Financing & Cost of Capital

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Returns

- Return R_{t+1} at time $t+1$ is defined

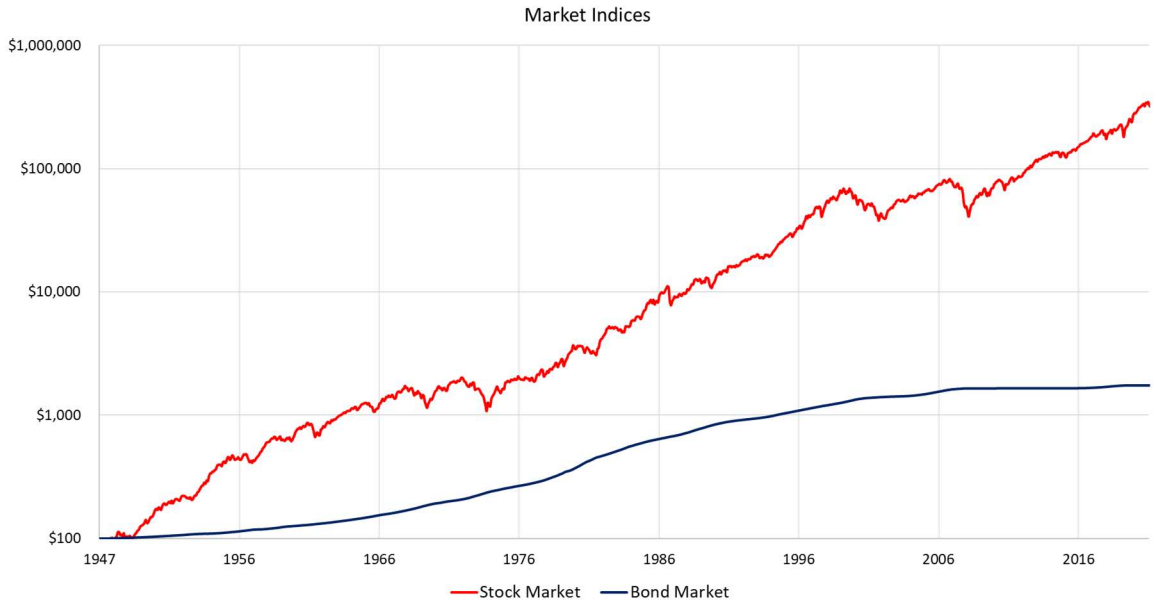
$$R_{t+1} = \frac{P_{t+1} - P_t}{P_t}$$

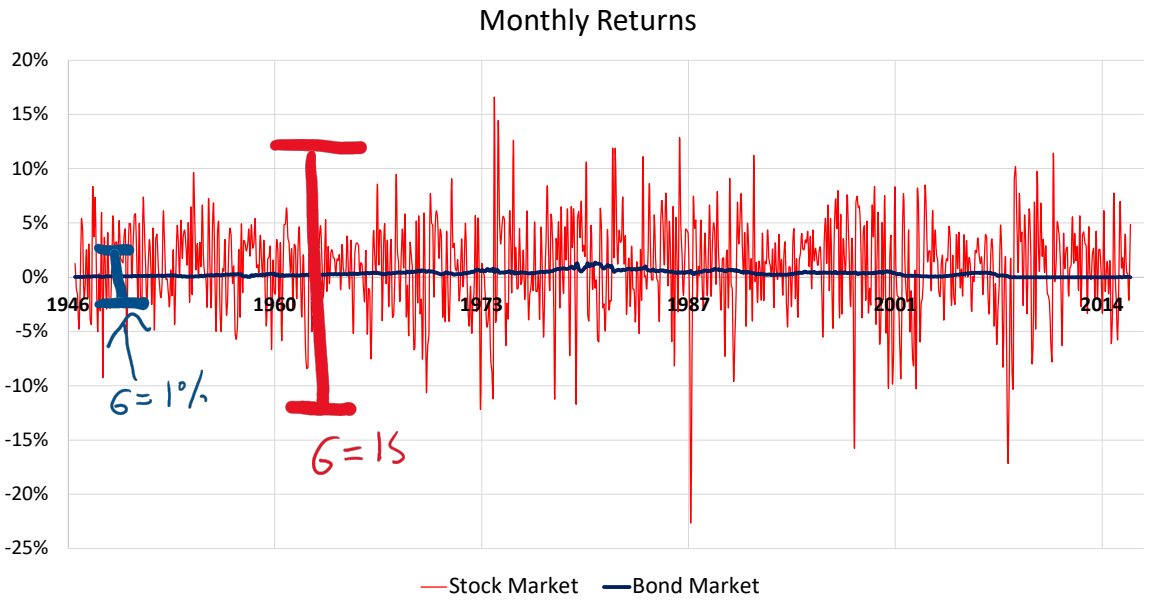
- where P_t Price at time t
- Example:
  - Buy stock at $P_t = \$100$
  - Sell stock at $P_{t+1} = \$110$
  - Return is $R_{t+1} = \frac{P_{t+1} - P_t}{P_t} = \frac{\$110 \quad \$100}{\$100} = 10\%$

