Bachelor thesis tutorial

Financial Ratios

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Valuation with multiples

- Many practitioners use multiples to value companies.
- Example: Price-Earnings ratio (P/E)
- Procedure:
  - Select set of comparable companies
  - Compute average P/E-ratio of comparables
  - Multiply earnings of company to be valued with average P/E of comparables
  - Done!
- Advantages: easy, no estimation of value drivers
- Problems: lots!

Popular multiples used for valuation

- Ratios for firm value (= debt + equity):
  - Value-to-sales ratio
  - Value-to-cash-flow ratio
  - Value-to-EBIT ratio
  - Value-to-EBITDA ratio
  - Market-to-book ratio (value over total assets)
  - Tobin's q (market value over replacement value)
- Ratios for equity value:
  - P/E ratio (price over net income)
  - Market-to-book ratio (price over book value of equity)
- Numerator and denominator should match!

Valuing a Company Using P/E-Multiples

- The three steps of using P/E multiples company valuation:
  1. Find a sample of comparable companies
  2. Compute the average of their P/E ratios
  3. Multiply earnings by average P/E from step 2
- *Example:* Daimler
  - Comparables: BMW, VW, Toyota, Renault, Fiat, (PSA)

Averaging method	Average	Value	Error
Mean	25.48	163.04 €	165%
Median	10.74	68.71 €	12%
Harmonic mean	12.57	80.44 €	31%
Geometric mean	15.85	101.43 €	65%
Actual values Daimler	9.61	61.53 €	0%

For calculations see *Financial Ratios – Multiples.xls*, tab "Valuation".

What is the conceptual basis?

- Develop a financial ratio from DCF-WACC:
  - Assume constant growth g of unlevered cash flows:

$$V_0 = \frac{(1+g)FCF_0^U}{r_{WACC} - g} \quad \Leftrightarrow \frac{V_0}{FCF_0^U} = \frac{1+g}{r_{WACC} - g}$$

  - "Value-to-unlevered-cash-flow" ratio
- Choose comparable firms with
  - similar growth rate g
  - similar costs of capital r_{WACC}

DCF and multiples

An example for a 2-stage model

- Assume that company
  - grows at rate g_1 for the next 5 years
  - grows at rate g in perpetuity thereafter

$$V_0 = \sum_{t=1}^{t=5} \frac{FCF_0^U \left(1+g_1\right)^t}{\left(1+r_{WACC}\right)^t} + \frac{(1+g)\left(1+g_1\right)^5 FCF_0^U}{\left(1+r_{WACC}\right)^5 \left(r_{WACC}-g\right)}$$

- Then the Value/Cash-Flow-ratio becomes:

$$\frac{V_0}{FCF_0^U} = \sum_{t=1}^{t=5} \left(\frac{1+g_1}{1+r_{WACC}} \right)^t + \left(\frac{1+g_1}{1+r_{WACC}} \right)^5 \frac{(1+g)}{\left(r_{WACC}-g\right)}$$

Other multiples

→ Recall the P/E-ratio and the DDM:

$$V_0 = \frac{(1+g)d_0}{r_e - g} \quad \& \quad d_0 = \pi EPS_0 \qquad \Rightarrow \frac{P_0}{EPS_0} = \frac{(1+g)\pi}{r_e - g}$$

→ Value to Sales in a two-stage model:

- Assume constant cash-flow margin $m=FCF^U/S$

$$\frac{V_0}{S_0} = m\left[\sum_{t=1}^{t=5}\left(\frac{1+g_1}{1+r_{WACC}}\right)^t + \left(\frac{1+g_1}{1+r_{WACC}}\right)^5 \frac{(1+g)}{(r_{WACC}-g)}\right]$$

Lessons for the selection of comparables

- Multiples valuation avoids the estimation of cash flows, sales forecasts, margins, growth rates, payout ratios.
- Instead uses market assessment of all valuations combined
- Implicit assumption: comparable companies have:
  - Similar growth rates
  - Similar stage (fast growth / slow growth)
  - Similar margins
  - Similar cost of capital or cost of equity (leverage!)
  - Similar payout ratios

Popular financial ratios used for valuation

- Which numbers are used?
  - Always: current market prices in the numerator
  - For **trailing ratios**, use the latest historical number in the denominator.
  - For **leading ratios**, use analysts' forecasts in the denominator.
- Some ratios are heavily influenced by accounting choices:
  - P/E ratio, EBIT ratio, EBITDA ratio
  - To get around this problem:
    - Re-adjust earnings for special items
    - Use ratios based on financial numbers "further up in the income statement", e.g. value-to-sales ratio.

