Valuing Stocks, Risk Analysis and Portfolio Investment

MOT111A Financial Management: Lecture 4

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Course Outline & Schedule

All lectures and workshops are mandatory and are held at 10:45-12:30 hours
Coffee hours are informal and voluntary and are held at 10.45-11.45 hours

Activity	Instructor*	Date	Location^	Topic	Material
Lecture 1	ZK	Tue 5 Sept	Flux Hall A	Introduction and financial statement analysis	Book chapters 1 (all) & 2 (all)
Workshop 1	AR	Thu 7 Sept	Flux Hall A	Exercises based on lecture 1	Lecture 1
Lecture 2	ZK	Tue 12 Sept	Echo-Hall B1	Evaluating investment opportunities	Chapters 3(3.1-3.4), 4 (all), 5(all) & 7 (all)
Coffee Hour	ZK/AR/WK	Thu 14 Sept	TPM Canteen		
There is no activity in the week of 18-22 September 2023 due to the MOT Introduction Week					
Lecture 3	AR	Tue 26 Sept	Echo-Hall B1	Long-term financing and financial markets Valuing bonds	Slides + Chapter 6 (all)
Workshop 2	AR	Thu 28 Sept	Flux Hall A	Exercises based on lectures 2 & 3	Lectures 2 & 3
Lecture 4	ZK	Tue 3 Oct	Echo-Hall B1	Valuing stocks Risk analysis and portfolio investment	• Chapter 9 (9.1-9.2) • Chapters 10: 10.1-10.3, 10.6-10.8 • Chapter 11: 11.1-11.2, 11.4 (until Example 11.9, p.404), 11.7-11.8
Workshop 3	AR	Thu 5 Oct	Flux Hall A	Exercises based on lecture 4	Lectures 4
Lecture 5	ZK	Tue 10 Oct	Echo-Hall B1	Cost of capital and Capital structure	• Chapter 12: 12.1, 12.5-12.7 • Chapters 14 (all) & 15 (all)
Coffee Hour	ZK/AR/WK	Thu 12 Oct	TPM Canteen		
Lecture 6	ZK	Tue 17 Oct	Echo-Hall B1	Financial distress and payout policy	Chapters 16 (16.1-16.4) & 17 (17.1-17.4)
Workshop 4	AR	Thu 19 Oct	Flux Hall A	Exercises based on lectures 5 & 6	Lectures 5 & 6
Guest Lecture	*To be announced*	*Tue 24 Oct*	Echo-Hall B1	*To be announced*	*Slides*
Coffee Hour	ZK/AR/WK	Thu 26 Oct	TPM Canteen		
Lecture 7 (Final)	ZK & AR	Thu 31 Oct	Echo-Hall B1	Q&A + Practice Exam	All materials discussed in Lectures 1-6

* ZK = Zenlin Roosenboom-Kwee; AR = Aleksandrina Ralcheva; WK = Wesley Kool
^ Locations can be viewed at: https://esviewer.tudelft.nl/

Lecture 4 Outline

VALUING STOCKS WITH DIVIDEND-DISCOUNT MODEL (DDM)

RISK ANALYSIS

PORTFOLIO INVESTMENT

Lecture 4 Learning Objectives

1. Understand stocks as a financial instrument (cf. bonds).

2. Use the dividend-discount model to compute the value of a dividend-paying company's stock, whether the dividends grow at a constant rate starting now or at some time in the future.

3. Understand the notions and the common measures of risk, risk premium and return.

4. Understand the concepts of systematic vs. unsystematic risks and the role of diversification.

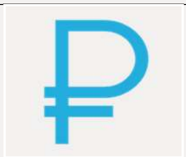
5. Define an efficient portfolio and a market portfolio.

6. Understand and apply capital asset pricing model (CAPM) to calculate the expected return for a risky security like stocks and/or to calculate the cost of capital for a particular project.

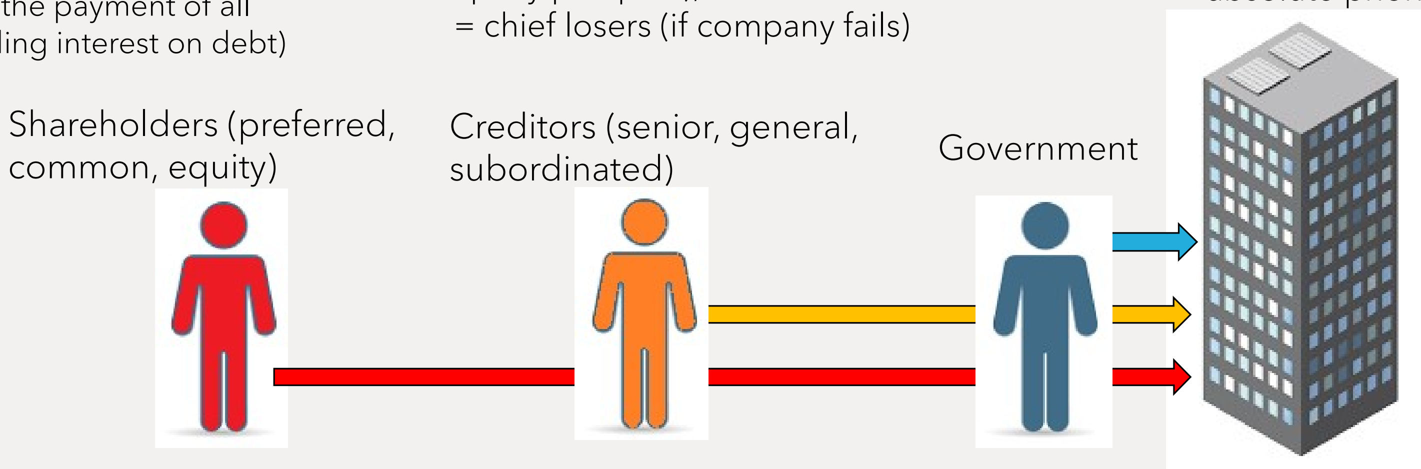
Common stock

Residual income security because the stockholder has a claim on any income remaining after the payment of all obligations (including interest on debt)

Stockholders = chief beneficiaries (if company prospers); but stockholders = chief losers (if company fails)



Rights in liquidation (the rights of absolute priority)



Issuing Stocks or Bonds?