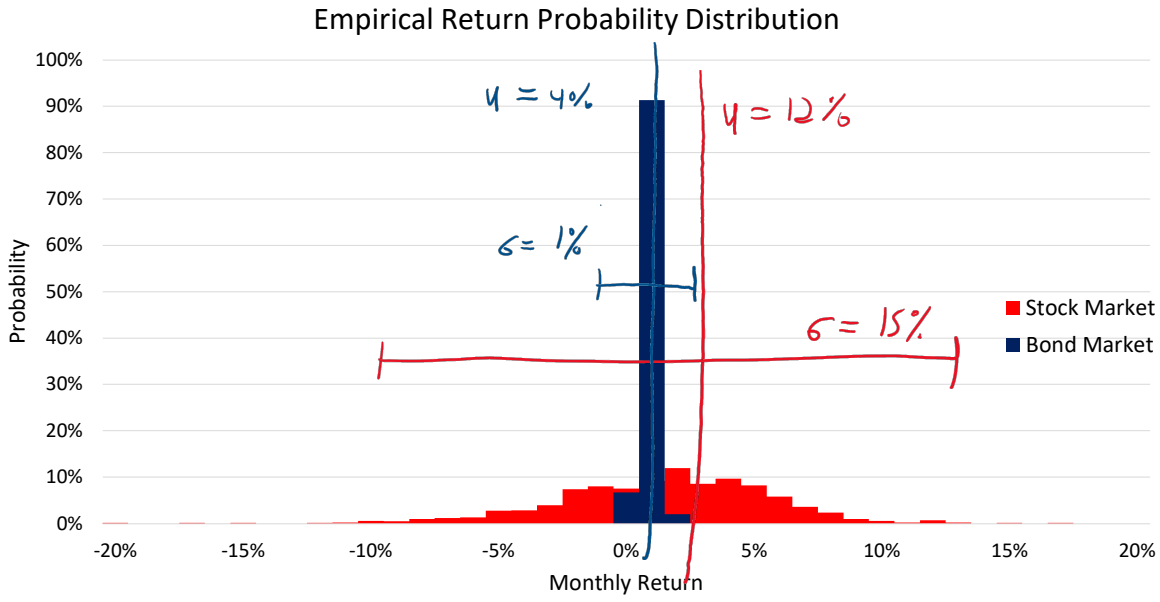
Decompose Returns

$$R = R_f + RP$$

- Risk-free rate R_f
  - The risk-free rate reflects the time value of money
  - How willing an investor is to give up $1 today for $$$ in the future
  - The more impatient a consumer, the more future compensation he will demand to delay consumption and hence the higher the risk-free rate
- Risk premium RP
  - Investors who dislike risk are risk averse and demand risk premiums for bearing risk
  - The risk-premium increases when:
    - The riskiness of an asset increases
    - Investors become more risk averse




Monthly Returns
20%
15%
10%
5%
0%
-5%
-10%
-15%
-20%
-25%
1946
1960
1973
1987
2001
2014
σ = 1%
σ = 15
Stock Market
Bond Market


Empirical Return Probability Distribution
Probability
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
μ = 4%
μ = 12%
σ = 1%
σ = 15%
-20%
-15%
-10%
-5%
0%
5%
10%
15%
20%
Monthly Return
Stock Market
Bond Market

Bond vs Stock Features

Debt

- Not an ownership interest.
- Creditors do not have voting rights.
- Interest is considered a cost of doing business and is tax deductible (up to 30% of EBIT).
- Creditors have legal recourse if interest or principal payments are missed.
- Excess debt can lead to financial distress and bankruptcy.

