Review of FIN 300 topics (part 2)
FIN 300 – Principles of Finance

Lecture 26
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COLLEGE OF BUSINESS
COLORADO STATE UNIVERSITY

Discussion Topics

- We will spend the time in class today going through key takeaways from the lectures that covered the topics in PowerPoint files 11 - 15.
- We won’t have time to go into detail about everything, but our class discussion is intended to help you remember some of the key points from the second half of the semester.
- As discussed in class, the final exam will cover key topics from earlier in the semester in addition to the topics covered since midterm 2.

Example review questions related to PowerPoint file 11

1. How is total risk measured in finance? How is systematic risk measured?
2. What happens to the total risk of a portfolio as you increase the number of assets together in the portfolio?
3. What is the difference between “market” and “firm specific” risk? What are some synonyms for “market” risk? What are some synonyms for “firm specific” risk?
4. According to the CAPM, what type of risk is “compensated”? What is the CAPM equation? What are the inputs?
5. How do you estimate a beta?
6. Can you draw and interpret the SML and SCL figures?

Variance and standard deviation are measures of total risk

To estimate the variance using sample observations, take the arithmetic *average* of the squared deviations from the estimated mean. Population averages divide by n, sample averages divide by n-1.

$$\hat{\sigma}^2 = \left(\frac{1}{n-1} \sum_i (r_i - \bar{r})^2 \right)$$

Example:

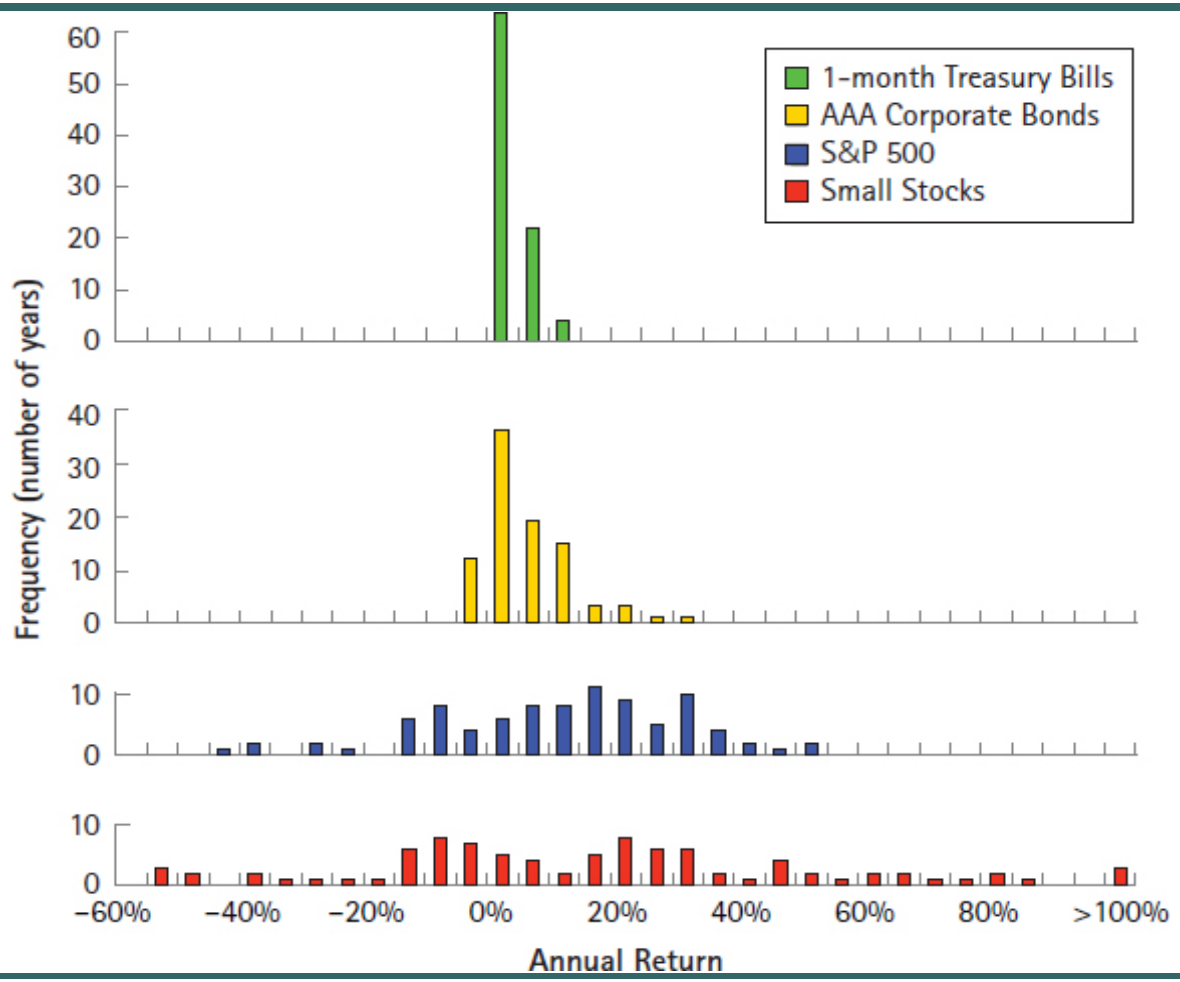
Sample of returns: 0.10, 0.05, 0, -.03 ➔ $\bar{r}$=.03