Exit multiples

- DCF-valuation always requires a terminal value.
  - Yet little is known about the distant future.
  - Growth rates in perpetuity formula difficult to evaluate
  - But the terminal value has a lot of weight in the final valuation (typically > 70%).
- Industry practice: use exit multiples:
  - Forecast cash flows, EBIT, EBITDA etc. for 5-8 years
  - Terminal value assessed as multiple of EBIT or EBITDA of final period:
    - Could also use multiples based on sales, assets
- Do this as a diagnostic check on your DCF valuations:
  - Calculate EBIT, EBITDA, capital invested, etc. for last period
  - Calculate multiples implied by your DCF valuation
  - Compare those to companies with the same industry, size, growth prospects

Exit multiples (2)

- Consider three-stage model from DCF-lecture
- Calculate common multiples for 2022 (first year of third stage)

Value/EBITDA	11.53
Value/EBIT	20.42
Value/Sales	1.84
$Value_t/FCF_{t+1}$	51.55
$Equity_t/CFE_{t+1}$	37.93
Dividend yield ($CFE_{t+1}/Equity_t$)	2.64%
$Equity_t/NI_{t+1}$ (PE-ratio)	29.62
Value/Book value of assets	3.79
Market to book ratio (equity)	6.63
Tobin's q	2.93

$$TobinsQ = \frac{\text{Market value of assets}}{\text{Replacement value of assets}}$$

- Valuation looks optimistic!

Empirical evidence:
Which ratios are successful?

- Liu, Nissim and Thomas (Journal of Accounting Research, 2002) perform a horse-race of different ratios:
  - For each firm, they use all firms from the same industry as comparables and calculate the average multiple.
  - Then they multiply this average multiple with the corresponding accounting number of the firm to be valued.
  - Finally, they compare the obtained value estimate with the firm's market capitalization.

- Their findings are:
  - Multiples derived from earnings *forecasts* have the lowest pricing errors.
  - Multiples with historical earnings come second.
  - Cash flow and book value of equity are tied for third.
  - Sales perform worst.

Empirical evidence:
Which ratios are successful?

- Repeated for
  - 26,613 firm-year observations between 1982 and 1999
  - for 19 different types of multiples.
  - Measure of accuracy: Absolute difference between estimated value and market value
- Their findings are:
  - Multiples derived from earnings *forecasts* have the lowest pricing errors.
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Empirical evidence:
Which ratios are successful?

→ Other finding: Harmonic mean results in lower errors than arithmetic mean or median.

- Harmonic mean:

$$m_h = n\left[\sum_{i=1}^{n}\left(x_i\right)^{-1}\right]^{-1}$$

- Arithmetic mean:

$$m_a = \frac{1}{n}\sum_{i=1}^{n} x_i$$

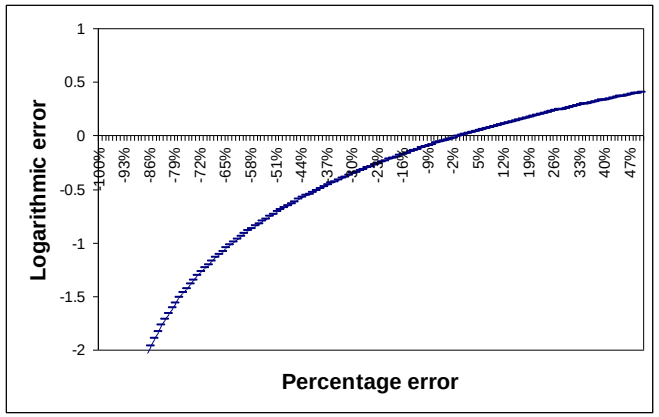
- These results are consistent across years and industries.

- Dittmann, Maug (WP 2005) also include median and geometric mean:

$$m_g = \prod_{i=1}^{i=n} x_i^{1/n} = \exp\left\{\frac{1}{n}\sum_{i=1}^{i=n} \ln x_i\right\} = \exp\left\{m_a\left(\ln x_i\right)\right\}$$

- Analyze percentage errors and log errors:

$$e_P = \frac{\hat{MV}_i - MV_i}{MV_i}, e_{\log} = \ln\frac{\hat{MV}_i}{MV_i}$$



- Benchmark against „dummy procedures“:
  - Set market value = book value, or equal to $1

Empirical evidence (2):

- Results of empirical analysis and simulations of Dittmann, Maug (WP 2005):
  - Harmonic mean is biased downward, about as much as arithmetic mean is biased upward.
  - Geometric mean and median are both good.

Conclusion

- Multiples provide a short-cut.
- Rely on comparability:
  - Companies from the same industry
  - Really companies with similar value drivers!
- Averaging methods matter!
- Recommended reading: Titman and Martin, Valuation: the Art and Science of Corporate Investment Decisions, Chapter 6.