	Stock (Equity) Financing	Bond (Debt) Financing
Ownership	Gives up ownership to investors	No ownership rights are given up
Tax implications	Dividends are not tax deductible	Interest on debt is tax deductible
Set payments	Dividends are not required to be paid	For coupon bonds, interest (coupon) payments are legally required to be made
Amount of payments	Dividend payment at the firm's discretion	Coupon payments are legally required to be specified
Time limit of payments	No limit	Time limit (maturity) is part of bond agreement

The Dividend Discount Model

- A One-Year Investor
  - Potential Cash Flows
    - Dividend
    - Sale of Stock
  - Timeline for One-Year Investor

- Since the cash flows are risky, we must discount them at the equity cost of capital.

$$P_0 = \left(\frac{Div_1 + P_1}{1 + r_E} \right)$$

Dividend Yields, Capital Gains, and Total Returns

$$r_E = \frac{Div_1 + P_1}{P_0} - 1 = \underbrace{\frac{Div_1}{P_0}}_{\text{Dividend Yield}} + \underbrace{\frac{P_1 - P_0}{P_0}}_{\text{Capital Gain Rate}}$$

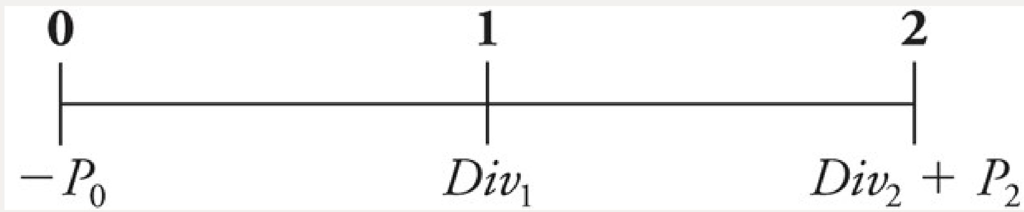
- Dividend Yield
- Capital Gain
  - Capital Gain Rate
- Total Return
  - Dividend Yield + Capital Gain Rate
    - *The expected total return of the stock should equal the expected return of other investments available in the market with equivalent risk.*

Illustration

- Problem
  - 3M (MMM) just paid a dividend of $4.50 per share.
  - You expect the stock price will be $178.50 and the dividend to be 5% higher by the end of the year.
  - Investments with equivalent risk have an expected return of 11%.
  - Based on the Dividend-Discount Model, what would you pay today for 3M stock?

A Multi-Year Investor

- What is the price if we plan on holding the stock for two years?



$$P_0 = \frac{Div_1}{1 + r_E} + \frac{Div_2 + P_2}{(1 + r_E)^2}$$

The Dividend-Discount Model Equation

- What is the price if we plan on holding the stock for N years?

$$P_0 = \frac{Div_1}{1 + r_E} + \frac{Div_2}{(1 + r_E)^2} + \cdots + \frac{Div_N}{(1 + r_E)^N} + \frac{P_N}{(1 + r_E)^N}$$

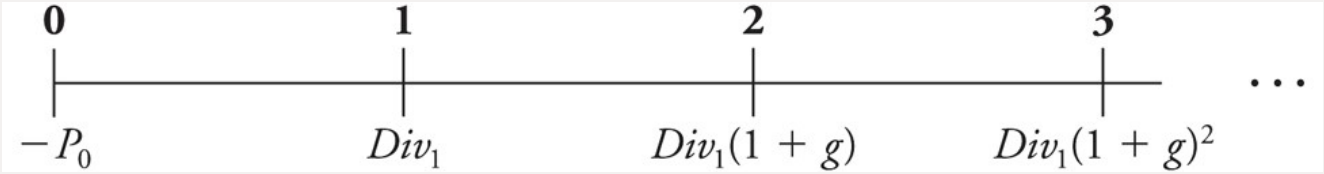
  - This is known as the Dividend Discount Model.

$$P_0 = \frac{Div_1}{1 + r_E} + \frac{Div_2}{(1 + r_E)^2} + \frac{Div_3}{(1 + r_E)^3} + \cdots = \sum_{n=1}^{\infty} \frac{Div_n}{(1 + r_E)^n}$$

The price of any stock is equal to the present value of the expected future dividends it will pay.

Applying the Dividend-Discount Model

- Constant Dividend Growth
  - The simplest forecast for the firm's future dividends states that they will grow at a constant rate, g, forever.



$$P_0 = \frac{Div_1}{r_E - g} \Rightarrow r_E = \frac{Div_1}{P_0} + g$$

Example Constant Dividend Growth

- Problem
  - AT&T plans to pay $1.44 per share in dividends in the coming year.
  - Its equity cost of capital is 8%.
  - Dividends are expected to grow by 4% per year in the future.
  - Estimate the value of AT&T's stock.

Dividends Versus Investment and Growth

- A Simple Model of Growth
  - Dividend Payout Ratio
    - The fraction of earnings paid as dividends each year

$$Div_t = \underbrace{\frac{\text{Earnings}_t}{\text{Shares Outstanding}_t}}_{EPS_t} \times \text{Dividend Payout Rate}_t$$

$$\text{Earnings Growth Rate} = \frac{\text{Change in Earnings}}{\text{Earnings}}$$

$$= \text{Retention Rate} \times \text{Return on New Investment}$$

$$g = \text{Retention Rate} \times \text{Return on New Investment}$$

Note: Retention rate is fraction of current earnings that the firm retains

Example

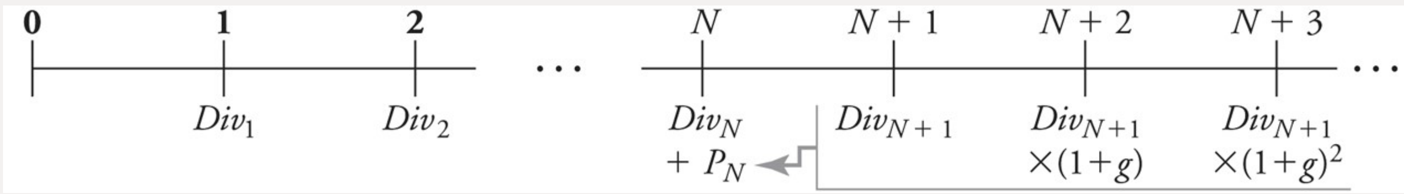
MOT, Inc., expects earnings at the end of this year of $4.19 per share, and it plans to pay a $2.43 dividend at that time. MOT will retain the rest of its earnings per share to reinvest in new projects with an expected return of 15% per year. Suppose MOT will maintain the same dividend payout rate, retention rate, and return on new investments in the future and will not change its number of outstanding shares.

a. What growth rate of earnings would you forecast for MOT?

b. If MOT's equity cost of capital is 12.2%, what price would you estimate for MOT stock today?

c. Suppose MOT considered increasing its dividend to $3.43 per share (instead of the original dividend of $2.43 per share) at the end of this year. If MOT maintains this higher payout rate in the future, what stock price would you estimate now? Should MOT raise its dividend?

