Calculating the cost of capital

Session 3

Overview

- In order to calculate the cost of equity, two models exist:
  - Gordon dividend model
  - Capital Asset Pricing Model (CAPM)

Summary

1. The Gordon Dividend Model
2. Adjusting the Gordon Model to Account for All Cash Flows to Equity
3. « Supernormal Growth » and the Gordon Model
4. Using the CAPM to Determine the Cost of Equity
5. Using the SML to Calculate Intel's Cost of Equity
6. Three Approaches to Computing the Expected Return on the Market
7. Calculating the Cost of Debt
8. Computing the WACC: Three Cases

Calculating the cost of capital

1. THE GORDON DIVIDEND MODEL

1. The Gordon dividend model

- The Gordon dividend model derives the cost of equity from:
  - The value of a share is the present value of the future anticipated dividend stream from the share, where the future anticipated dividends are discounted at the appropriate risk-adjusted cost of equity r_e

M.J. Gordon, « Dividends, Earnings, and Stock Prices », Review of Economics and Statistics 41, 1959

1. The Gordon dividend model

$$P_o = \frac{Div_0(1+g)}{1+r_E} + \frac{Div_0(1+g)^2}{(1+r_E)^2} + \frac{Div_0(1+g)^3}{(1+r_E)^3} + \frac{Div_0(1+g)^4}{(1+r_E)^4} + \ldots = \sum_{t=1}^{\infty} \frac{Div_0(1+g)^t}{(1+r_E)^t}$$

- Provided that $|g| < r_e$, $\sum_{t=1}^{\infty} \frac{Div_0(1+g)^t}{(1+r_E)^t}$ can be reduced to $\frac{Div_0(1+g)}{r_E - g}$

- Given a constant anticipated dividend growth rate, we derive the Gordon model cost of equity:

$$Po = \frac{Div_0(1+g)}{r_e - g}$$

- The Gordon-model cost of capital:

$$r_E = \frac{Div_0(1+g)}{P_0} + g$$

1. The Gordon dividend model

- The Gordon model cost of equity

Feuille de calcul

- Kellogg dividends, May 1996 – May 2006

Feuille de calcul

- Computing Kellogg's r_e with the Gordon model

Feuille de calcul

Calculating the cost of capital

2. ADJUSTING THE GORDON MODEL TO ACCOUNT FOR ALL CASH FLOWS TO EQUITY

2. Adjusting the Gordon Model…

- The Gordon model is computed on a per-share basis and for dividends only. In addition to dividends, cash flows to equity include:
  - Share repurchase accounts for around 50% of the total cash disbursed by American corporations to their shareholders
  - The issuance of stock by the firm is an important *negative cash flow to equity*.

Dittmar, A.L., and R. F. Dittmarm, 2004. « Stock Repurchase Waves: An Explanation of the Trends in Aggregate Corporate Payout Policy. »

2. Adjusting the Gordon Model…

- The basic valuation model of Gordon now becomes:

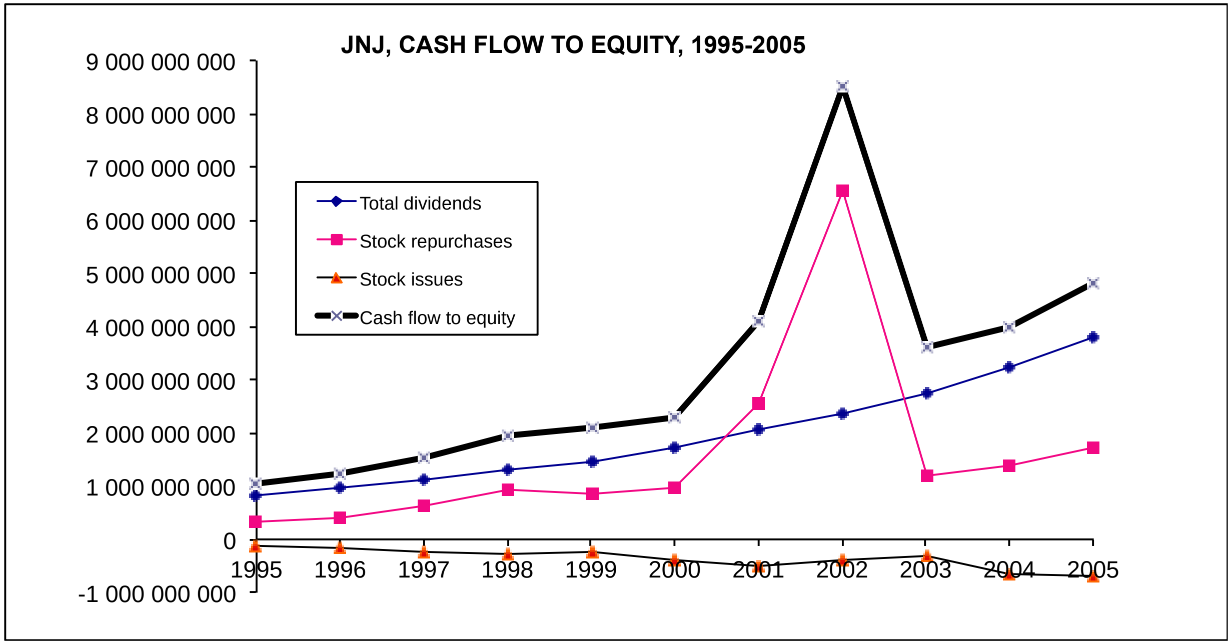
$$Market\ value\ of\ equity = \sum_{t=1}^{\infty} \frac{Cash\ flow\ to\ equity_0 * (1+g)^t}{(1+r_E)^t}$$

where *g* is the anticipated growth rate of cash flow to equity. This gives the formula for the cost of equity r_E as:

$$r_E = \frac{Cash\ flow\ to\ equity_0 * (1+g)}{Market\ value\ of\ equity} + g,\ if\ |g| < r_E$$

2. Adjusting the Gordon Model…

- Example with Johnson & Johnson:



2. Adjusting the Gordon Model…

- Is JNJ’s r_E different when computed on a dividend-per-share basis versus total equity cash flows?

Feuille de calcul

Calculating the cost of capital

3. « SUPERNORMAL GROWTH » AND THE GORDON MODEL

3. « Supernormal growth » …

- In finance examples, violation of $|g| < r_e$ usually occurs for very fast growth rates, so that $g > r_E$.

- The original dividend discount formula shows that P_0 would have an infinite value since when $g > r_E$,

$$\sum_{t=1}^{\infty} \frac{Div_0(1+g)^t}{(1+r_E)^t} = \infty$$

3. « Supernormal growth » …

- Supposed that the firm is anticipated to pay high-growth dividends during periods 1,…,m and that for subsequent periods the growth rate of dividends will be lower…

3. « Supernormal growth » …

- Using algebra, we obtain:

Share value today

= Present value of dividends

$$= \underbrace{\sum_{t=1}^{m} \frac{\text{Div}_0 * (1+g_1)^t}{(1+r_E)^t}}_{\substack{\text{PV of m years} \\ \text{of high-growth } g_1 \\ \text{dividends}}} + \underbrace{\sum_{t=m+1}^{\infty} \frac{\text{Div}_5 * (1+g_2)^{t-m}}{(1+r_E)^t}}_{\substack{\text{PV of remaining} \\ \text{normal-growth } g_2 \\ \text{dividends}}}$$

$$= \sum_{t=1}^{m} \frac{\text{Div}_0 * (1+g_1)^t}{(1+r_E)} + \frac{1}{(1+r_E)^m} \sum_{t=1}^{\infty} \frac{\text{Div}_m * (1+g_2)^t}{(1+r_E)^t}$$

$$= \frac{\text{Div}_0 * \left(\frac{1+g_1}{1+r_E}\right) * \left[1 - \left(\frac{1+g_1}{1+r_E}\right)^m\right]}{1 - \frac{1+g_1}{1+r_E}} + \frac{1}{(1+r_E)^m} \sum_{t=1}^{\infty} \frac{\text{Div}_m * (1+g_2)^t}{(1+r_E)^t}$$

$$= \frac{\text{Div}_0 * \left(\frac{1+g_1}{1+r_E}\right) * \left[1 - \left(\frac{1+g_1}{1+r_E}\right)^m\right]}{1 - \frac{1+g_1}{1+r_E}} + \frac{1}{(1+r_E)^m} \frac{\text{Div}_0 (1+g_1)^m (1+g_2)}{r_E - g_2}$$