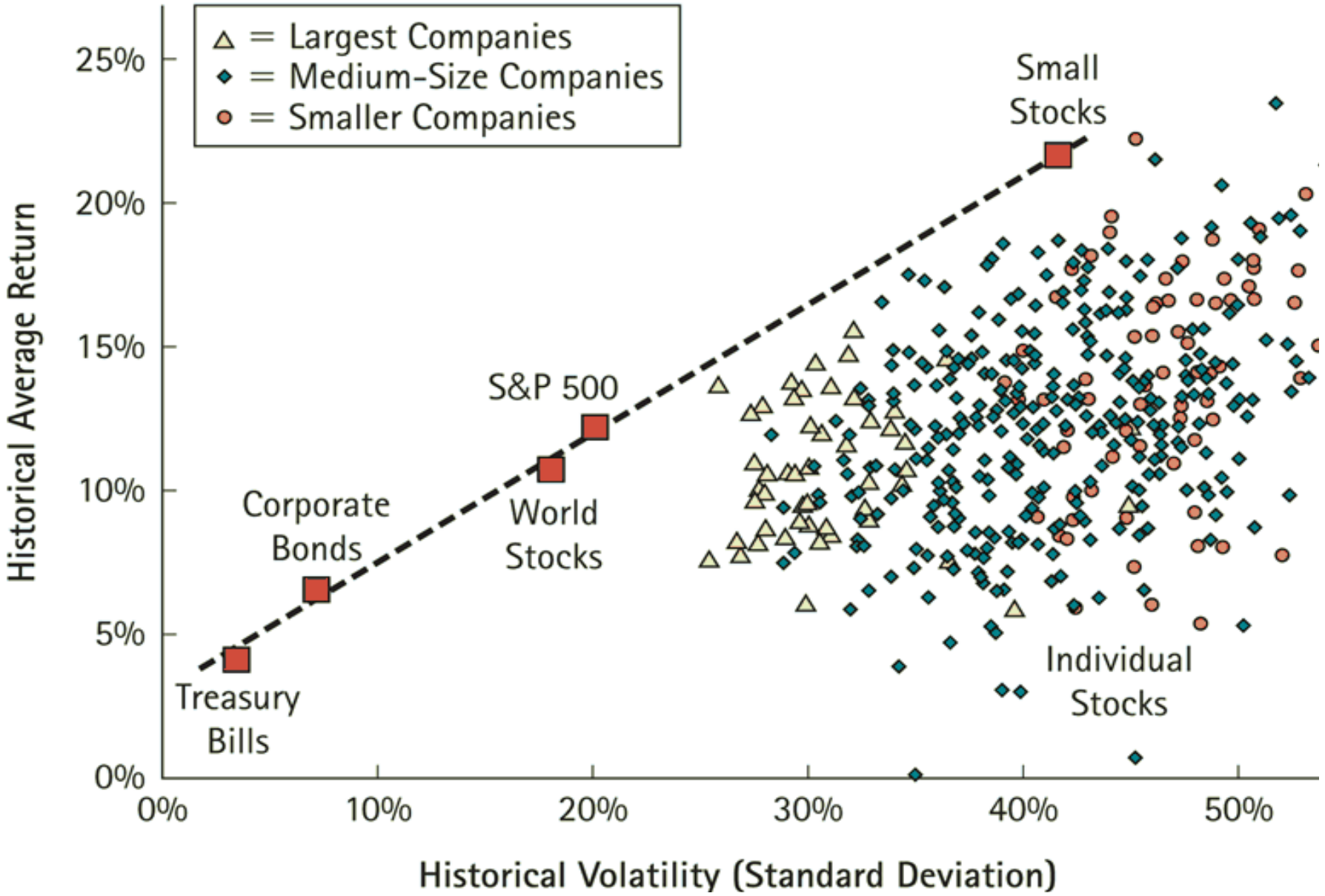
$$\hat{\sigma}^2 = \frac{1}{4-1}[(.10 - .03)^2 + (.05 - .03)^2 + (0 - .03)^2 + (-.03 - .03)^2]$$

=.003

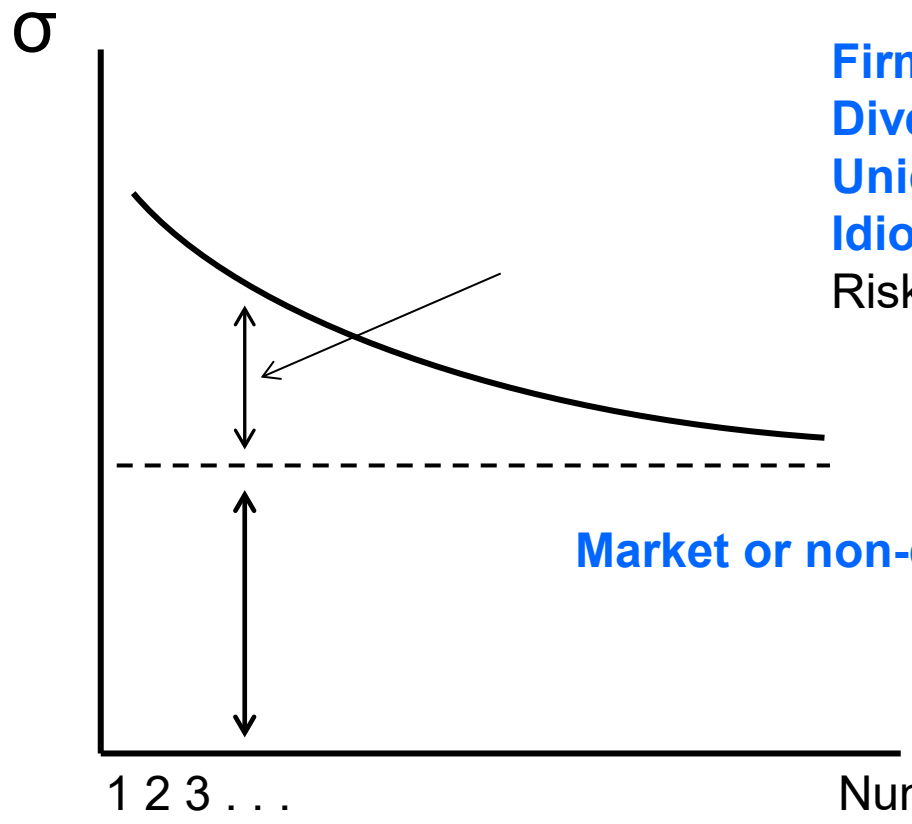
The distribution of annual returns (1926-2015) for…