Changing Growth Rates



$$P_N = \frac{Div_{N+1}}{r_E - g}$$

- Dividend-Discount Model with Constant Long-Term Growth

$$P_0 = \frac{Div_1}{1 + r_E} + \frac{Div_2}{(1 + r_E)^2} + \cdots + \frac{Div_N}{(1 + r_E)^N} + \frac{1}{(1 + r_E)^N}\left(\frac{Div_{N+1}}{r_E - g}\right)$$

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Example 9.5

EPS_0 = \$2
g (year 1-year 4) = 20%
g (year 5 onwards) = 4%
DPR (year 1 – year 4) = 0%
DPR (year 4 onwards) = 60%

	Year 0	1	2	3	4	5	6
Earnings							
1 EPS Growth Rate (versus prior year)		20%	20%	20%	20%	4%	4%
2 EPS	\$2.00	\$2.40	\$2.88	\$3.46	\$4.15	\$4.31	\$4.49
Dividends							
3 Dividend Payout Rate		0%	0%	0%	60%	60%	60%
4 Dividend		\$ —	\$ —	\$ —	\$2.49	\$2.59	\$2.69

$$P_3 = \frac{Div_4}{r_E - g} = \frac{\$2.49}{0.08 - 0.04} = \$62.25$$

$$P_0 = \frac{Div_1}{1+r_E} + \frac{Div_2}{(1+r_E)^2} + \frac{Div_3}{(1+r_E)^3} + \frac{P_3}{(1+r_E)^3} = \frac{\$62.25}{(1.08)^3} = \$49.42$$

Limitations of the Dividend-Discount Model

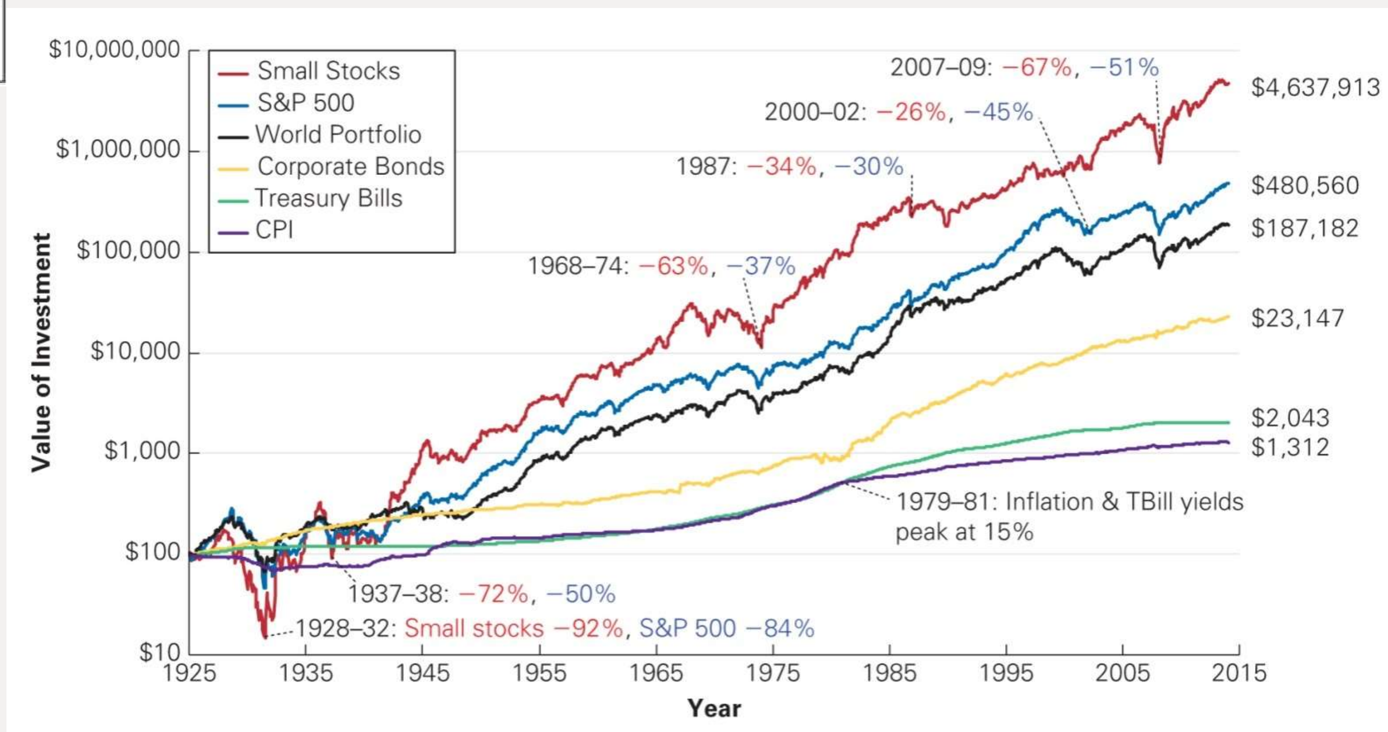
There is a tremendous amount of uncertainty associated with forecasting a firm's dividend growth rate and future dividends.

Small changes in the assumed dividend growth rate can lead to large changes in the estimated stock price.

Figure 9.1 A Comparison of Discounted Cash Flow Models of Stock Valuation

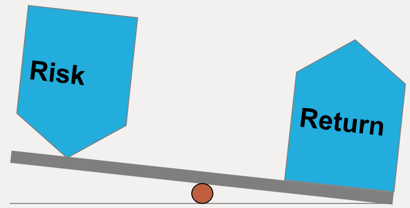
Present value of…	At the …	Determines the..
Dividend Payments	Equity cost of capital	Stock Price
Total Payouts (All dividends and repurchases)	Equity cost of capital	Equity Value
Free Cash Flow (Cash available to pay all security holders)	Weighted average cost of capital	Enterprise Value

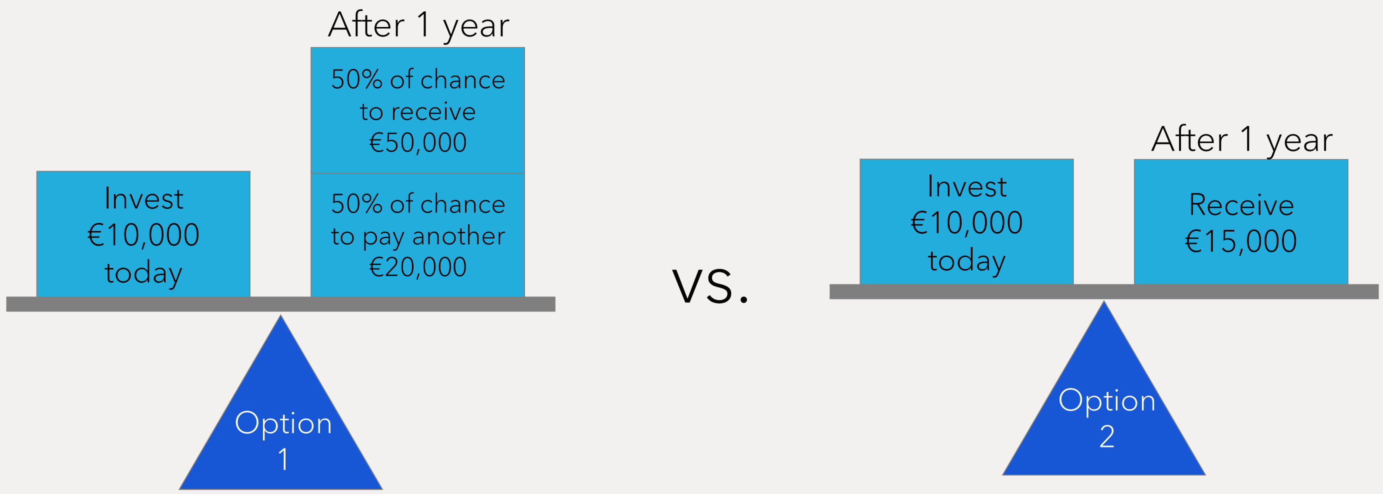
How would $100 invested at the end of 1925 have grown if it were placed in one of the following investments?