3. « Supernormal growth » …

- The Gordon Model with two growth rates

Feuille de calcul

3. « Supernormal growth » …

- Computing the cost of equity for a firm with supernormal growth rates
  - The supernormal growth model can be used to compute the cost of equity r_E for companies whose historical equity payout data overstate any anticipation of future growth rates.
  - Example: Wachovia Bank

Feuille de calcul

3. « Supernormal growth » …

- Perhaps the large historical equity payout growth rate is unsustainable in the long run and will slow down to « normal » growth rates after a number of years.

$P_0 =$ Current equity value

$$= \sum_{t=1}^{m} \frac{\text{Div}_0 (1+g_{\text{High}})^t}{(1+r_E)^t} + \sum_{t=m+1}^{\infty} \frac{\text{Div}_0 (1+g_{\text{High}})^m (1+g_{\text{Normal}})^{t-m}}{(1+r_E)^t}$$

(Note that we now use P_0 to stand for total equity value at time 0 and Div_0 for total equity payouts at time 0.) As shown previously, we can simplify this expression as follows:

$$P_0 = \text{Div}_0 \left(\frac{1+g_{\text{High}}}{1+r_E}\right) * \frac{1-\left(\frac{1+g_{\text{High}}}{1+r_E}\right)^m}{1-\frac{1+g_{\text{High}}}{1+r_E}} + \text{Div}_0 \left(\frac{1+g_{\text{High}}}{1+r_E}\right)^m (1+g_{\text{Normal}}) * \frac{1}{r_E - g_{\text{Normal}}}$$

3. « Supernormal growth » …

- Given the dividend growth rates g_{High} and g_{Normal}, the current dividend D0, and the number of years m of supernormal growth, *the cost of equity* r_E *is the internal rate of return*

- Wachovia, two-stage gordon model and its function

Feuille de calcul

```
Function TwoStageGordon(P0, Div0, Highgrowth,
Highgrowthyrs, Normalgrowth)
     High = 4
     Low = 0

     Do While (High - Low) > 0.0000001
     Estimate = (High + Low) / 2
     factor = (1 + Highgrowth) / _
        (1 + Estimate)
     Term1 = Div0 * factor * _
        (1 - factor ^ Highgrowthyrs) / _
        (1 - factor)
     Term2 = Div0 * factor ^ Highgrowthyrs * _
        (1 + Normalgrowth) / _
        (Estimate - Normalgrowth)
     If (Term1 + Term2) > P0 Then
          Low = (High + Low) / 2
          Else:  High = (High + Low) / 2
     End If
     Loop
     TwoStageGordon = Estimate
End Function
```

Calculating the cost of capital

4. USING THE CAPITAL ASSET PRICING MODEL TO DETERMINE THE COST OF EQUITY R_E

4. Using the CAPM to determine...

- The CAPM derives the firm's cost of capital from its covariance with the market return (see chapter 7 in Benninga for more details).

