EQUITY VALUATION IN R

What is a discount rate?

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Capital Asset Pricing Model (CAPM)

Mathematically, the CAPM is as follows:

$$E(R_i) = R_f + \beta_i(R_m - R_f)$$

where

- $E(R_i)$ is the return on stock i
- R_f is the risk-free rate of return
- R_m is the market return
- $R_m - R_f$ is the equity risk premium (ERP)
- β_i is the sensitivity of stock i's return to the market return

Beta

- Don't put your eggs in one basket
- You should always try to reduce firm-specific risk
- Investors are only compensated from taking on systematic risk (a/k/a market or undiversifiable risk)
- **Beta** is a measure of ***systematic risk***

Using Regression Analysis to Estimate Beta

Beta is typically estimated using a market model regression of the form:

$$R_i = \alpha + \beta \times R_m$$

(no risk-free rate!!!)

where

- α and β are coefficients generated by the regression
- R_i is the return on stock i
- R_m is the market return

Using Regression Analysis to Estimate Beta

The regression is typically performed using

- 2 to 5 year estimation period
- Weekly or monthly returns

Estimating Beta

```
> # Calculate stock return
> rets <- Delt(prices$firm_ret)

> # Calculate market return
> rets$spy <- Delt(prices$spy)

> # Rename first variable
> names(rets)[1] <- "firm_ret"

> # Remove first observation - NA
> rets <- rets[-1, ]

> # Run regression
> reg <- lm(myl ~ spy, data = rets)

> # Extract beta
> beta <- summary(reg)$coeff[2]
```

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Let's practice!

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Unlevering Betas

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The Hamada Formula

Unlevering Beta using Hamada Formula:

$$\beta_U = \beta_L / (1 + (1 - T_c) \times D/E)$$

where

- β_U is the Unlevered Beta (beta without effects of leverage)
- β_L is the Levered or Equity Beta (beta from regression)
- T_c is the corporate tax rate
- D/E is the debt-to-equity ratio

Relevering Beta Using Hamada Formula:

$$\beta_L = \beta_U \times (1 + (1 - T_c) \times D/E)$$

Fernandez Formula

Unlevering Beta using Fernandez Formula:

$$\beta_U = [\beta_L + \beta_D(1 - T_c)D/E]/[1 + (1 - T_c)D/E]$$

Same variable definitions as Hamada Formula, except for the addition of β_D for the debt beta.

Relevering Beta Using Fernandez Formula:

$$\beta_L = \beta_U + (\beta_U - \beta_D)(1 - T_c)D/E$$

Hamada Formula = Fernandez Formula if $\beta_D = 0$

Betas Used in Valuation

Which betas do you use in the CAPM?

- Use the beta obtained form regressing the stock's return on the market's return
- Use the relevered beta based on the median or average peer company's unlevered beta

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Risk-Free Rate and Equity Risk Premium

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Risk-Free Rate

- A risk-free security is an asset with a beta of zero (i.e., no systematic risk)

  If $\beta_i = 0$, then $R_i = R_f + \beta_i(R_m - R_f) \Rightarrow R_i = R_f$
- Yield on US Treasury securities is often used as proxy for risk-free rate
- Use a long-term US Treasury security (i.e., 10, 20, or 30 years)
- We can obtain the data from the Federal Reserve Electronic Database or the Federal Reserve H.15 Selected Interest Rates Database

Equity Risk Premium

- Equity Risk Premium (ERP) is the extra return that investors demand for putting their money in stocks, as proxied by the S&P 500, instead of Treasuries
- Mathematically, $ERP = R_m - R_f$
- The ERP can be different depending on the term of the risk-free rate used but **consistency is key**
    - For example, if R_f in the CAPM is based on 10-year Treasuries, then ERP should be calculated using 10-year Treasuries
- ERP is the average annual $R_m - R_f$ over a period of **at least 35 years**
- The typical range for the ERP is 5% to 8%

EQUITY VALUATION IN R

Let's practice!