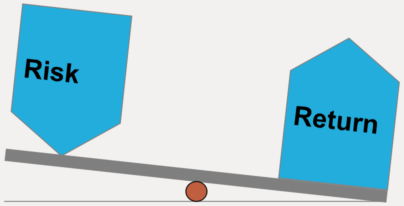
Source: Chicago Center for Research in Security Prices, Standard and Poor's, MSCI, and Global Financial Data.

Introduction to risk

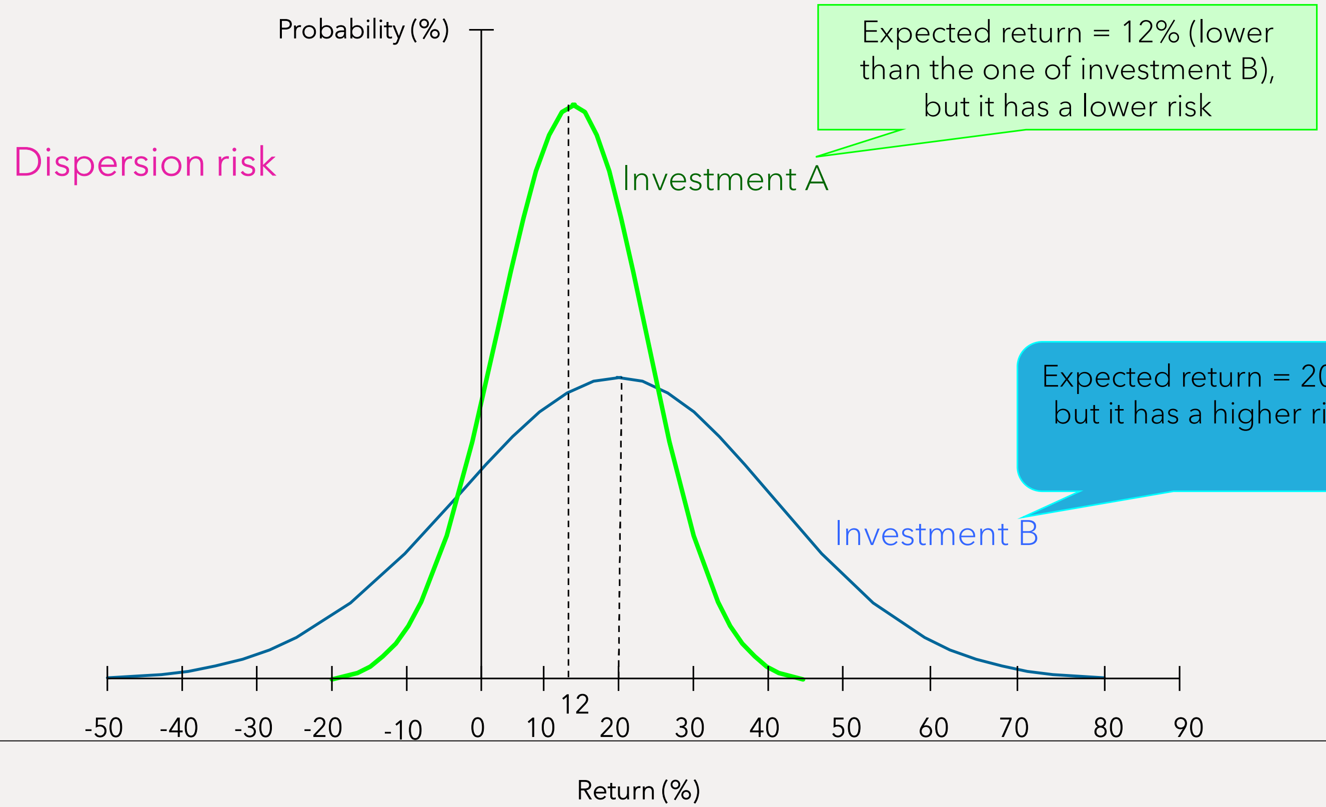




Introduction to risk



- Investment involves *risk* –*return* tradeoff



Calculating expected return and dispersion risk

Possible Returns (%)	Probability
8	0.4
12	0.3
18	0.3

$$\text{Expected Return} = E[R] = \sum_R P_R \times R$$

Expected return = (0.4 * 8%) + (0.3 * 12%) + (0.3 * 18%) = 12.2%

Dispersion risk = standard deviation of probability-weighted average

$$SD(R) = \sqrt{Var(R)} \Rightarrow Var(R) = E\left[(R - E[R])^2\right] = \sum_R P_R \times (R - E[R])^2$$

Standard deviation = $\sqrt{0.4(8\%-12.2\%)^2 + 0.3(12\%-12.2\%)^2 + 0.3(18\%-12.2\%)^2} = 4.1\%$

Computing Historical Returns

- Computing realized return (i.e., return over a particular time period)
  - Suppose for a stock

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

$$= \text{Dividend Yield} + \text{Capital Gain Rate}$$

$$1 + R_{\text{annual}} = (1 + R_{Q1})(1 + R_{Q2})(1 + R_{Q3})(1 + R_{Q4})$$

  - Computing realized annual return

See Texbook Example 10.2

Example 10.2

Date	Price	Dividend	Return	Date	Price($)	Dividend	Return
12/31/03	27.37			12/31/07	35.06		
8/23/04	27.24	0.08	−0.18%	2/19/08	28.17	0.11	−20.56%
11/15/04[6]	27.39	3.08	11.86%	5/31/08	27.32	0.11	6.11%
12/31/04	26.72		−2.45%	8/19/08	19.62	0.11	−7.89%
				11/18/08	19.44	0.13	−27.71%
				12/31/08			−0.92%

The return from Dec 31,2003,until Aug 23,2004 is equal to: $\frac{0.08+27.24}{27.37}-1=-0.18\%$

Calculating the realized annual returns:

$$1 + R_{\text{annual}} = (1 + R_{Q1})(1 + R_{Q2})(1 + R_{Q3})(1 + R_{Q4})$$

$$R_{2004} = (0.9982)(1.1186)(0.9755) - 1 = 8.92\%$$

$$R_{2008} = (0.7944)(1.0611)(0.7229)(0.9908) - 1 = -43.39\%$$

Average annual return, historical volatility, and standard error

- Average annual return $\bar{R} = \frac{1}{T}\left(R_1 + R_2 + \cdots + R_T\right) = \frac{1}{T}\sum_{t=1}^{T} R_t$

  Where R_t is the realized return of a security in year t, for the years 1 through T

- Volatility estimate using realized return

$$SD(R) = \sqrt{Var(R)} \Rightarrow Var(R) = \frac{1}{T-1}\sum_{t=1}^{T}\left(R_t - \bar{R}\right)^2$$