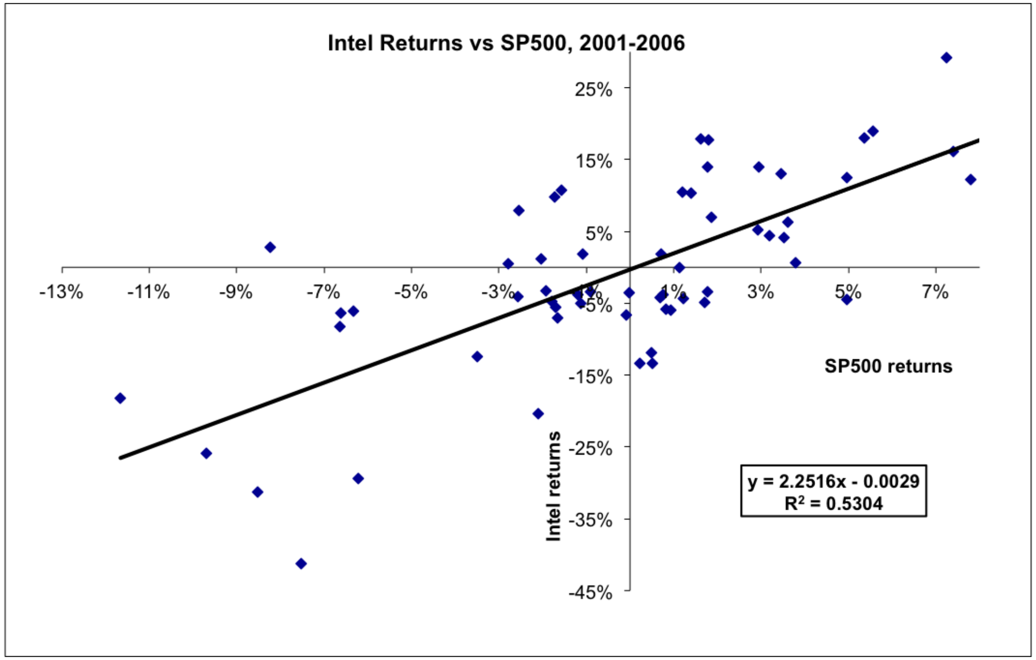
- The firm's cost of equity is $r_E = r_f + b[E(r_M) - r_f]$ where rf is the market risk-free rate of interest, R(rM) is the expected return on the market portfolio, and b is a firm-specific risk measure

$$\frac{Cov(r_{Stock}, r_M)}{Var(r_M)}$$

4. Using the CAPM to determine...

- Computing the beta for Intel

Feuille de calcul



4. Using the CAPM to determine...

Feuille de calcul

- Computing the beta for Intel
  - b_{Intel} shows the sensitivity of its stock return to the market return
  - a_{Intel} shows that irrespective of changes in the S&P500, the monthly return on Intel over the period was -0,29%
  - R^2 of the regression shows that 53% of the variation in Intel's returns is accounted for by bariability in the S&P500

4. Using the CAPM to determine...

- Function tintercept

```
Function tintercept(yarray, xarray)
     tintercept = Application.
Index(Application.
        LinEst(yarray, xarray, , 1), 1, 2) / _
     Application.Index(Application.
LinEst(yarray,
        xarray, , 1), 2, 2)
End Function
```

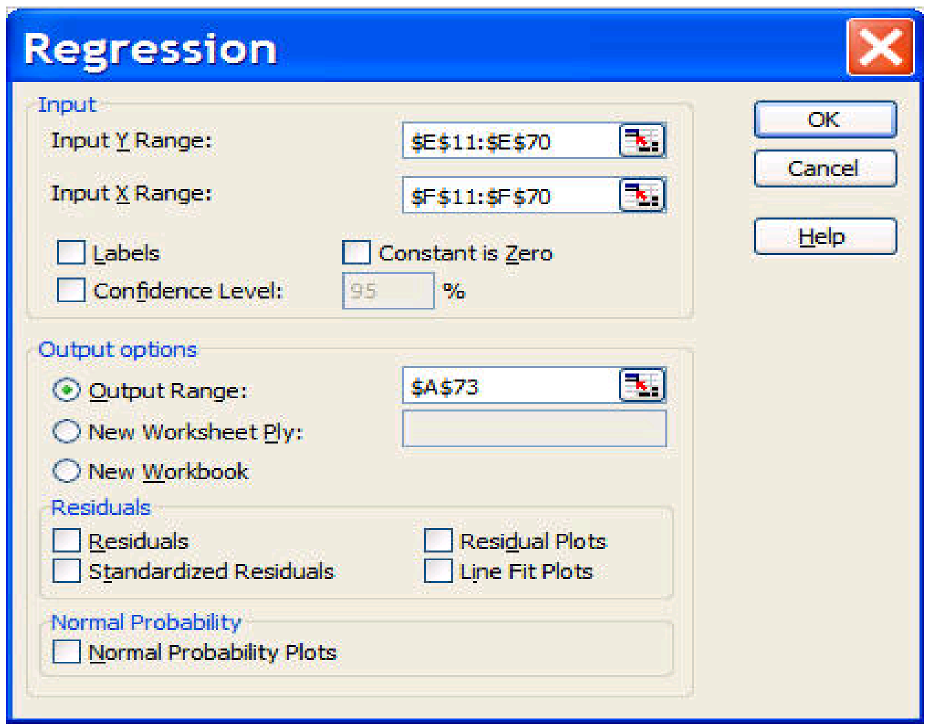
- Function tslope

```
Function tslope(yarray, xarray)
     tslope = Application.Index(Application.
        LinEst(yarray, xarray, , 1), 1, 1) / _
     Application.Index(Application.
LinEst(yarray,
        xarray, , 1), 2, 1)
End Function
```