Equity

- Ownership interest.
- Common stockholders vote for the board of directors and other issues.
- Dividends are not considered a cost of doing business and are not tax deductible.
- Dividends are not a liability of the firm, and stockholders have no legal recourse if dividends are not paid.
- An all-equity firm cannot go bankrupt.

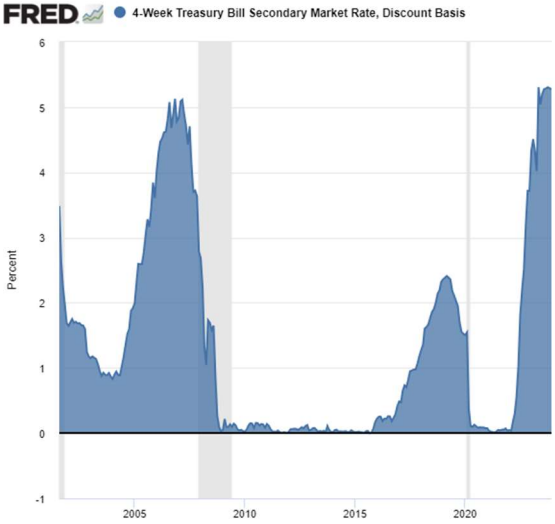
Cost of Debt R_D

For corporate bonds, the cost of debt is

$$R_D = R_f + Default\ Spread$$

Risk-free Rate R_f

- Treasury bills have no risk of default, very short-term maturities, a known return and are traded in active markets
- They are the closest approximation available to a riskless investment
- 30-day Treasury bill rate will be used to approximate the monthly riskless rate of interest