Treasury Bills
Corporate Bonds
U.S. Large Stocks (S&P 500)
Small Stocks




△ = Largest Companies
◆ = Medium-Size Companies
○ = Smaller Companies
Small Stocks
S&P 500
World Stocks
Corporate Bonds
Treasury Bills
Individual Stocks
Historical Average Return
25%
20%
15%
10%
5%
0%
0%
10%
20%
30%
40%
50%
Historical Volatility (Standard Deviation)

Effect of diversification on firm specific risk in portfolio.



Firm or
Diversifiable or
Unique or
Idiosyncratic
Risk

Market or non-diversifiable Risk

CAPM

This portion of the formula calculates the risk premium to be added to the risk-free rate

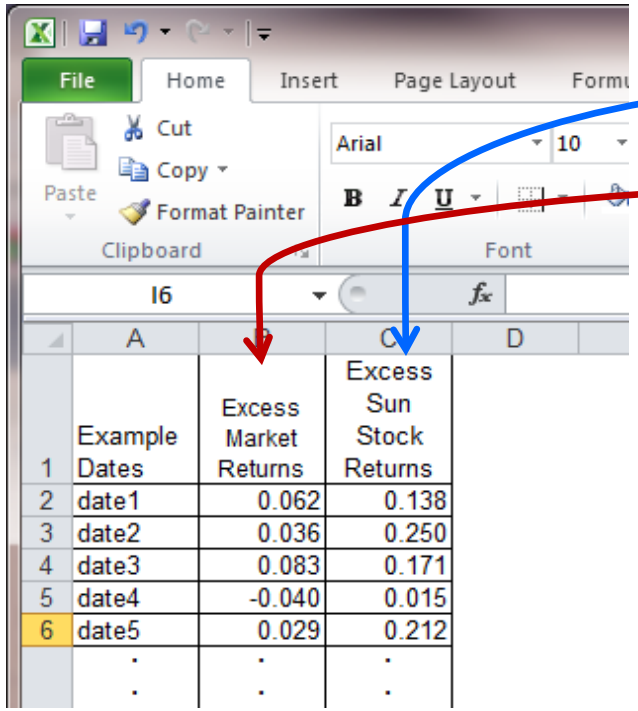
Model: $E[r_i] = r_f + \beta_i * (E(r_M) - r_f)$

Intuition: The **expected return on asset i** is higher than the **return on the risk-free asset** by the risk premium.

The beta measures the amount of systematic risk in asset i. The market risk premium is **a fair return for each unit of systematic risk.**

To estimate an equity beta from a regression you need two columns of historical return data as shown below. You can also view the data in a scatterplot as shown on the next slide.

The top 5 rows of data are copied from the example excel file below. In the file there are more data points.