4. Using the CAPM to determine…

- Using Excel's data analysis add-in
  - Tool/data analysis/regression

Feuille de calcul



Calculating the cost of capital

5. USING THE SECURITY MARKET LINE (SML) TO CALCULATE INTEL'S COST OF EQUITY

5. Using the security market line…

- In the CAPM, the security market line (SML) is used to calculate the risk-adjusted cost of capital
  - Method 1: the classic security market line
  - Method 2: the tax-adjusted security market line

5. Using the security market line…

- Method1 : The classic security line market (ignoring taxes)
  - Cost of equity, $r_E = r_f + b[E(r_M) - r_f]$

    R_f is the risk-free rate of return in the economy (i.e. the yield of Treasury bills, could be found with Yahoo finance data)

    $E(r_M)$ is the expected rate of return on the market : equals to the historic average of the market return, defined as the average return of a broad-based market porfolio

- Computing the cost of equity for intel

Feuille de calcul

5. Using the security market line…

- Method2: The tax-adjusted security market line
  - Cost of equity $= r_f f(1- T_C) + b[E(r_M) - r_f(1- T_C)]$

    T_C is the corporate tax rate

    The intercept is $r_f f(1- T_C)$ instead of r_f

    The slope is $E(r_M) - r_f(1- T_C)$ instead of $E(r_M) - r_f$

Feuille de calcul

Calculating the cost of capital

6. THREE APPROACHES TO COMPUTING THE EXPECTED RETURN ON THE MARKET $E(R_M)$

6. Three approaches…

- The historical return on a major market index
- The historical market risk premium
- The Gordon model

6. Three approaches…

- 1: The historical return on a major market index
  - A simple approach is to take the average of the historical returns of a major market index (i.e. Vanguard's 500 Index Fund used as a proxy for the market)

Feuille de calcul

6. Three approaches…

- 2: The historical market risk premium
  - We had to the preceding Vanguard data (method1) data from the St. Louis Federal Reserve Bank on three-month Treasury bill rates
  - Vanguard 500 index – Treasury Bills

Feuille de calcul

  - Computing the cost of equity for Intel using the market risk premium

Feuille de calcul

6. Three approaches…

- 3: The Gordon model (calculate directly the future ancitipated market yield)
  - From $r_E = \frac{Div_0(1+g)}{P_0} + g$, we can obtain for the market porfolio $r_M = \frac{Div_0(1+g)}{P_0} + g$
  - Assuming that the firm pays out a constant proportion *a* of its earning per share, and with *g* to be the growth of the firm,

$$E(r_M) = \frac{a * EPS_0(1+g)}{P_0} + g = \frac{a*(1+g)}{P_0 / EPS_0} + g$$

  with P_0/EPS_0 the price-earnings ratio of the market
  - Using the prince/earnings multiple to compute $E(r_M)$