- Average return is an estimate of the expected return
  - Standard error: an indication of how far the sample average deviate from the expected return (see Example 10.4)

$$SD(\text{Average of Independent, Identical Risks}) = \frac{SD(\text{Individual Risk})}{\sqrt{\text{Number of Observations}}}$$

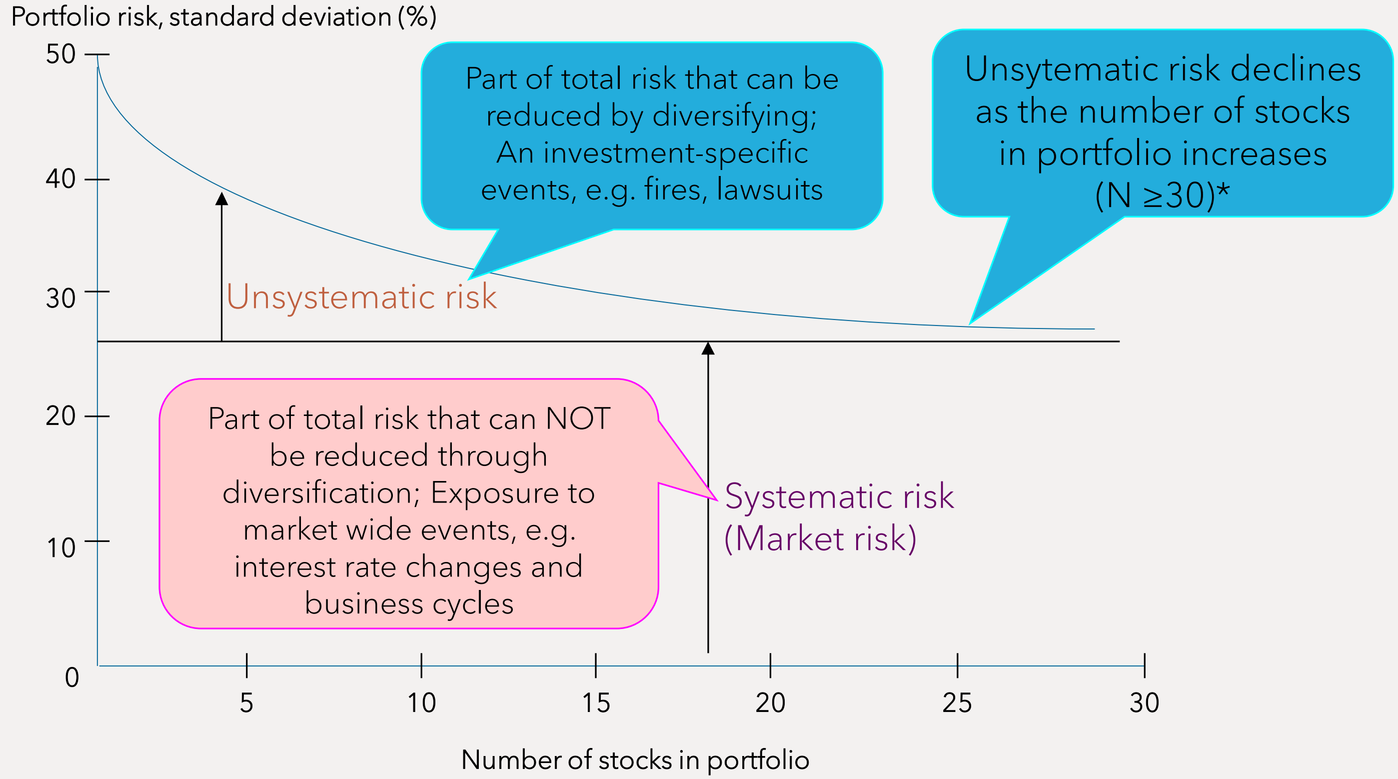
Risk reduction through diversification

- An investment's risk in isolation is greater than its risk as part of a portfolio
- The investment variability is *offset* by variability in the portfolio's return
- When assets are combined in a portfolio, an "*averaging out*" process occurs that reduces risk

Diversifying dispersion risk

Investment	Weather	Probability	Return on Investment	Weighted Outcome
a. Ice cream stand	Sun	0.5	60%	30%
	Rain	0.5	-20%	-10%
		Risk = std. dev. = 40%		Expected outcome = 20%
b. Umbrella shop	Sun	0.5	-30%	-15%
	Rain	0.5	50%	25%
		Risk = std. dev. = 40%		Expected outcome = 10%
c. Portfolio: ½ ice cream stand and ½ umbrella shop				
	Sun	0.5	15%	7.5%
	Rain	0.5	15%	7.5%
		Risk = std. dev. = 0%		Expected outcome = 15%

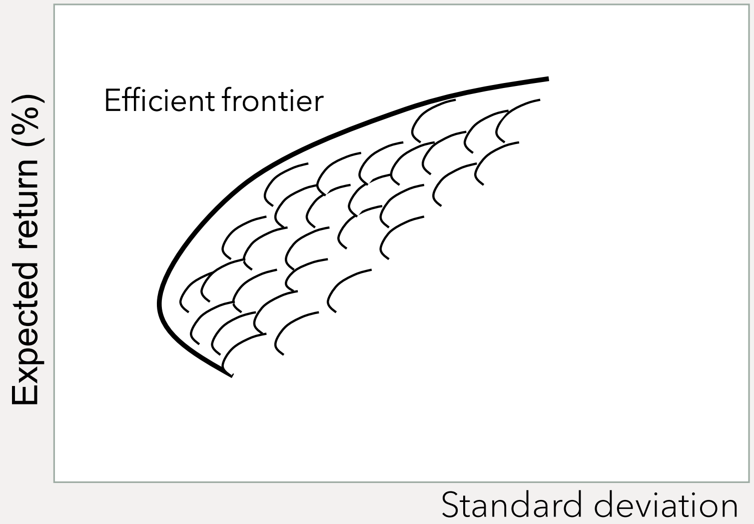
Total risk = Systematic risk + unsystematic risk



* Meir Statman, "How many stocks make a diversified portfolio?" *Journal of Financial and Quantitative Analysis*, **22**, 353-63.