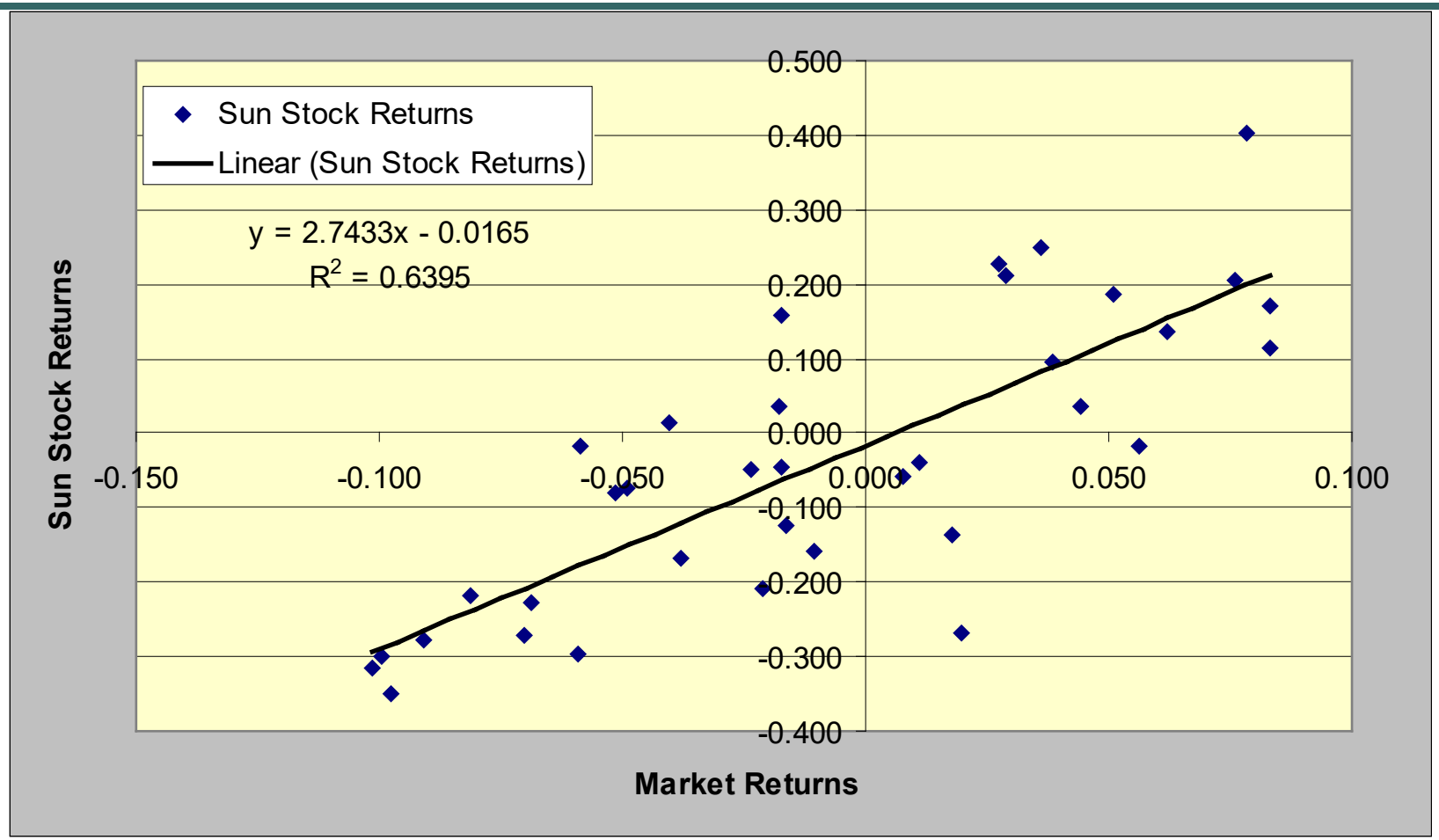


	Example Dates	Excess Market Returns	Excess Sun Stock Returns
2	date1	0.062	0.138
3	date2	0.036	0.250
4	date3	0.083	0.171
5	date4	-0.040	0.015
6	date5	0.029	0.212

Dependent variable

Explanatory variable

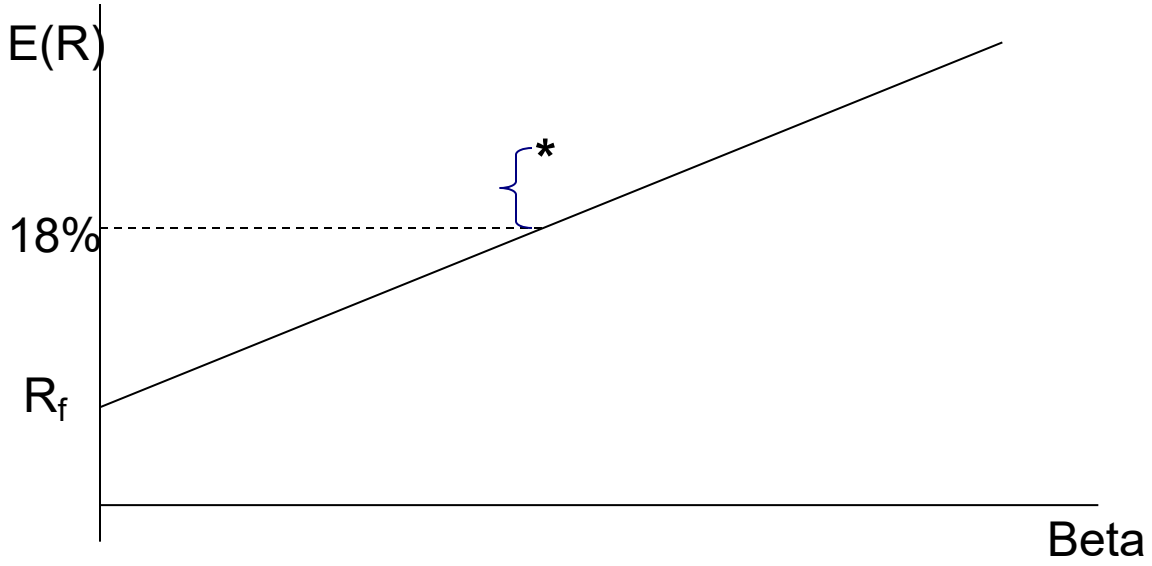
The beta measures the slope of the trend line. What does the R-squared mean?



Security Market Line (SML) and Alphas
CAPM: $E(r_i) = r_f + \beta_i * (E(r_m) - r_f)$

If stock i provided a 20% return in a given year and was expected (given its B_i and the other CAPM inputs) to only provide 18%, then the alpha is shown as the vertical difference between the SML and the actual return (*).

The **alpha** is a measure of over and under performance.



Example review questions related to PowerPoint file 13

1. What are some of the key differences between owning debt versus equity?
2. What are 3 ways to solve for the cost of equity?
3. Share price can be modeled using a DCF approach with TVM formulas. What are 3 approaches for modeling infinite series of cash flows?
4. How do these models change if we focus on FCFs instead of dividends?
5. The terminal value is usually modeled as a perpetuity or as a growing perpetuity.
6. How do you use a multiple to do a relative valuation?