Feuille de calcul

Calculating the cost of capital

7. CALCULATING THE COST OF DEBT

7. Calculating the cost of debt

- The cost of debt r_D is the marginal cost to the firm of borrowing an additional dollar. Several methods exist to calculate it.
  - Method 1 : approximation of the average cost of the firm's existing debt
  - Method 2: using the yield of similar-risk, newly issued corporate securities

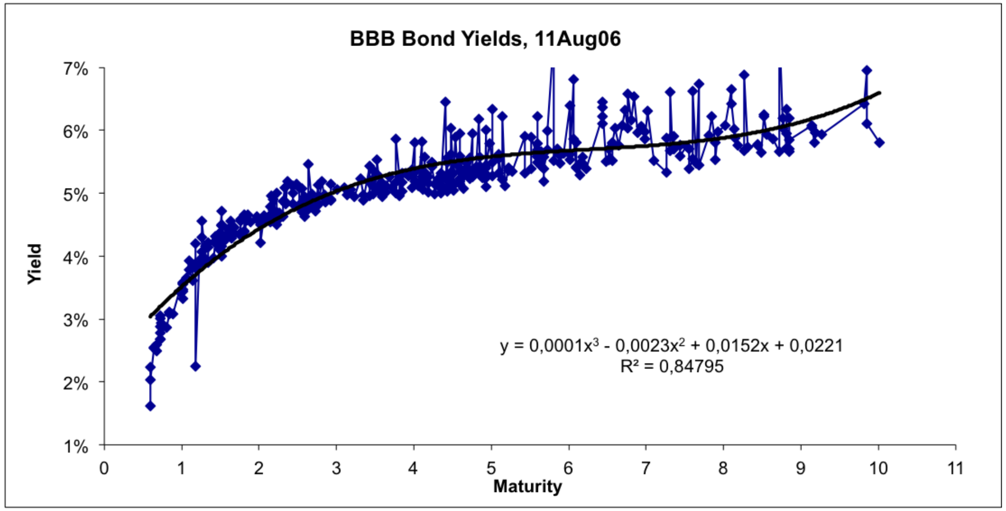
7. Calculating the cost of debt

- Method1 : approximation of the average cost of the firm’s existing debt
  - It is important to include all financial debt, without distinguishing between short-term and long-term items.
  - Liquid assets (cash and cash equivalents) are *negative debt* and should be subtracted from the firm’s debt

Feuille de calcul

7. Calculating the cost of debt

- Method 2: using the yield of similar risk, newly issued corporte securities
  - From Kraft's financial statements, in August 2006, the company was rated BBB+ (see page 68 for more details)
  - It is possible to impute the marginal cost of Kraft's debt from a yield curve



Feuille de calcul

Computing the cost of borrowing for Kraft

Feuille de calcul

Calculating the cost of capital

8. COMPUTING THE WACC: THREE CASES

8. Computing the WACC: Three cases

- Kraft Corporation: large divergence between the Gordon r_E and the CAPM r_E
- Tyson Foods: no change in its dividend payout per share for four years
- Cascade Corporation: negative leverage

8. Computing the WACC: Three cases

- Kraft
  - Cost of equity r_E based on dividends

    Feuille de calcul

  - Cost of equity r_E based on cash flow to equity

    Feuille de calcul

  - Computing the cost of equity r_E using the market price/earnings multiple

    Feuille de calcul

  - Computing the WACC

    Feuille de calcul

8. Computing the WACC: Three cases

- Tyson Foods
  - Cost of equity r_E based on dividends

    Feuille de calcul

  - Cost of equity r_E based on cash flow to equity

    Feuille de calcul

  - Cost of equity r_E using the market price/earnings multiple

    Feuille de calcul

  - Computing the cost of debt

    Feuille de calcul

  - Computing the WACC

    Feuille de calcul

8. Computing the WACC: Three cases

- Cascade Corporation
  - Cost of equity r_E based on dividends

    Feuille de calcul

  - Cost of equity r_E based on cash flow to equity

    Feuille de calcul

  - Cost of equity r_E using the market price/earnings multiple

    Feuille de calcul

  - Computing the cost of debt

    Feuille de calcul

  - Computing the WACC

    Feuille de calcul