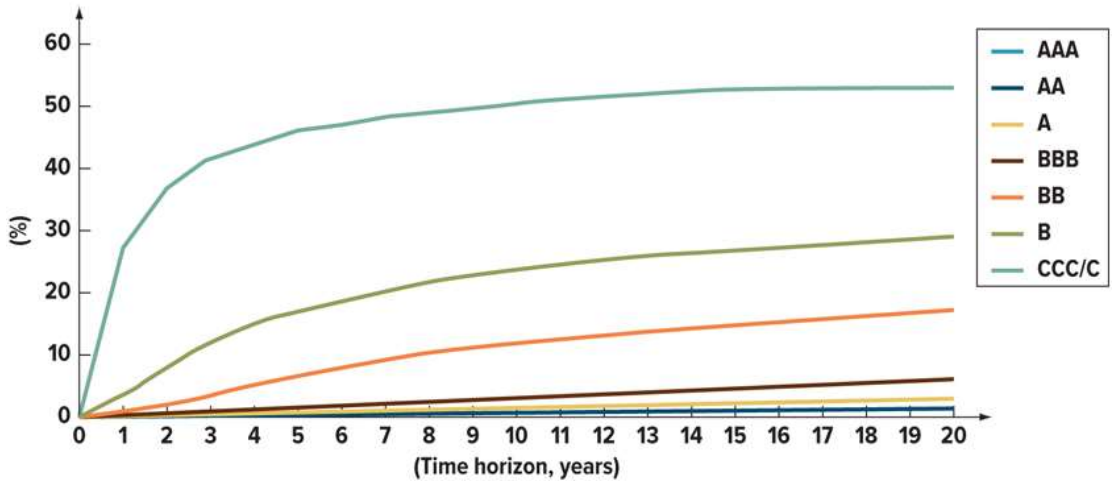


Bond Ratings

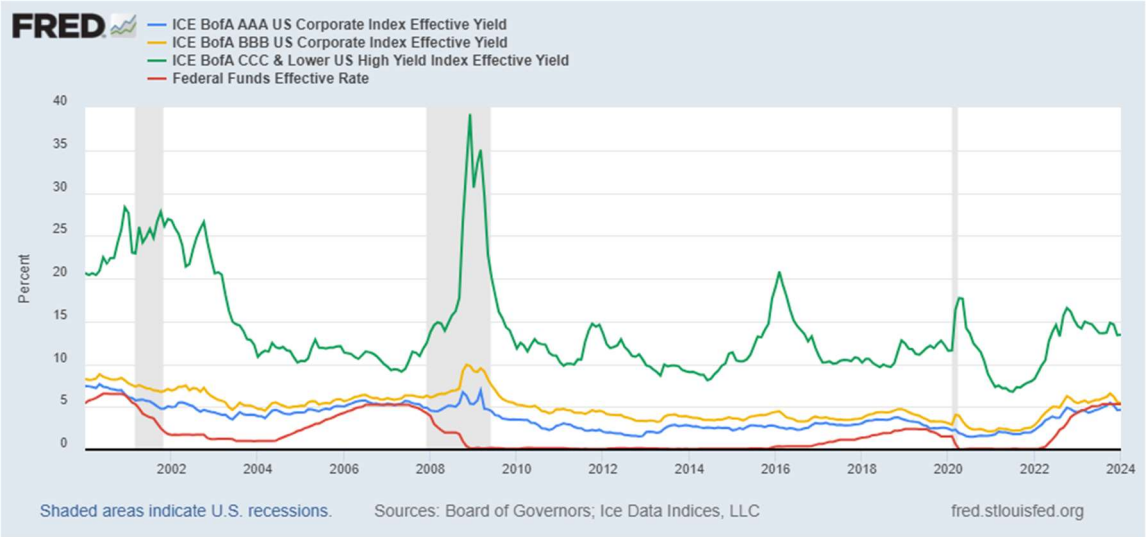
	Investment-Quality Bond Ratings				Low-Quality, Speculative, and/or "Junk" Bond Ratings					
	High Grade		Medium Grade		Low Grade		Very Low Grade			
Standard & Poor's	AAA	AA	A	BBB	BB	B	CCC	CC	C	D
Moody's	Aaa	Aa	A	Baa	Ba	B	Caa	Ca	C	

Moody's	S&P	
Aaa	AAA	Debt rated Aaa and AAA has the highest rating. Capacity to pay interest and principal is extremely strong.
Aa	AA	Debt rated Aa and AA has a very strong capacity to pay interest and repay principal. Together with the highest rating, this group comprises the high-grade bond class.
A	A	Debt rated A has a strong capacity to pay interest and repay principal, although it is somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than debt in higher-rated categories.
Baa	BBB	Debt rated Baa and BBB is regarded as having an adequate capacity to pay interest and repay principal. Whereas it normally exhibits adequate protection parameters, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity to pay interest and repay principal for debt in this category than in higher-rated categories. These bonds are medium-grade obligations.
Ba; B Caa Ca C	BB; B CCC CC C	Debt rated in these categories is regarded, on balance, as predominantly speculative with respect to capacity to pay interest and repay principal in accordance with the terms of the obligation. BB and Ba indicate the lowest degree of speculation, and Ca, CC, and C the highest degree of speculation. Although such debt is likely to have some quality and protective characteristics, these are outweighed by large uncertainties or major risk exposures to adverse conditions. Issues rated C by Moody's are typically in default.
	D	Debt rated D is in default, and payment of interest and/or repayment of principal is in arrears.