How are debt and equity claims similar? How do they differ?

Key Characteristics	Differences
Nature of claim on cash flows	fixed vs residual?
Priority of claim on cash flows	primary vs secondary?
Maturity	finite vs ongoing?
Managerial control	ownership?
Expected return/risk	risk?

Important intuition: Debt contracts tend to have fixed claims on cash flows that have higher priority than equity claims. This is why debt tends to be less risky (lower variability in returns) and to have lower average returns across time than equity. Equity contracts lay claim to the upside and represent ownership in the firm.

Key ideas related to common stock ownership

- Common shares grant ownership claims to all future residual cash flows.
- Common shares have no maturity.
- Mangers can choose to distribute residual cash flows in the form of dividends or to retain the cash for future use.
- Common shares generally grant voting rights. Voting rights have value.

Important intuition: The value of a share today can be modeled as the present value of all future residual cash flows and voting rights. If you assume that "dividends" encompass the future residual cash flows then….

Share price today = PV(all future dividends) + value of voting rights

Three ways to calculate r_E

1. Common practice: Use the **CAPM** to find the cost of equity at firm j:

$$E(r_{E,j}) = r_f + \beta_{E,j}(E(r_m) - r_f)$$

2. Rough estimate – use the **constant growth model** to back out the cost of equity at firm j. Given the current dividend, an assumed growth rate and an observed price…

   Price = $D_1/(r_E - g)$

3. Very rough estimate – add 6% to the firm's cost of debt.

Bond and stock valuation using DCF approaches…

Bond price can be thought of as the present value of future coupons and face value.

$$Bond\ Price = \frac{coupon}{(1+r)^1} + \frac{coupon}{(1+r)^2} + \cdots + \frac{face\ value + coupon}{(1+r)^n}$$

The value of a share of stock can be thought of as the present value of expected future dividend payments and resale value.

$$Stock\ Price = \frac{E[div1]}{(1+r)^1} + \frac{E[div2]}{(1+r)^2} + \cdots + \frac{E[sale\ of\ stock\ n\ periods\ from\ now]}{(1+r)^n}$$

Key question for stock valuation: What will the future dividends be?

We will consider 3 approaches to modeling future dividends:

1. **Constant dividend (no growth)**
2. **Constant growth**
3. **Two stage** (high growth followed by constant growth)

Note that the same growth assumptions (and formulas) used with dividend can be used when modeling "**free cash flows**". We will discuss free cash flow modeling later in the lecture.

No-growth approach

With the **no growth** assumption for dividend growth:

$D_0 = D_1 = D_2 \ldots$

$\text{Price}_0 = \frac{D_0}{(1+r)^1} + \frac{D_0}{(1+r)^2} + \frac{D_0}{(1+r)^3} + \cdots$

$\mathbf{Price_0 = \frac{D_0}{r}}$

Constant growth approach

With the **constant growth** assumption:

$D_1 = D_0(1+g)$ and

$D_2 = D_1(1+g) = D_0(1+g)(1+g)$

$$\text{Price}_0 = \frac{D_0(1+g)^1}{(1+r)^1} + \frac{D_0(1+g)^2}{(1+r)^2} + \frac{D_0(1+g)^3}{(1+r)^3} + \cdots$$

$$\textbf{Price}_0 = \frac{D_1}{r-g} = \frac{D_0(1+g)^1}{r-g}$$

Example valuation using Caterpillar dividends and a constant growth model. Assume today is Jan 1, 2022.

Year	Annual Dividend	Dividend growth
2021	4.28	3.88%
2020	4.12	8.99%
2019	3.78	15.24%
2018	3.28	5.47%
2017	3.11	0.97%
2016	3.08	2.33%
2015	3.01	15.77%
2014	2.6	12.07%
2013	2.32	14.85%
2012	2.02	10.99%
2011	1.82	4.60%
2010	1.74	3.57%

Assumptions:

- Dividends will grow at 6% constantly forever
- Caterpillar's beta is .91, the risk-free rate is 3%, and the market risk premium is 5.5%. This means the cost of equity is 8%

$$Price = \frac{CF_0(1+g)}{r-g} = \frac{CF_1}{r-g}$$

$$Price = \frac{\$4.537}{.08-.06} = \$226.27$$

Two-stage approach (terminal value is in second stage)

With a two stage model:

Dividends are assumed to grow at a high rate (g_1) for the first N periods and then to grow at a lower stable rate (g_2) after N periods.

$$\text{Price}_0 = \left(\sum_{t=0}^{N} \frac{D_0(1+g_1)^t}{(1+r)^t}\right) + \left(\frac{D_N(1+g_2)^1}{(1+r)^{N+1}} + \frac{D_N(1+g_2)^2}{(1+r)^{N+2}} + \cdots\right)$$

$$\text{Price}_0 = \left(\sum_{t=0}^{N} \frac{D_0(1+g_1)^t}{(1+r)^t}\right) + \frac{\frac{D_N(1+g_2)}{r-g_2}}{(1+r)^N}$$

D_N is the "N"th future dividend.
$D_N*(1+g_2)$ is the "N+1" dividend.
$\frac{D_N(1+g_2)}{r-g_2}$ is in "year N" dollars.

