LECTURE 1

EC3333 Financial Economics I

Learning Objectives

- Recognise the roles of financial markets in an economy and the differences between financial and real assets.
- Identify the major components of the investment process.
- Compute the realized or total return for an investment.
- Estimate expected return, variance, and standard deviation (or volatility) of returns using the empirical distribution of realized returns.

An introduction to the financial markets

- What are the roles of financial markets in the economy?

- What are the differences between a financial asset and a real asset?

Classes of financial assets

- Fixed-income security (Debt security)
  - Promises either a fixed stream of income or a stream of income determined by a specified formula
  - E.g., government bond
- Equity
  - Claims an ownership share in a firm
  - E.g., common stock
- Currency
  - E.g., Cash & foreign currencies
- Derivative security
  - Payoff is dependent on the value of other assets such as stock prices, interest rates, commodities or exchange rates
  - E.g., commodities future contracts such as metals, agricultural produce and energy

The business of investment

- Portfolio: a collection of investment assets
- Asset allocation
  - Choosing among broad asset classes (e.g., stocks, bonds, real estate, etc.)
- Security selection
  - Choosing securities within each asset class
- Security analysis
  - Valuating specific security for portfolio inclusion
- Investment approaches
  - “Top-down”- from determining asset allocation → to particular securities to be held in each asset class (Top-down)
  - “Bottom-up”- from determining attractively priced securities

The business of investment

- Management style
  - Passive management - by holding a highly diversified portfolio with little attempt to improve investment performance by identifying mispriced securities
  - Active management – by focussing on performance enhancement through finding mispriced securities or timing the performance of broad asset classes in the market.

Competitive nature of the financial markets

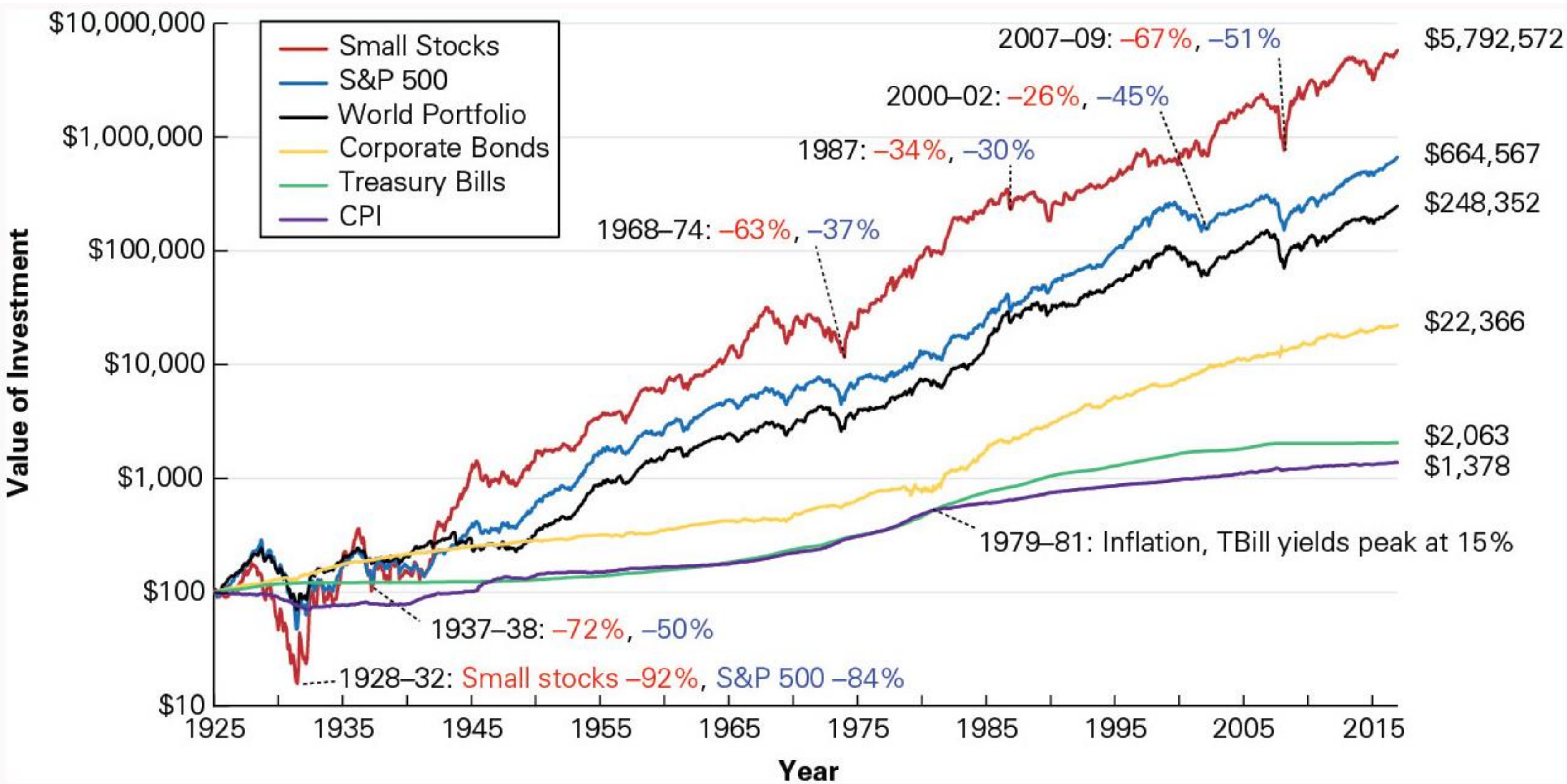
- Risk-return trade-off
  - Higher-risk assets are priced to offer higher expected returns than lower-risk assets