Measuring systematic risk

- As investors cannot eliminate systematic risk, they must be compensated for holding it → risk premium



- Efficient Frontier
  - Each half-ellipse represents possible weighted combinations for two stocks
  - Composite of all stock sets constitutes efficient frontier

- Efficient portfolio: portfolio that contains only systematic risk and cannot be diversified further
  - Various weighted combinations of stocks that create specific standard deviation (northwest edge)
  - As market portfolio contains all shares of all stocks and securities in the market, it is assumed to be efficient
  - S&P 500 is often used as a proxy for the market portfolio

Sensitivity to systematic risk (β)

- *The expected percent change in the excess return of a security for a 1% change in the excess return of the market portfolio*
- Beta differs from volatility.
  - Volatility measures total risk (systematic plus unsystematic risk), while beta is a measure of only systematic risk

$$\text{Market Risk Premium} = E\left[R_{Mkt}\right] - r_f$$

$$E\left[R\right] = \text{Risk-Free Interest Rate} + \text{Risk Premium}$$

$$= r_f + \beta \times (E\left[R_{Mkt}\right] - r_f)$$

→ Capital Asset Pricing Model (CAPM)

Expected return of a portfolio

- The expected return of a portfolio is the weighted average of the expected returns of the investments within it
  - The portfolio weights must add up to 1.00 or 100%
  - Fraction of an individual investment (x_i)

$$x_i = \frac{\text{Value of investment } i}{\text{Total value of portfolio}}$$

$$R_P = x_1 R_1 + x_2 R_2 + \cdots + x_n R_n = \sum_i x_i R_i$$

- The return of the portfolio (R_p)

$$E[R_P] = E\left[\sum_i x_i R_i\right] = \sum_i E[x_i R_i] = \sum_i x_i E[R_i]$$

Volatility of a two-stock portfolio

$$\boxed{\text{Expected portfolio return} = (x_1 R_1) + (x_2 R_2)}$$

Portfolio variance:

$$Var(R_P) = x_1^2 Var(R_1) + x_2^2 Var(R_2) + 2x_1 x_2 Cov(R_1, R_2)$$

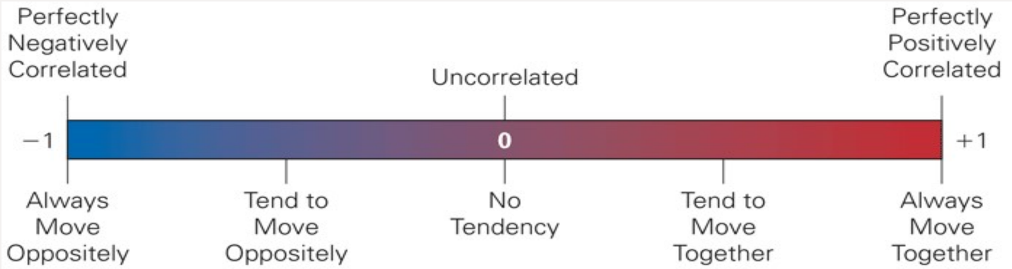
Portfolio covariance:

$$Cov(R_1, R_2) = E[(R_1 - E[R_1])(R_2 - E[R_2])]$$

$$Cov(R_1, R_2) = Corr(R_1, R_2)\, SD(R_1)\, SD(R_2)$$

Correlation:

$$Corr(R_1, R_2) = \frac{Cov(R_1, R_2)}{SD(R_1)\, SD(R_2)}$$



Example

- Invest 60% of portfolio in Heinz and 40% in ExxonMobil. Expected dollar return on Heinz stock is 6% and 10% on ExxonMobil . Standard deviation of annualized daily returns are 14.6% and 21.9%, respectively. Assume correlation coefficient of 0.49 and calculate portfolio variance.

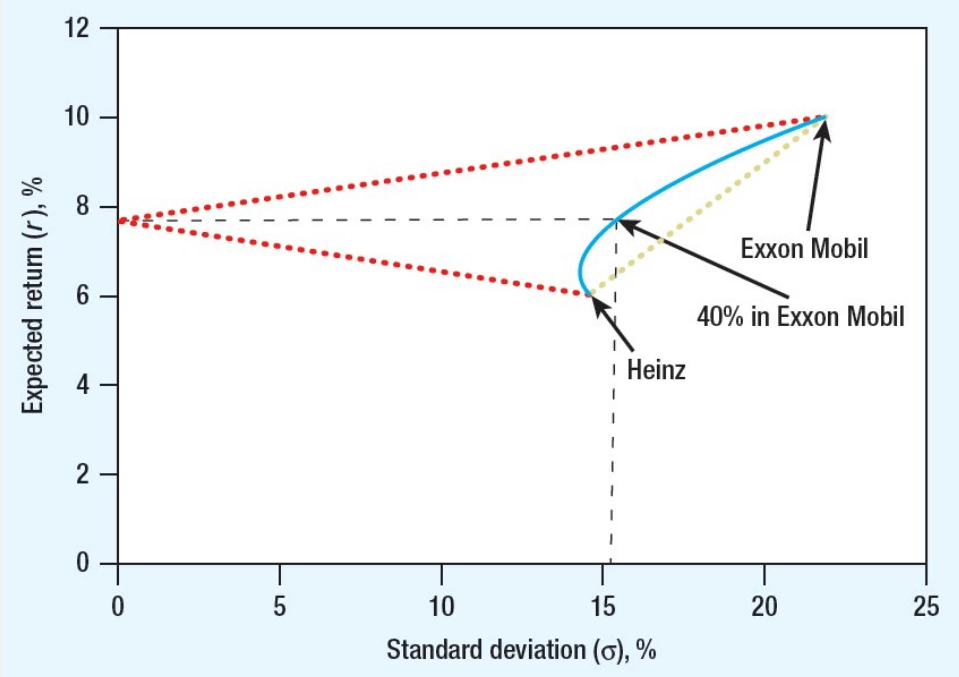
$$\boxed{\text{Expected return} = (.60 \times 6) + (.40 \times 10) = 7.6\%}$$

$$\begin{aligned}\text{Portfolio variance} &= [(.60)^2 \times (14.6)^2] + [(.40)^2 \times (21.9)^2] \\ &\quad + 2(.40 \times .60 \times 0.49 \times 14.6 \times 21.9) \\ &= 229 \\ \text{Standard deviation} &= \sqrt{229} = 15.1\,\%\end{aligned}$$

Example

Correlation Coefficient = .49			
Stocks	σ	% of Portfolio	Average Return
Heinz	14.6	60%	6.0%
ExxonMobil	21.9	40%	10.0%

- Standard deviation = weighted average = 17.52
- Standard deviation = portfolio = 15.1
- Return = weighted average = portfolio = 7.6%
- Higher return, lower risk through diversification