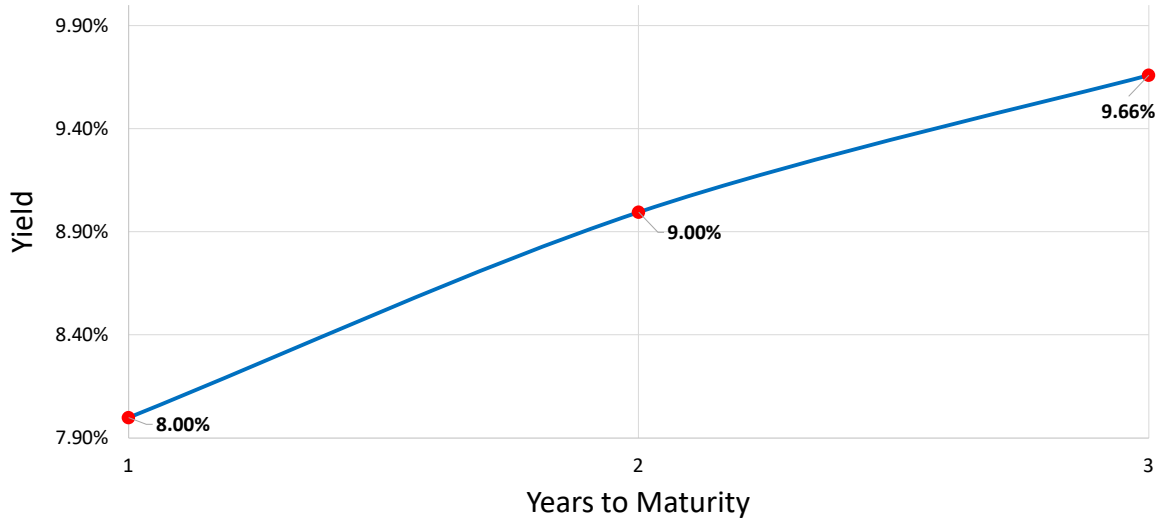
Bond Ratings & Default Rate



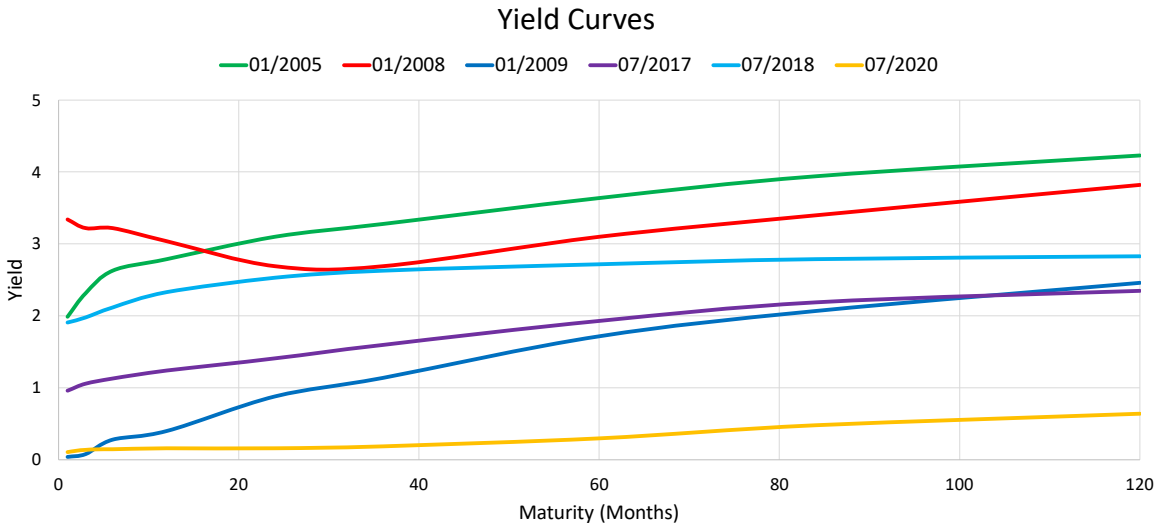
Credit Spreads over Time

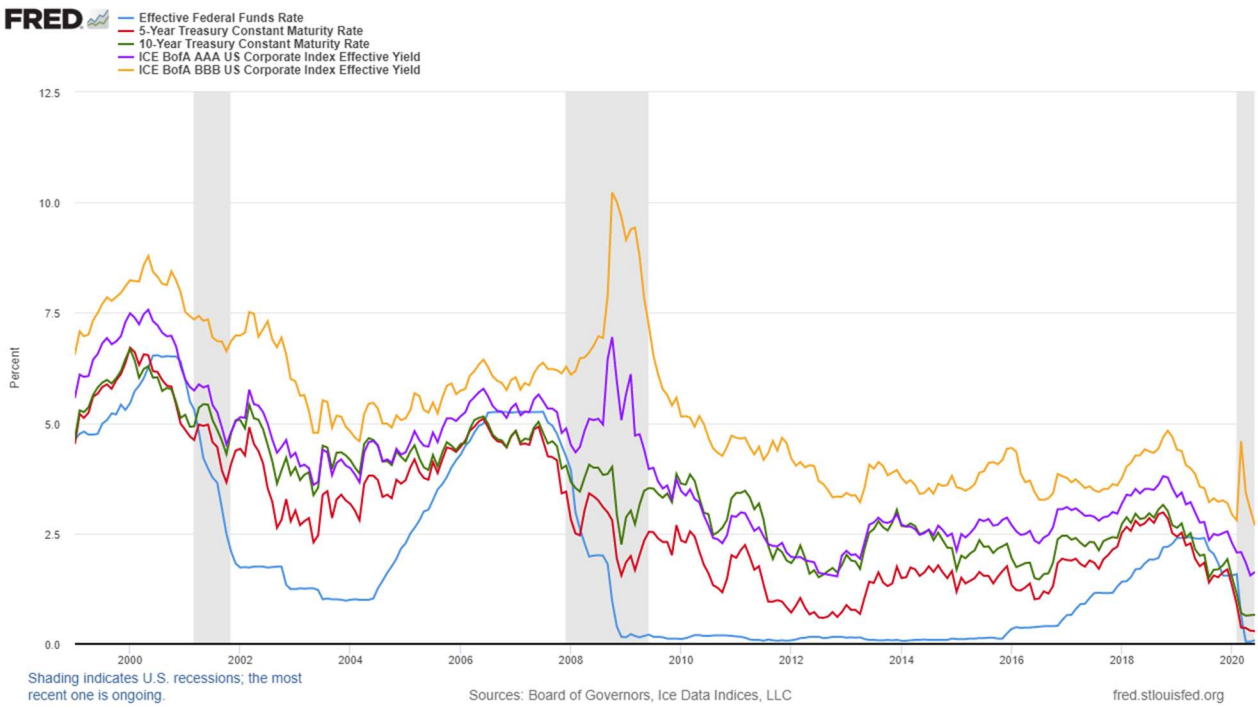


Yield Curve



Historic Yield Curves





Cost of Equity R_E

Via the CAPM, the cost of equity is

$$R_i = R_f + \beta_i(R_M - R_f)$$

- R_i: Expected return on asset i
- β_i: Asset i's beta
- R_M: Expected return on market
- R_f: Risk-free rate

CAPM Interpretation

$$R_i - R_f = \beta_i \times \left(R_M - R_f\right)$$

- $R_i - R_f$: Risk premium on asset i
  - The price of asset i's risk
- β_i: Comovement of asset i with the market
  - Quantity of market risk
- $R_M - R_f$: Market risk premium
  - Price of market risk

- Interpretation