Concept check

$$\text{Price}_0 = \left(\sum_{t=0}^{N} \frac{D_0(1+g_1)^t}{(1+r)^t}\right) + \frac{\left[\frac{D_N(1+g_2)}{r-g_2}\right]}{(1+r)^N}$$

1. Describe what type of model this is.
2. What stage of the life cycle would this type of model be used for?
3. Describe what D_0 is.
4. Describe what r is.
5. How is g_2 different than g_1?
6. Describe what the formula in the square brackets in the numerator of the second term means. What purpose does the $(1+r)^N$ serve?

Three ways to write the same thing

$$(1)\ \text{Share value} = \frac{D_1}{(1+r)^1} + \frac{D_2}{(1+r)^2} + \frac{D_3}{(1+r)^3} + \frac{D_4}{(1+r)^4} + \frac{D_5}{(1+r)^5} + \frac{D_6}{(1+r)^6} + \frac{D_7}{(1+r)^7} + \ldots$$

$$(2)\ \text{Share value} = \left(\sum_{t=1}^{4} \frac{D_t}{(1+r)^t}\right) + \left(\frac{PV\ in\ year\ 4\ dollars\ of\ all\ dividends\ after\ t=4}{(1+r)^4}\right)$$

$$(3)\ \text{Share value} = \left(\sum_{t=1}^{4} \frac{D_t}{(1+r)^t}\right) + \left(\frac{PV\ in\ year\ 5\ dollars\ of\ all\ dividends\ after\ t=4}{(1+r)^5}\right)$$

There are 2 ways of thinking about the "**terminal value**". The numerator in the second part of (2) would be in year 4 dollars if a constant growth formula were used $\left(PV_4 = \frac{D_5}{r-g}\right)$ to estimate the value of all future dividends. The numerator in the second part of (3) would be in year 5 dollars if it were the sales value from selling the stock in year 5.

Dividend discount model vs discounted free cash flow model

- In the previous valuation examples, we focused on the dividends and discounted them using the **equity cost of capital**.
- Using a related valuation approach, we could instead value the entire firm (not just the equity) by discounting the cash flows that pertain to both the equity and debt holders using the **WACC**.
- These cash flows are the **free cash flows**.

Discounted free cash flow model

$$Enterprise\ value = \frac{FCF_1}{(1+wacc)^1} + \frac{FCF_2}{(1+wacc)^2} + \cdots$$

The PV of FCFs is equal to the **enterprise value** which is a measure of firm value. The words "firm value" are used in different ways. Sometimes "enterprise value" is referred to as "firm value" and sometimes "enterprise value + cash" is referred to as "firm value".

Note that the PV of future FCFs (equation shown above) does not include the cash already in place. I.e., if a firm has a large amount of excess cash then

Firm value (with cash) = D + E = Enterprise value + cash

All 3 of these firm value expressions are the same if the projected future FCFs are the same

$$\text{Firm Value} = \frac{FCF_1}{(1+wacc)^1} + \frac{FCF_2}{(1+wacc)^2} + \frac{FCF_3}{(1+wacc)^3} + \frac{FCF_4}{(1+wacc)^4} + \frac{\boldsymbol{FCF_5}}{\boldsymbol{(1+wacc)^5}} + \frac{\boldsymbol{FCF_6}}{\boldsymbol{(1+wacc)^6}} + \frac{\boldsymbol{FCF_7}}{\boldsymbol{(1+wacc)^7}} + \boldsymbol{\ldots}$$

$$Firm\ Value = \sum_{t=1}^{\infty} \frac{FCF_t}{(1+wacc)^t}$$

$$Firm\ Value = \left(\sum_{t=1}^{4} \frac{FCF_t}{(1+wacc)^t}\right) + \left(\frac{\boldsymbol{Terminal\ Value}}{\boldsymbol{(1+wacc)^4}}\right)$$

The terminal value can be modeled using a constant growth model. In this example the "Terminal Value" would be in year 4 dollars and the formula would be $\frac{FCF_5}{wacc-g}$. This needs to be divided by $(1+wacc)^4$ to bring it to year 0.

Concept check - Firm value

1. The firm value is the present value of what types of cash flows?
2. What is the appropriate discount rate for these cash flows?
3. If a firm has no debt, is the firm value the same as the equity value?
4. How do you convert an earnings number to a free cash flow number? What is the intuition behind the formula?
5. Free cash flows extend indefinitely into the future. How do you model an infinite series of cash flows?
6. How do you choose a growth rate when forecasting cash flows?
7. What would you need to do to the firm value in order to use it to then calculate the value of a single share of stock?

Relative valuation

In relative valuation, the value of an asset is derived from the pricing of “comparable” assets, standardized using a common variable such as earnings, cash flows, book value or revenues.

Examples include --

- Price/Earnings (P/E) ratios and variants (EBIT multiples, EBITDA multiples, Cash Flow multiples)
- Price/Book (P/BV) ratios and variants (Tobin's Q)
- Price/Sales ratios

Example of relative valuation

Summary information from the previous table
Average P/E ratio for software firms: 28.41 "benchmark PE"
Average PEG ratio for software firms: 1.4 "benchmark PEG"

Assume a software company Z had earnings of $977,300 and expected growth in earnings of 27.03%. What is Z's value of equity?

Using the P/E ratio: $977,300 * 28.41 = $27.765 million

Logic: $firm\ value = firm's\ \mathbf{earnings} * \frac{benchmark\ price}{benchmark\ \mathbf{earnings}}$

Using the PEG ratio: = $977,300 * 27.03 * 1.40 = $ 37.056 million

Logic: $firm\ value = firm's\ \mathbf{earnings} * \mathbf{growth} * \frac{benchmark\ price}{benchmark\ \mathbf{earnings} * \mathbf{growth}}$

Example review questions related to PowerPoint file 14

1. What is the WACC formula? What are the inputs?
2. What effect does debt have on taxes? On firm value? On probability of default?
3. What kinds of characteristics would make debt more valuable for one firm compared to another?
4. What does M&M say about capital structure?
5. How much is the tax shield worth? Under what conditions is the value of the tax shield estimated as t*D?