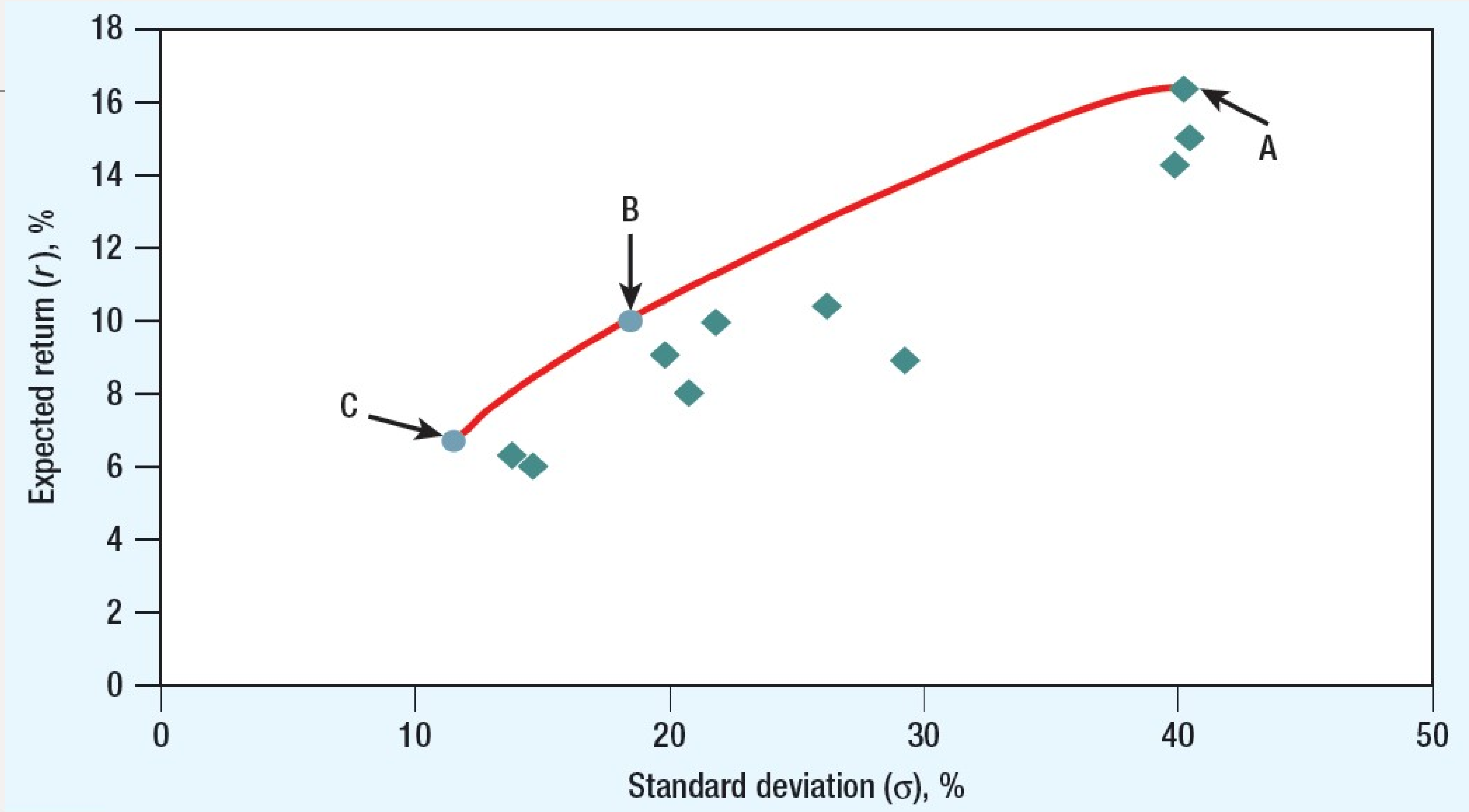


Example of 10-stock portfolios

			Efficient Portfolios—Percentages Allocated to Each Stock		
Stock	Expected Return	Standard Deviation	A	B	C
Dow Chemical	16.4%	40.2%	100	6	
Bank of America	14.3	30.9		10	
Ford	15.0	40.4		8	
Heinz	6.0	14.6		11	35
IBM	9.1	19.8		18	12
Newmont Mining	8.9	29.2		6	1
Pfizer	8.0	20.8		10	8
Starbucks	10.4	26.2		12	
Walmart	6.3	13.8		9	42
ExxonMobil	10.0	21.9		8	
Expected portfolio return			16.4	10.0	6.7
Portfolio standard deviation			40.2	18.4	11.8

Note: Standard deviation and the correlations between stock returns were estimated from weekly returns, Dec 2009 – Dec 2011

Efficient portfolios from 10 stocks

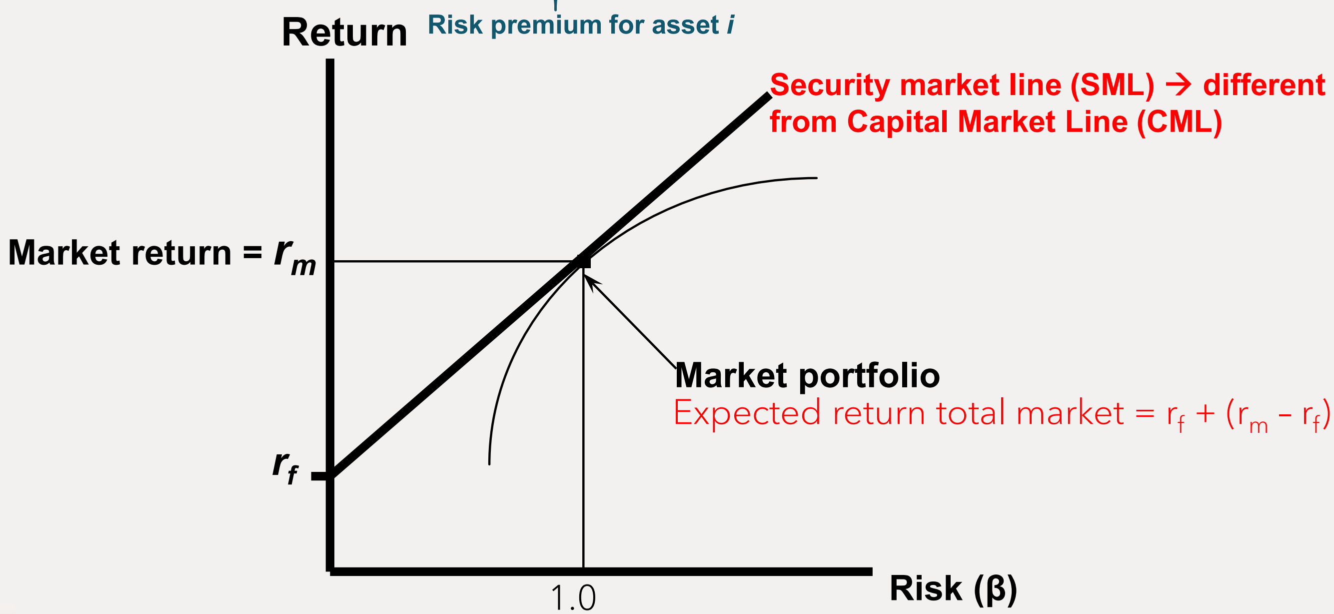


Capital Asset Pricing Model (CAPM)

