CAPM v. DGM - Technical Knockout or a Fight to a Draw?

Hal Heaton, PhD
Wichita Program: Appraisal for Ad Valorem Taxation
July 29, 2019  3:00 p.m.
Two approaches

• Capital Asset Pricing Model (CAPM)
  • Required Return = \( R_f + \beta (R_m - R_f) \)
  • \( R_f \) = the risk free rate,
  • \( R_m \) = the market expected return
  • \( \beta \) (beta) = the measure of systematic risk
  • (\( R_m - R_f \)) often referred to as the Equity Risk Premium (ERP)

• Dividend Growth Model (DGM)
  • \((\text{Dividend} / \text{Price}) + \text{expected growth} = \text{Yield} + \text{Growth}\)
History

- CAPM and DGM gave very similar estimates for decades
- For most centrally assessed industries the two started coming apart in 2009
  - DGM stayed much in line with history
  - CAPM started to drop
  - Now CAPM coming in much lower than DGM and has since 2009
- What caused the divergence?
  - Primarily due to falling long term Treasury rates ($R_f$ in CAPM equation)
  - Technically, the drop in Treasury rates is a drop in real rates
Current Versus Historical Treasury Rates

• Long term averages as of January 2019:
  • Long-Term Government Bonds 6.1%
  • Inflation 3.0%

• January 1, 2019
  • Long Term Government Bonds 2.89%
  • Expected Inflation 2.00%
Federal Reserve Intervention

U.S. Treasury Rates

- 10 Year
- 3 Month
Parameter estimation: CAPM

• Which risk free rate to use?
  • Should match the investment horizon of the subject property
  • “Normalizing” risk free rate: be careful
  • If unable to adjust for unusual economic situation, put less weight on CAPM

• Estimating beta
  • Choose comparables with risk as similar to subject property as possible
  • Problem 1: subject property is small and standalone but available data come from much larger, more diversified companies
    • Partial solution: size premium
    • Alternative: use total beta – be careful
  • Problem 2: entire industry undergoing restructuring
    • Distorts entire industry data
Dealing with industry restructuring

• Beta decomposition
  • $\beta_i = \rho_{im} \times (\sigma_i/\sigma_m)$
    • $B_i$ = beta
    • $\rho_{im}$ = correlation coefficient between investment and market returns
    • $\sigma_i$ = volatility (standard deviation) of return on investment
    • $\sigma_m$ = volatility (standard deviation) of return on market

• Beta’s are calculated using historical returns:
Separating future and past

Company/Market Correlation

Company Volatility/Market Volatility
CAPM parameter estimation: Equity Risk Premium

• Historical
• “Supply Side”
  • Must make several assumptions
• Survey data
  • Small response rate => bias???
  • Incentive to understate
• Damodaran
  • Assumes market grows at 10 year Treasury bond rate after year 5
  • Currently 10 year Treasury bond rate approximately equals inflation
  • Implies zero percent real growth in stock market forever
Damodaran approach
Parameter estimation: DGM

• Formula = ($D_1/P_0$) + growth
• $D_1$ generally available from Value Line and others
• Growth must be future, expected growth not past
  • Use Value Line future growth, not straddle growth (left side of page)
  • Do not use expected dividend growth
    • Share repurchases now represent a greater portion of cash distributions
      • Provide more flexibility for shareholders than dividends
      • Provide more flexibility for companies than dividends
    • As a result, dividend growth understates future expected growth in cash distributions
• Use expected growth in earnings per share
  • Picks up faster growth in earnings per share caused by share repurchases
### Value Line Data

#### Norfolk Southern NYSE: NSC

<table>
<thead>
<tr>
<th>ANNUAL RATES</th>
<th>Past 10 Yrs.</th>
<th>Past 5 Yrs.</th>
<th>Est'd '15-'17 to '21-'23</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenues</td>
<td>4.5%</td>
<td>2.0%</td>
<td>5.5%</td>
</tr>
<tr>
<td>&quot;Cash Flow&quot;</td>
<td>6.0%</td>
<td>4.0%</td>
<td>9.5%</td>
</tr>
<tr>
<td>Earnings</td>
<td>5.5%</td>
<td>3.5%</td>
<td>11.5%</td>
</tr>
<tr>
<td>Dividends</td>
<td>13.0%</td>
<td>7.5%</td>
<td>6.0%</td>
</tr>
<tr>
<td>Book Value</td>
<td>7.0%</td>
<td>9.0%</td>
<td>10.0%</td>
</tr>
</tbody>
</table>