The weighted average cost of capital

The WACC summarizes the after-tax cost of capital to the firm from all sources of financing. Assuming no preferred stock, the weights are the % of equity and debt in the capital structure.

$$WACC = r_E\left(\frac{E}{D+E}\right) + r_D(1-t)\left(\frac{D}{D+E}\right)$$

WACC inputs

- r_E : Cost of equity (CAPM, constant growth, or ~6% + cost of debt)
- r_D : Cost debt (YTM on straight debt, tables that relate cost of debt to ratings or synthetic ratings)
- E: market value of equity
- D: market value of debt (often approximated using book value of debt)
- t : corporate tax rate

As debt increases in the capital structure…

- Tax payments decrease
- Initially firm value goes up (because of saved taxes), but eventually firm value decreases (because of the negative valuation effects of financial distress)
- The probability of default goes up
- The return on equity is leveraged (both bad and good outcomes are more extreme)

Debt tends to work better at firms….

That have relatively more tangible assets, are more profitable, and tend to have relatively less variability in earnings.

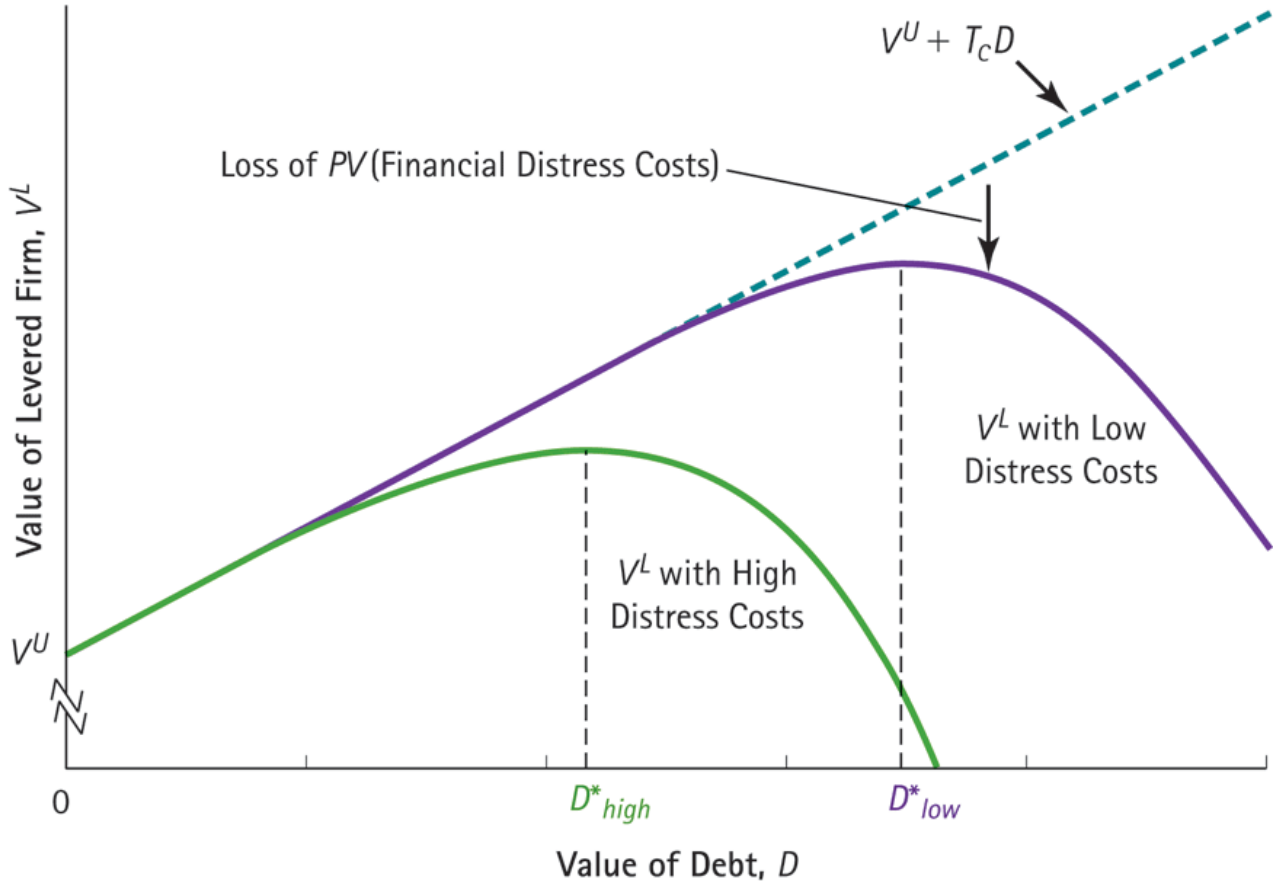
M&M

Miller and Modigliani showed that under certain assumptions the capital structure was not important for firm value. These assumptions are described collectively in the lecture as “perfect capital markets”.

These assumptions are violated in the real world and show why/how debt matters for firm value.