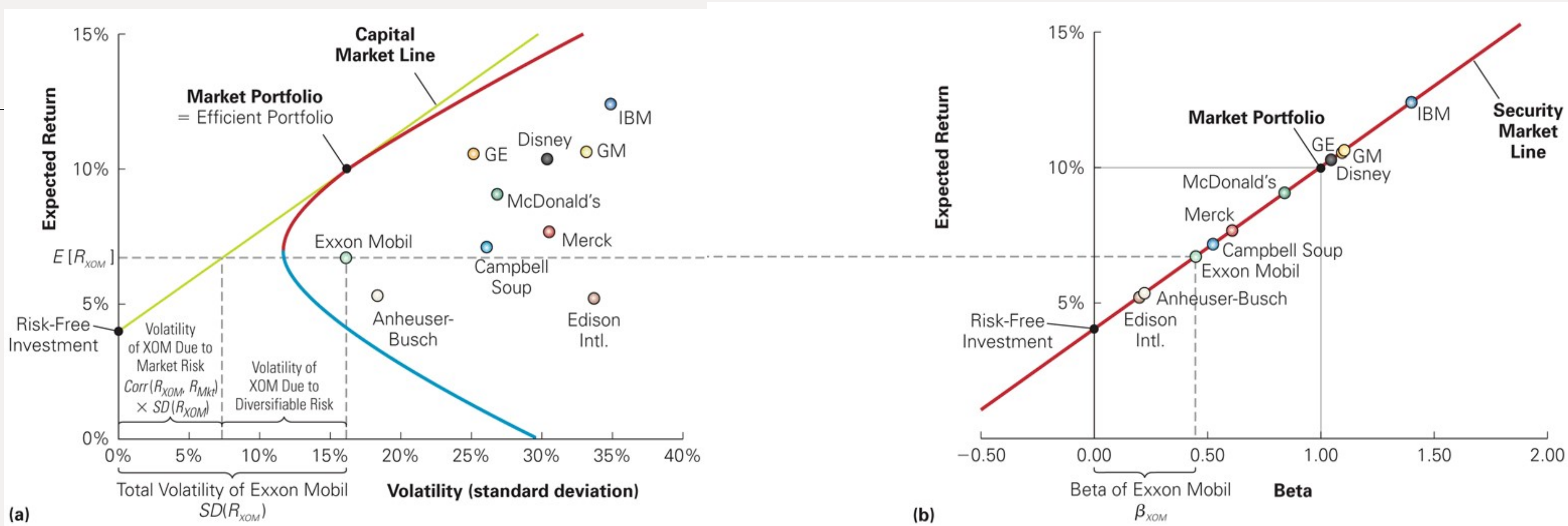
- Definition: a model based on risk and expected return used for pricing risky assets (i.e. investments/securities)

$$\boxed{r_i = r_f + \underbrace{\beta(r_m - r_f)}_{\text{Risk premium for asset } i}}$$

r_i = expected return of asset i
r_f = risk free rate of return
r_m = market return

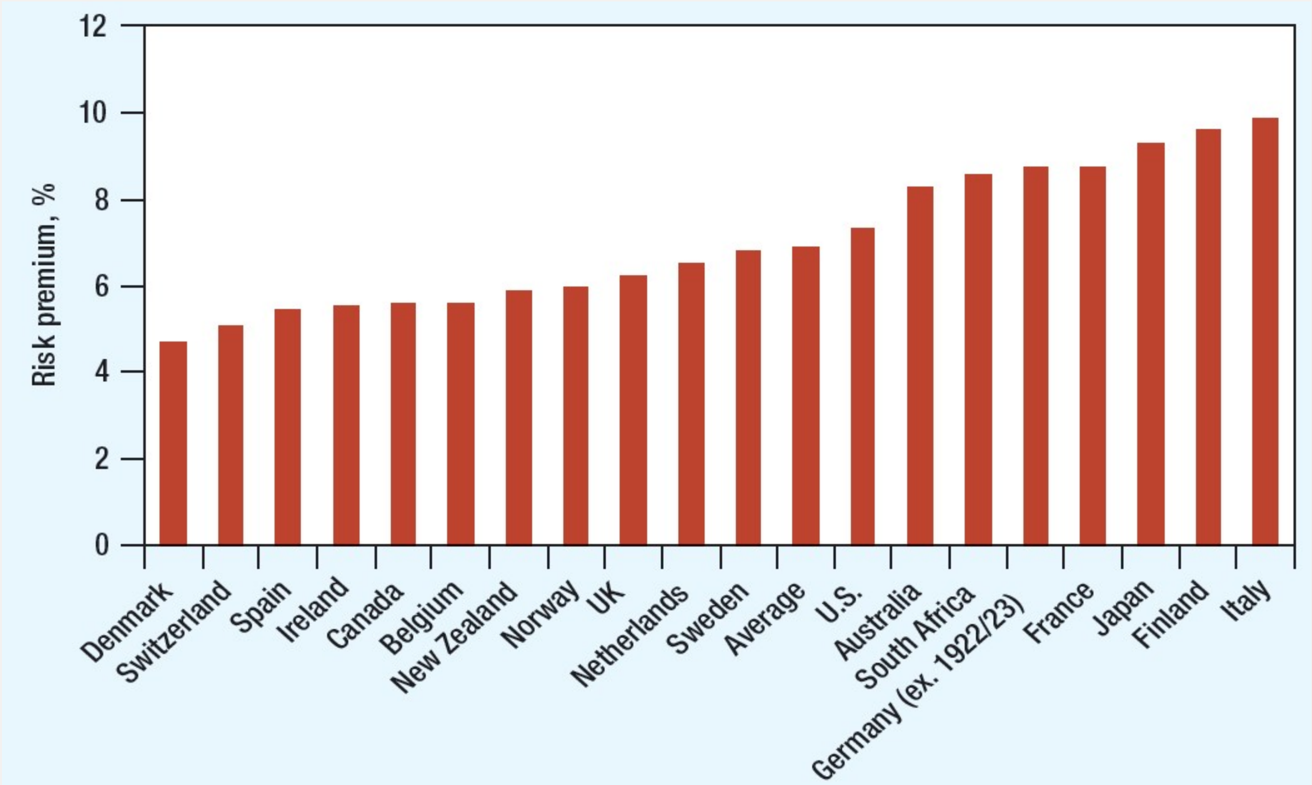


CML vs. SML



CML	SML
Standard deviation as the measure of risk	Beta coefficient as the measure of risk
Efficient portfolios	Efficient & inefficient portfolios (individual securities/stocks)

Average Market Risk Premiums ($=r_m - r_f$)



Source: Dimson, E., Marsh, P.R. and Staunton, M. 2002. *Triumph of the Optimists: 101 years of investment returns.* Princeton, NJ: Princeton University Press

Beta

$$\beta_i^{Mkt} \equiv \beta_i = \frac{\overbrace{SD(R_i) \times Corr(R_i, R_{Mkt})}^{\text{Volatility of } i \text{ that is common with the market}}}{SD(R_{Mkt})} = \frac{Cov(R_i, R_{Mkt})}{Var(R_{Mkt})}$$

1	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2							Product of
3				Deviation	Deviation	Squared	deviations
4				from	from average	deviation	from average
5		Market	Anchovy Q	average	Anchovy Q	from average	returns
6	Month	return	return	market return	return	market return	(cols 4 × 5)
7	1	− 8%	− 11%	− 10	− 13	100	130
8	2	4	8	2	6	4	12
9	3	12	19	10	17	100	170
10	4	− 6	− 13	− 8	− 15	64	120
11	5	2	3	0	1	0	0
12	6	8	6	6	4	36	24
13	Average	2	2		Total	304	456
14				Variance $= \sigma_m^2 = 304/6 = 50.67$			
15				Covariance $= \sigma_{im} = 456/6 = 76$			
16				Beta $(\beta) = \sigma_{im}/\sigma_m^2 = 76/50.67 = 1.5$			