#### Quarterly Revenues (4Q)

<table>
<thead>
<tr>
<th>Year</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>Revenues per sh</th>
<th>&quot;Cash Flow&quot; per sh</th>
<th>Earnings per sh</th>
<th>Div'ds Decl'd per sh</th>
<th>Cap'I Spanding per sh</th>
<th>Book Value per sh</th>
<th>Common Shs Outst'g</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>21.60</td>
<td>26.63</td>
<td>33.82</td>
<td>35.16</td>
<td>36.41</td>
<td>37.71</td>
<td>35.30</td>
<td>34.05</td>
<td>37.13</td>
<td>42.35</td>
<td>45.10</td>
<td>51.30</td>
<td>17.30</td>
<td>12.40</td>
<td>4.25</td>
<td>7.00</td>
<td>72.90</td>
<td>250.00</td>
</tr>
</tbody>
</table>
Beware of “multistage growth” DGM model

• A new “multistage growth” version of the DGM has appeared in recent years

• Two key assumptions
  • Holds current yield constant \((D_1/P_0)\)
  • For growth component it averages
    • Value Line analyst growth for five years
    • Drops growth evenly over a number of years to GDP growth
    • Uses GDP growth forever thereafter
“Multistage Growth” DGM Model (continued)
“Multistage Growth” DGM Model (continued)

• Problem 1: Implicitly assumes that discount rates for longer-term cash flows are lower --- not true!

<table>
<thead>
<tr>
<th>Maturity</th>
<th>Treasurys</th>
<th>AA</th>
<th>A</th>
<th>BBB</th>
<th>BB</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.61</td>
<td>2.83</td>
<td>3.01</td>
<td>3.37</td>
<td>4.77</td>
<td>5.75</td>
</tr>
<tr>
<td>5</td>
<td>2.50</td>
<td>3.24</td>
<td>3.42</td>
<td>3.98</td>
<td>6.20</td>
<td>7.46</td>
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<tr>
<td>10</td>
<td>2.67</td>
<td>3.65</td>
<td>3.87</td>
<td>4.56</td>
<td>7.08</td>
<td>8.41</td>
</tr>
<tr>
<td>15</td>
<td>2.72</td>
<td>3.91</td>
<td>4.26</td>
<td>4.94</td>
<td>7.54</td>
<td>8.98</td>
</tr>
<tr>
<td>20</td>
<td>2.83</td>
<td>4.09</td>
<td>4.42</td>
<td>5.14</td>
<td>7.73</td>
<td>9.18</td>
</tr>
<tr>
<td>25</td>
<td>2.90</td>
<td>4.15</td>
<td>4.37</td>
<td>5.11</td>
<td>7.60</td>
<td>9.06</td>
</tr>
<tr>
<td>30</td>
<td>2.99</td>
<td>4.16</td>
<td>4.35</td>
<td>5.06</td>
<td>7.58</td>
<td>9.00</td>
</tr>
</tbody>
</table>

Source: Bloomberg

January 1, 2019
“Multistage Growth” DGM Model (continued)