- Taxes
- Transaction/Information Costs
- Investment Policy

Figure 16.8: Optimal Leverage with Taxes and Financial Distress Costs



Concept check

$V_L = V_U + t * D - PV(\text{Financial distress})$

- What is V_L?
- How is V_L related to V_U?
- What does t*D represent?
- How might you get a sense of how much the PV of financial distress costs equals?

Example from the lecture

The interest tax shield each year is calculated at the tax rate times interest expense. The overall value of the tax shield would be the present value of all the annual savings.

($ million)	**2014**	**2015**	**2016**	**2017**
Interest expense	20	25	25	30
Interest tax shield (35% × interest expense)	7	8.75	8.75	10.5

Why (when?) is the debt tax shield = t*D?

Assumptions:

- Interest expense this year = r_D* D
- Tax savings this year = t * r_D* D
- These savings occur every year (in perpetuity)
- r_D measures the riskiness of the annual tax shield

If all of these assumptions hold then the PV of the annual tax shield = (t * r_D* D) ÷ r_D = t * D

Example review questions related to PowerPoint file 15

1. What information is incorporated into stock prices?
2. If prices are “efficient”, then what information can we use to predict future price changes?
3. Even if prices are generally “efficient”…

Any information that changes expect future cash flows or investors' views on risk will change the stock price.

Today's firm value can be thought of as the present value of future cash flows.

$$Firm\ Value = \sum_{t=1}^{\infty} \frac{E[FCF_t]}{(1 + WACC)^t}$$

This means that any news that causes investors to either…

(1) revise their expectations for future cash flows, or

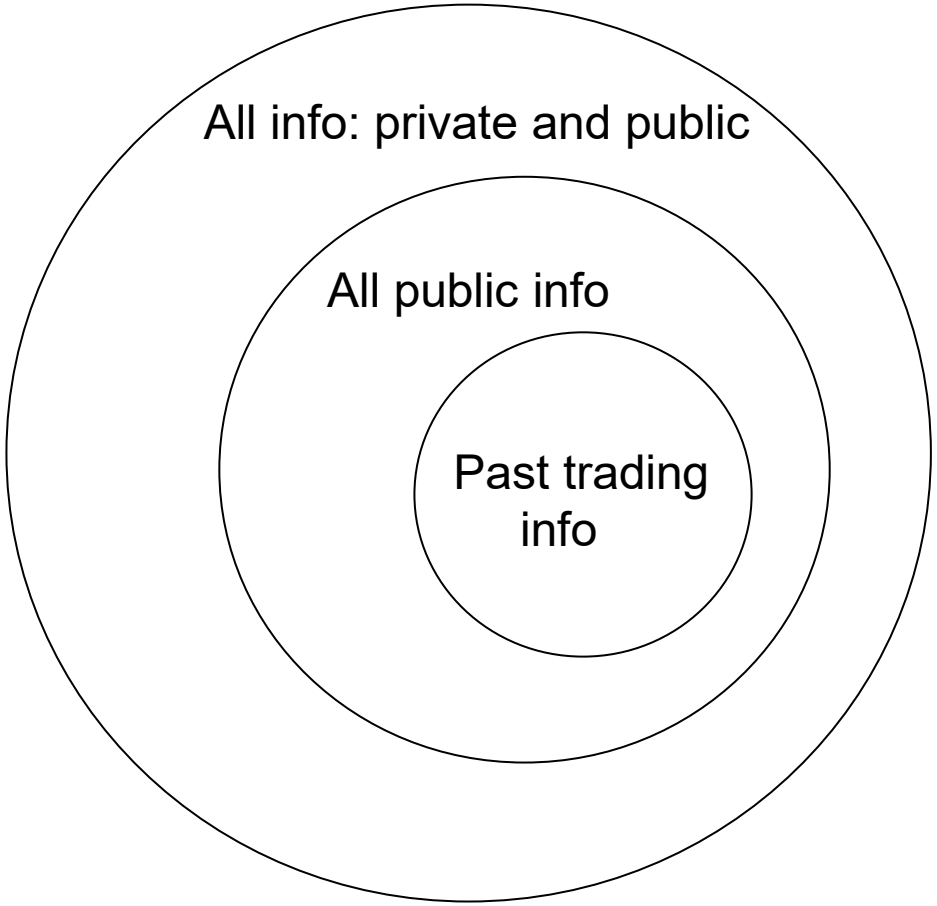
(2) to revise their opinion about the risk in the firm (and hence the WACC) would cause today's stock price to change.

If prices already incorporate all this information, can we predict future returns? If so, what information would we use to do it?

Efficient market hypothesis: Security prices are "efficient" in that they already reflect information.

Important Intuition: This means it is difficult to predict future returns using current information because the current information is already, to some extent, reflected in the current price.

Information sets related to 3 forms of market efficiency (strong, semi-strong, and weak-form efficiency)



Examples of non-efficiency – "limits to attention"?

- Repeated news announcements
- Friday announcements
- High news days
- Market reaction to wrong company (investors mistakenly trade in the wrong stock around a negative event at another firm)
  - Herballife in Jan 2013
  - Twitter vs Tweeter Oct 2014
  - Graco Inc vs Graco Children's Product Inc
  - Nest Labs vs NEST
  - Castle Convertible Fund (ticker CVF) drops 32% in 1 day due to Financial Times article about Czech Value Fund abbreviated CVF being investigated for fraud. (See discussion in Journal of Finance "Massively Confused Investors".)
- Other anomalies
  - Time of day matters (see next slide)

Thank You –

I hope you have enjoyed FIN 300.

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