$$\text{Price of Asset } i\text{'s Risk} = \text{Quantity of Market Risk} \times \text{Price of Market Risk}$$

Estimating CAPM via Regression Analysis

- CAPM: $R_i - R_f = \beta_i \times \left(R_M - R_f\right)$
- Regression: $y = \alpha + \beta \cdot x$
  - Seek to explain y with x
  - Regress y onto x
  - Estimate y-intercept α and slope β
- Apply regression to CAPM
  - $y \equiv R_i - R_f$
  - $x \equiv R_M - R_f$
  - Seek to explain asset i's excess returns with market excess returns
  - Regress asset i's excess returns onto market excess returns

Risk Decomposition

- To price asset i, we can decompose asset i's risk premium into

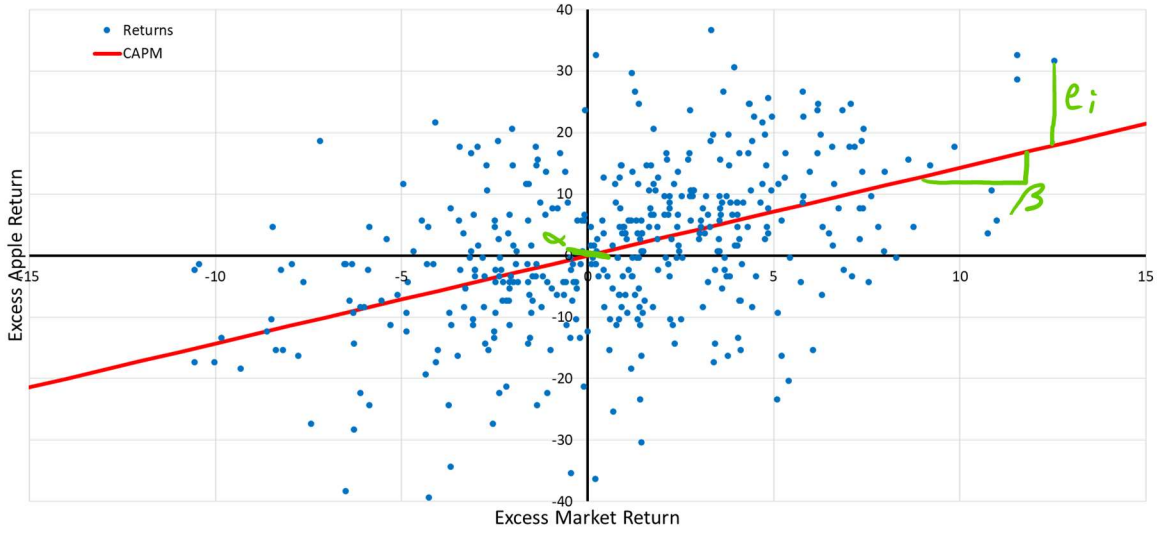
$$RP_i = \hat{\alpha}_i + \hat{\beta}_i \cdot RP_M$$