- Problem 2: As growth slows, yield must increase

<table>
<thead>
<tr>
<th>Period</th>
<th>Beginning Assets</th>
<th>Income</th>
<th>Payout Ratio</th>
<th>Payout</th>
<th>Retained</th>
<th>Ending Assets</th>
<th>Asset Growth</th>
<th>Dividend Yield</th>
<th>Total Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$1,000</td>
<td>$100</td>
<td></td>
<td>$30</td>
<td>$70</td>
<td>$1,070</td>
<td>7%</td>
<td>3%</td>
<td>10%</td>
</tr>
<tr>
<td>1</td>
<td>$1,070</td>
<td>$107</td>
<td>30%</td>
<td>$32</td>
<td>$75</td>
<td>$1,145</td>
<td>7%</td>
<td>3%</td>
<td>10%</td>
</tr>
<tr>
<td>2</td>
<td>$1,145</td>
<td>$114</td>
<td>30%</td>
<td>$34</td>
<td>$80</td>
<td>$1,225</td>
<td>7%</td>
<td>3%</td>
<td>10%</td>
</tr>
<tr>
<td>3</td>
<td>$1,225</td>
<td>$123</td>
<td>60%</td>
<td>$74</td>
<td>$49</td>
<td>$1,274</td>
<td>4%</td>
<td>6%</td>
<td>10%</td>
</tr>
<tr>
<td>4</td>
<td>$1,274</td>
<td>$127</td>
<td>60%</td>
<td>$76</td>
<td>$51</td>
<td>$1,325</td>
<td>4%</td>
<td>6%</td>
<td>10%</td>
</tr>
<tr>
<td>5</td>
<td>$1,325</td>
<td>$133</td>
<td>60%</td>
<td>$80</td>
<td>$53</td>
<td>$1,378</td>
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<td>6%</td>
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<td>$138</td>
<td>60%</td>
<td>$83</td>
<td>$55</td>
<td>$1,433</td>
<td>4%</td>
<td>6%</td>
<td>10%</td>
</tr>
<tr>
<td>7</td>
<td>$1,433</td>
<td>$143</td>
<td>60%</td>
<td>$86</td>
<td>$57</td>
<td>$1,490</td>
<td>4%</td>
<td>6%</td>
<td>10%</td>
</tr>
<tr>
<td>8</td>
<td>$1,490</td>
<td>$149</td>
<td>60%</td>
<td>$89</td>
<td>$60</td>
<td>$1,550</td>
<td>4%</td>
<td>6%</td>
<td>10%</td>
</tr>
</tbody>
</table>
“Multistage Growth” DGM Model (continued)

• Problem 3: Appraiser can affect value through an arbitrary choice

<table>
<thead>
<tr>
<th>Averaging Period</th>
<th>Cost of Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>17.30%</td>
</tr>
<tr>
<td>10</td>
<td>16.55%</td>
</tr>
<tr>
<td>20</td>
<td>14.30%</td>
</tr>
<tr>
<td>30</td>
<td>12.80%</td>
</tr>
<tr>
<td>40</td>
<td>12.05%</td>
</tr>
<tr>
<td>70</td>
<td>11.09%</td>
</tr>
<tr>
<td>100</td>
<td>10.70%</td>
</tr>
</tbody>
</table>
A Point on DGM Growth Rates

• Why are growth rates used to forecast future cash flows for property tax DCF valuations so much different than analyst forecasted growth in earnings per share used in DGM calculations?
  • Share repurchases affect stock earnings per share growth, even if underlying NOI growth is low
  • Analyst forecast growth in EPS includes expansionary growth
    • Includes value from assets which do not even exist today
    • Includes subjective growth estimates from several factors
• Property tax valuations only include assets which exist on the lien date
• Share prices and hence expected returns to shareholders are driven by earnings per share growth based on many factors
• But cash flow forecasts for property tax purposes only include cash flows from existing assets less only maintenance capital expenditures
Capitalization Rates: Perpetual Growth Formula

• If the cash flow stream grows forever at a constant rate “g” then the formula simplifies to

\[
Value = \frac{CashFlow_1}{(1+k)^1} + \frac{CashFlow_2}{(1+k)^2} + \ldots
\]

\[
= \frac{CashFlow_1}{k - g}
\]

• Only if: Cash Flow in period t = (1 + g) x (Cash flow in period t-1)

• For all t
Yield Capitalization

- If the company is just expected to earn its cost of capital on average in future years, then the formula can be expressed as

\[
Value = \frac{NOI}{k} = \frac{CashFlow_1}{(1+k)^1} + \frac{CashFlow_2}{(1+k)^2} + \ldots + \frac{CashFlow_n}{(1+k)^n}
\]

- “NOI” is net operating income

- “Cash flow” in this case is the payout ratio times NOI, i.e. the portion of NOI that is paid out every year to the investors.

