather than an arithmetic average. The adjustment for dividends and geometric averaging cause it to differ from a simple average of ROE over multiple years.

Historical ROE can be compared to forecasted ROE. A material difference suggests that earnings forecasts are unrealistic. To investigate this issue further one often needs to strip out the effect of leverage. A second spreadsheet provides the unleveraged or enterprise version with multiperiod ROIC and unlevered IRR.

Conservative accounting biases book values downwards and inflates the IRR and ROE. To mitigate the problems arising from biased book values, one can replace book values by market values to compute the return on market equity (ROME). ROME can then be compared to the cost of equity to gauge whether the firm has created shareholder value over the measurement period.

2. IRR and ROE

2.1. Internal rate of return

Current year = Y_0. Previous year= Y_{-1}, and so on.

Assume that all dividends are paid at the end of the year. One could use quarterly data for accuracy.

d_{-5} = dividends per share paid at the end of Year -5, and so on.

b_{-6} = book value at the at the end of Y_{-6} or at the beginning of Y_{-5}

b_0 = book value on the measurement date

The IRR is the rate of return r that solves the following equation:

$$b_{-6} = d_{-5}/(1+r)^1 + d_{-4}/(1+r)^2 + d_{-3}/(1+r)^3 + d_{-2}/(1+r)^4 + d_{-1}/(1+r)^5 + (b_0+d_0)/(1+r)^6$$

That is, the internal rate of return is computed as if the firm was purchased for b_{-6} at the end of Y_{-6}. The holder then received the dividends over the next six years and sold the investment for b_0.

The IRR computation implicitly assumes that the dividends are reinvested at IRR. Conservative accounting exerts a downward bias on both b_{-6} and b_0. These two biases partially offset each other, thereby lowering the susceptibility of IRR to accounting rules.

3.   ROE: A different assumption of yield on reinvested dividends

The multiperiod ROE computation differs in only aspect from IRR. The ROE computation assumes that the dividends earn income at the rate of cost of equity. One computes a hypothetical book value h_0, which equals what the current book value would have been had the firm not paid dividends. h_0 equals the sum of b_{-T}, the total earnings over T years, and the earnings foregone on dividends over the T years if the dividends earned income at the rate of cost of equity. Alternatively, h_0 equals the sum of b_0, cumulative dividends over T years, and the earnings foregone on those dividends at the rate of cost of equity.

E_0 = Sum of earnings per share over the current year and previous five years

$D_0 = \Sigma \, d_{-n}$ = sum of dividends per share over current and previous five years

r_e = cost of equity

F_0 = Sum of earnings foregone on dividends paid over previous five years

$= \Sigma \, d_{-n}(1+r)^n - \Sigma \, d_{-n} = d_{-5}(1+r_e)^5 - d_{-5} + d_{-4}(1+r_e)^4 - d_{-4} + d_{-3}(1+r_e)^3 - d_{-3} + d_{-2}(1+r_e)^2 - d_{-2} + d_{-1}(1+r_e)^1 - d_{-1}$

h_0 = Hypothetical book value at the end of Y_0 assuming investment of dividends had yielded cost of equity r_e

$h_0 = b_{-6} + E_0 + F_0$

Alternatively, $h_0 = b_0 + \Sigma \, d_{-n} + F_0$.

ROE = annualized rate of return over the six years including the current year = $(h_0/b_{-6})^{(1/6)} - 1$

ROE differs from r_e if the firm creates shareholder value or if its accounting is biased.

3.1.   Advanced: Computing <u>R</u>eturn <u>O</u>n <u>M</u>arket <u>E</u>quity (ROME) by replacing book value with stock price

Investors often raise the question "Does the stock look expensive/cheap given its past financial performance?" They start by comparing the trailing price earnings ratio to the inverse of the cost of equity. However, the PE ratio is a single-period measure. We provide a way of incorporating multiple periods into the computation. We replace the current book value with the current market value in our multiperiod computations, but otherwise keep all inputs and ROE computations the same. The so redefined ROE can be thought of as Return on Market Equity (ROME). In a one-period setting, ROME is simply the trailing earnings yield or the inverse of the trailing PE ratio. Our multi-year computation of ROME reduces the sensitivity of ROME to timing issues.

ROME is a percentage performance score that can be compared to the cost of equity: A stock looks cheap relative to its track record when ROME exceeds its cost of equity, and vice versa. However, there is always a competing reason other than mispricing. First, the past performance may not be a good indication of the future performance. Second, there are numerous hard-to-resolve issues related to how far back one wants to go in time and the extent to which the ROME depends on accounting principles. Accordingly, ROME can only be part of the information that leads to a buy or sell decision.