- RP_i: Risk premium on asset i
  - The price of asset i's risk
- β_i: Comovement of asset i with the market
  - Quantity of market risk
- RP_M: Market risk premium
  - Price of market risk

- Interpretation

$$\text{Price of Asset } i\text{'s Risk} = \text{Quantity of Market Risk} \times \text{Price of Market Risk}$$

Apple's CAPM Estimation



Apple's CAPM Interpretation

- Market's monthly risk premium: $R_M - R_f = 0.62\%$
- Apple's monthly risk premium: $R_A - R_f = 1.84\%$
- Apple's beta: $\beta_A = 1.42$

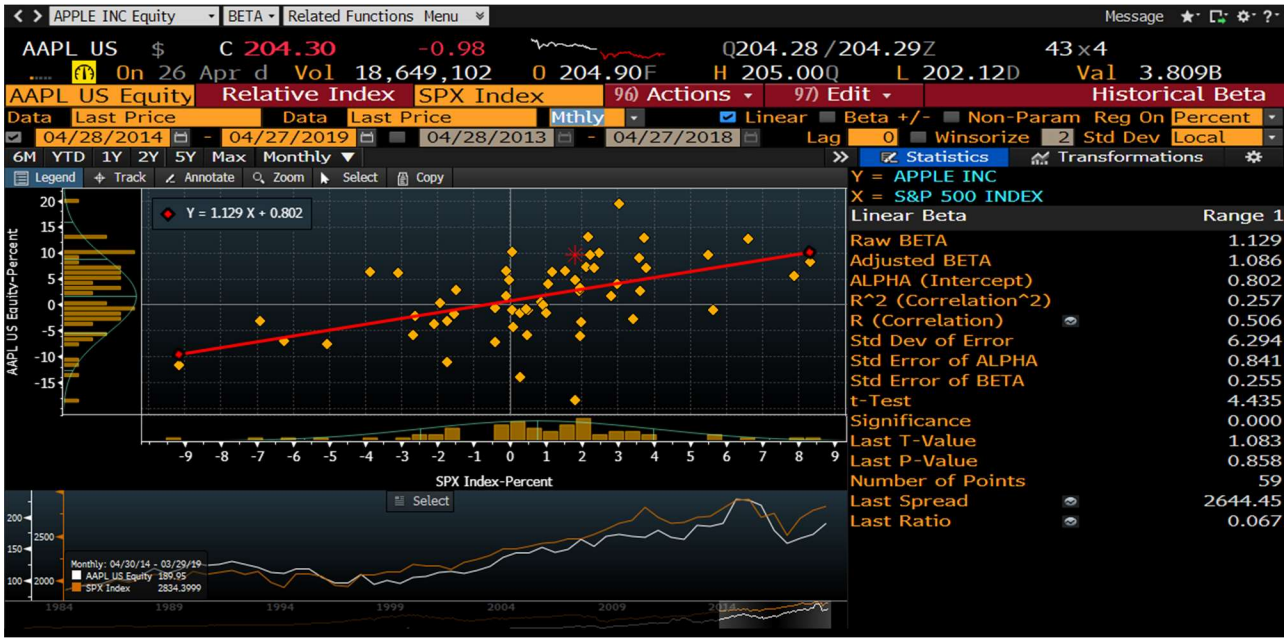
- Risk premium decomposition:

$$R_A - R_f = \beta_A \times (R_M - R_f)$$
$$1.84\% \approx 1.42 \times 0.62\%$$

- Annualized:

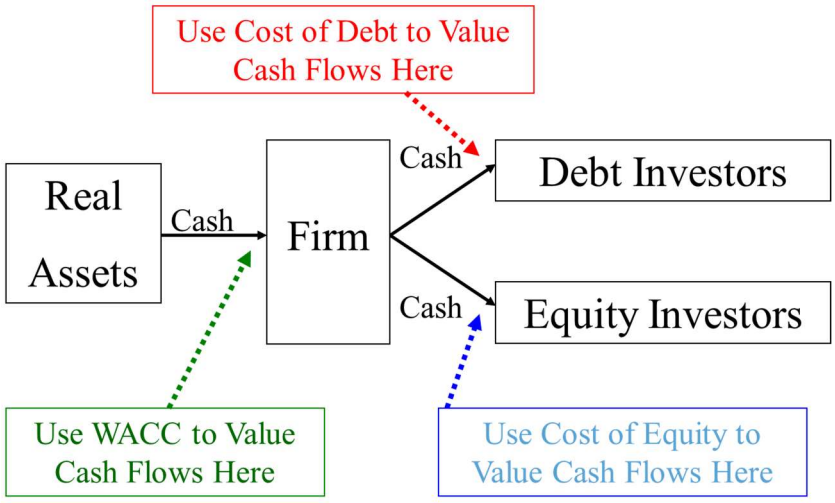
$$22\% \approx 1.42 \times 7.4\%$$

Apple's $\beta > 1$



Procter & Gamble's $\beta < 1$

Cost of Capital



Why Do We Care?

- If you overestimate the WACC, you will…
  - Reject profitable projects
- If you underestimate the WACC, you will…
  - Accept unprofitable projects

WACC - Weighted Average Cost of Capital

$$R_{WACC} = \frac{D}{D+E} R_D(1-t) + \frac{E}{D+E} R_E$$

- WACC: R_{WACC}
- Cost of debt: R_D
- Cost of equity: R_E
- Firm's tax rate: t
- Market value of debt: D
- Market value of equity: E

Why do we need to adjust for tax?

	With debt		FCF (no debt)
EBIT	$100		$100
Interest	$3		$0
EBT	$97		$100
Taxes	97*33% = $32		100*33%=$33
Savings	$1M		

Adjust WACC for the savings

Financial Leverage

- Financial leverage (debt) magnifies the risk of a project for the shareholders
- The "asset beta" is an unlevered beta β_A
  - Measurement of the operational risk
- The "equity beta" is a levered beta β_E
  - Measurement of the total risk, including the impact of financial (leverage) risk
  - Financial leverage magnifies the risk of a project for the shareholders
- The relationship

$$\beta_E = \beta_A \left[1 + \frac{D}{E} \times (1 - t)\right]$$

Capital Structure & Financial Leverage

In practice, there are two common times a manager needs to account for financial leverage in their cost of equity calculations:

- When you are changing your capital structure, or
  - Need to unlever and relever based on your old and new capital structure
- When you are investing in a new business model whose risk profile is different from your existing line of business.
  - Need to identify a pure play, measure their equity beta, and unlever with their capital structure
  - Relever with your own capital structure to find your own equity beta

Optimal Capital Structure

- Increased use of debt has the following results:
  - Higher financial leverage will increase the value of debt's tax shield
  - Higher financial leverage may increase cost of debt due the increase likelihood of bankruptcy
  - In practice, mangers should choose their capital structure such that they equate the marginal benefit of debt's tax shield with the marginal cost of bankruptcy

Summary

- WACC

$$R_{WACC} = \frac{D}{D+E} R_D (1-t) + \frac{E}{D+E} R_E$$

- Cost of Debt: $R_D = R_f + RP_D$
- Cost of Equity: $R_E = R_f + \beta_E \times RP_M$

- Equity Beta

$$\beta_E = \beta_A \left[1 + \frac{D}{E} \times (1-t) \right]$$