- Note that, by assumption, in this case: \[Value \times k = NOI.\]
Be Careful of an Erroneous Formula

- **Erroneous Value = Net Operating Income (NOI) / [Cost of Capital - Inflation (growth)]**
  - NOI/(k-g)
- **Proof of Error**
  - \( V = CF/(k-g) \)
  - \( CF = NOI \) (PayOut Rate = PO)
  - \( g = (1-PO)ROI \)
  - \( ROI=k \)
  - \( V = NOI(PO)/[k-(1-PO)k] = NOI/k \quad \text{not} \quad NOI/(k-g) \)
- **Bank deposit example**
  - Deposit $1000 earning 10% and withdraw 30% of interest every year
  - NOI= $100
  - Cash flow = $30
  - G =7%
  - **Correct Value =** \( NOI/k = $100/10% = $1000 \quad \text{or} \quad CF/(k-g) = $30/(.10-.07) = $1000 \)
  - **NOT** \( $100/(.10-.07) = $3,333 \)
Textbook Direct Capitalization

• Rate is calculated by finding other comparable properties which have recently sold and dividing ‘income’ by the sales price for each comparable.

• ‘Income’ can be almost anything (gross rents, net rents, EBIT, NOI, etc.) as long as it is calculated the same way for all comparable properties and the subject property.

• Must be very careful to choose truly comparable properties (same age, condition, location, financing, similar expectations for the future, etc.)

• Value is determined by taking the ‘rate’ from the comparable properties and dividing it into the ‘income’ of the subject property

• This ‘rate’ is not a cost of capital; in fact this approach is mathematically a market/sales comparison approach rather than an income approach where you assume that value has the same ratio to the characteristic as the comparables.
Stock Market “Direct Capitalization”

- Uses stock market EP (1/PE) ratios for cost of equity in band of investment calculation (similar to “WACC” calculation)
- Not discussed in any appraisal text
- Mathematically a stock and debt approach
- Because it is a stock and debt approach, it will include all intangible values of comparables as well as other advantages to security claims compared to property
- Includes liquidity value
  - Stocks and bonds are liquid, property is not
“Direct Capitalization” Using Stock and Debt Data

• Calculate total value of stock and debt claims of “comparables”
  • Stock value = price x number of shares outstanding
  • Debt = fair value from SEC 10K, sometimes book value is used
  • Total = “Enterprise Value” (EV)
• Calculate ratio of stock and debt value to some accounting parameter
  • NOI
  • Revenues
  • Net Property Plant and Equipment
  • …
• Multiply (or divide by inverse) same accounting parameter of subject property
  • Value = (EV/characteristic) x subject property characteristic
  • Value = subject property characteristic / (characteristic/EV)
• Produces a stock and debt value not value of operating property
Reasons Stock and Debt Claims Sell for Higher Values than Underlying Physical Properties

• Liquidity
• Divisible
  • Property tax valuations look at “unit” values
• Shareholders and bondholders don’t have to deal with management hassles
  • Hiring/firing
  • Technical knowledge of equipment
  • Meeting property regulatory requirements ....
• Shareholders have absolute limited liability
• Stockholders and bondholders have claim on future investment opportunities
• Stock and bond prices include value of management, licenses, patents, copyrights, contracts, customer base, ....
Summary

• Both CAPM and DGM work in many situations and economic periods
  • Look carefully at individual comparable companies to determine if something is distorting the numbers (i.e. not good comparables for the issue at hand)
  • Look carefully at economic circumstances and logic behind the approaches to see if they fit the current situation
  • Make sure your implicit assumptions do not violate fundamental economics

• Currently CAPM tends to understate required returns
  • Primarily due to highly unusual Treasury rates due to trillions of dollars of intervention from Federal Reserve

• If “Capitalization Rates” are not required returns, but simply ratios of stock and debt values to a characteristic
  • “Capitalizing” produces stock and debt values not property values