4.   Enterprise-level or unlevered analysis

The second spreadsheet shifts the analysis to enterprise activities to derive unlevered ratios and highlight the role of enterprise cash flows (ECF). The analysis also shifts from a per share basis to a total dollar basis because the number of shares outstanding depends on the financial policy.

Equity-level or levered analysis	Enterprise-level or unlevered analysis
Book value of equity per share	Net enterprise assets [NEA]
Dividends per share	Enterprise cash flows [ECF]
Earnings per share	Enterprise profit after tax [EPAT]
ROE	**Return on invested capital [ROIC] or return on NEA [RNEA]**
Equity or levered IRR	**Enterprise or unlevered IRR**

The table shows that the two key metrics correspond to multiperiod ROIC and unlevered IRR.

A new feature of this spreadsheet pertains to sales: sales growth is now compared to the growth in net enterprise assets (NEA). NEA growth can exceed sales growth for four reasons. First, the firm is investing in NEA and the sales will follow, i.e., NEA growth is a leading indicator of expected sales growth. Second, the firm has shifted its strategy by moving to a lower sales volume but a higher profit margin business. Third, the firm's productivity in using its assets is falling. Fourth, the firm has overstated enterprise assets or understated enterprise liabilities. This will reverse in the future and hurt profits. While it is not easy to pinpoint the cause of disproportionate rise in NEA, one must consider these possibilities when interpreting. multiperiod ROIC and unlevered IRR.

5.   Detailed steps to be read with the spreadsheet

The numbers below are assumed to be on a per share basis. One can also use total dollar amounts as long as one changes dividends per share to dividends net of capital contributions.

5.1.   Intermediate computations

5.1.1.   Earnings

1.   Input: Earnings per share e_{-n} for the current year and previous five years. The EPS numbers should include all non-recurring items (such as gains/losses due to discontinued operations). Conservatism also suggests that the diluted EPS are preferable to basic EPS.

   1.1.   The spreadsheet refers to data on a per share basis. This approach is the simplest one because EPS and DPS histories on a comparable per share basis are readily available. The spreadsheet works equally well on a total dollar basis. In that case, one derives the net dividends via the equation, net dividend = comprehensive earnings - change in equity.

2.   Refer to the input for earnings per share.

3.   Sum these earnings over six years: E_0

5.1.2.   Dividends

4.   Input: Dividends per share d_{-n} for the current year and previous five years

5.   Refer to the input for dividends per share

6.   Sum these dividends over six years: D_0

5.1.3.   Reconstructed historical book values

7.   Input: Current book value is given.

8.   Infer book values b_{-n} at the end of each prior year. $b_{-n} = b_{-n+1} - (e_{-n+1} - d_{-n+1})$

5.2. IRR computation

9. Assume that an investor purchased the firm by paying b_{-6} at the end of Y_{-6}.

10. The investor receives dividends each year.

11. The investor sells the firm for b_0 at the end of Y_0.

12. Hypothetical cash flows = Sum of the above three items

13. Use the Excel IRR function to compute the internal rate of return.

5.2.1. Cost of equity: Hypothetical earnings rate on dividends

14. Input: Cost of equity r_e. This is the yield assumed to be obtainable on dividends had they been reinvested.

5.2.2. Hypothetical earnings foregone because of dividends paid out

15. Compounding factor for dividends at the end of year-n is $(1+r_e)^n$. One could use quarterly data for earnings and dividends if more accuracy is desired.

16. Compound each year's dividend to the end of the current year by multiplying by the compounding factor.

17. Subtract the original dividend to compute what could have been earned on those dividends at r_e.

18. Sum these foregone earnings: F_0

5.3. Multiperiod return on common equity

19. Numerator: Sum actual and foregone earnings over six years: E_0+F_0

20. Denominator: Book value at the end of Y_{-6}

21. Total return over $b_{-6} = (E_0 + F_0)/ b_{-6}$

22. Annualized return = $(1 + \text{total return})^{1/6} - 1$.

5.3.1. Alternate computation of multiperiod ROE

23. h_0 = Hypothetical book value at the end of $Y_0 = b_{-6} + E_0 + F_0$

24. Sum of dividends and earnings foregone: $D_0 + F_0$

25. Alternate computation: $h_0 = b_0 + D_0 + F_0$

26. Annualized return over six years $r = (H_0/b_{-6})^{1/6} - 1$

6. Questions addressed by the spreadsheet: Summary

1. Has the company's return on equity generally exceeded its cost of equity?

2. Have there been any changes in the performance in the more recent past? In other words, is the trend positive, neutral, or negative?

3. How does the past ROE compare to those projected by analysts for the next two years? Are the analysts too optimistic?

4. Does the past performance suggest the stock is currently cheap or expensive?