- Efficiency
  - You should rarely expect to find bargains in the security markets
  - **Efficient market hypothesis:** The prices of securities fully reflect available information. (There are various forms of the efficient market hypothesis, pertaining to the type of available information.)
  - If this were true, there would exist neither underpriced nor overpriced securities.

If you have invested $100 at the end of 1925 in:

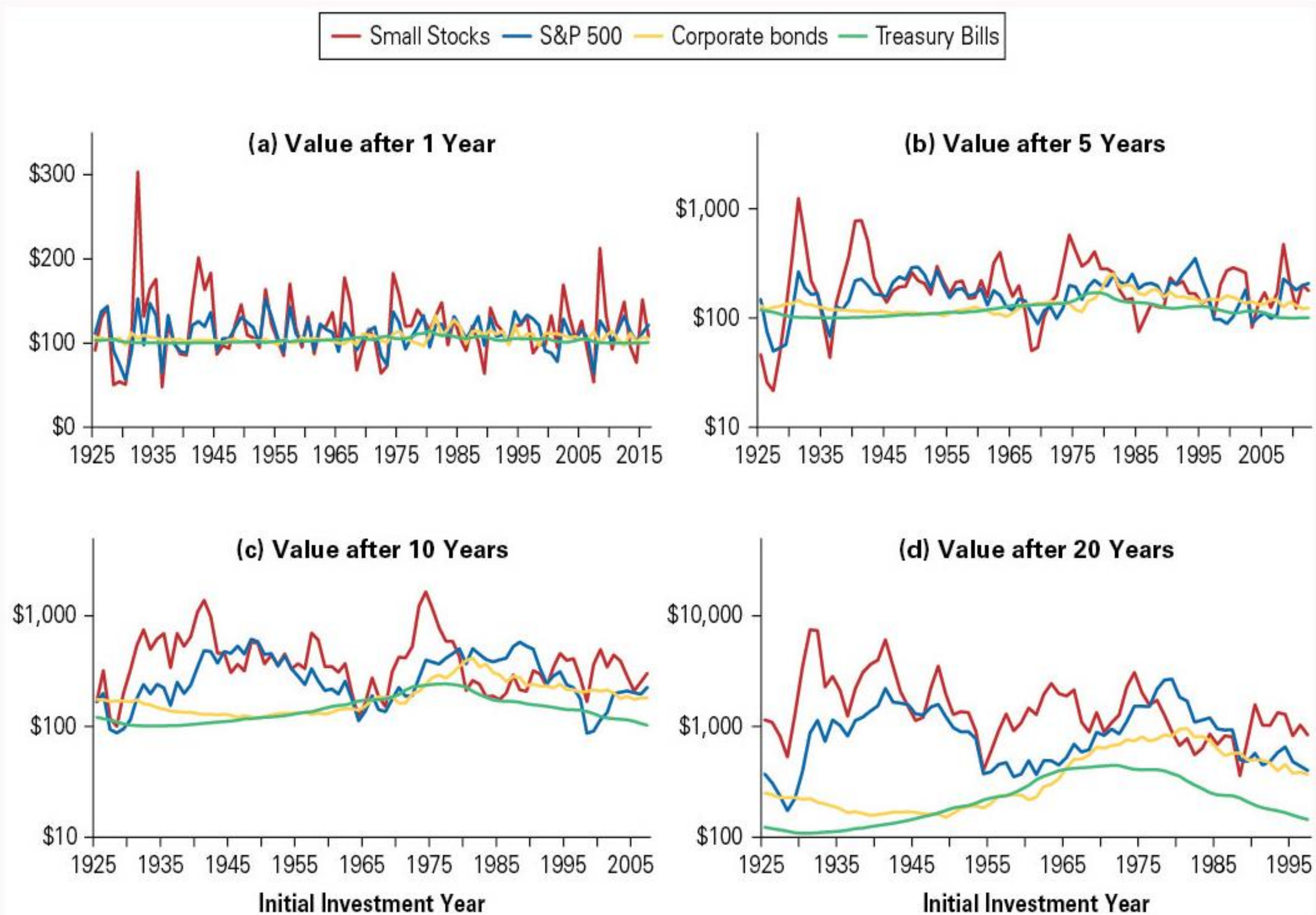
- Standard & Poor's 500
  - 90 U.S. stocks up to 1957 and 500 after that.   Leaders in their industries and among the largest U.S. firms
- Small stocks
  - NYSE Securities with market capitalizations in the bottom 20%
- World Portfolio
  - International stocks from North America, Europe, and Asia
- Corporate Bonds
  - Long-term, AAA-rated U.S. corporate bonds with maturities of about 20 years
- Treasury Bills
  - Three-month Treasury bills

Figure 10.1 Value of $100 Invested at the End of 1925 (from adopted text, Berk and DeMarzo, Corporate Finance, Pearson, 5e)



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

Figure 10.2 Value of $100 Invested in Alternative Investment for Differing Horizons
(from adopted text, Berk and DeMarzo, Corporate Finance, Pearson, 5e)



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

Computing Historical Returns

- Realized Return
  - The return that *actually occurs over a particular time period*

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

$$\boldsymbol{= Dividend\,Yield + Capital\,Gain\,Rate}$$

Computing Historical Returns

- Assume that all dividends are immediately reinvested in the same asset
- If a stock pays dividends at the end of each quarter, with realized returns $R_{Q1}, \ldots, R_{Q4}$ each quarter, then its annual realized return, R_{annual}, is computed as:

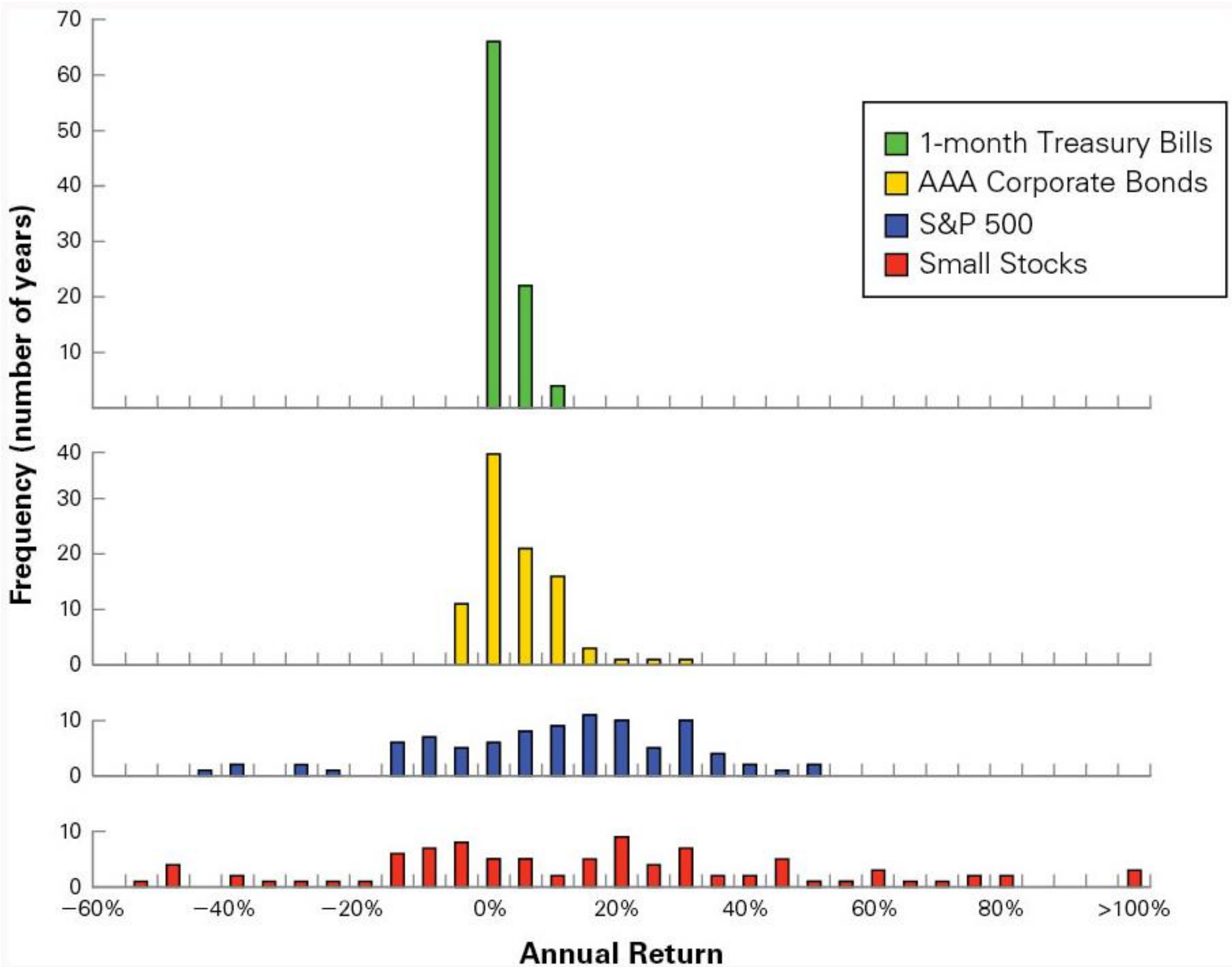
$$\mathbf{1 + R_{annual} = (1 + R_{Q1})(1 + R_{Q2})(1 + R_{Q3})(1 + R_{Q4})}$$

Table 10.2 Realized Return for the S&P 500, Microsoft, and Treasury Bills, 2005–2017
(from adopted text, Berk and DeMarzo, Corporate Finance, Pearson, 5e)

Year End	S&P 500 Index	Dividends Paid*	S&P 500 Realized Returned	Microsoft Realized Return	1-Month T-Bill Return
2004	1211.92				
2005	1248.29	23.15	4.9 %	−0.9 %	3 %
2006	1418.3	27.16	15.8 %	15.8 %	4.8 %
2007	1468.36	27.86	5.5 %	20.8 %	4.7 %
2008	903.25	21.85	−37 %	−44.4 %	1.5 %
2009	1115.1	27.19	26.5 %	60.5 %	0.1 %
2010	1257.64	25.44	15.1 %	−6.5 %	0.1 %
2011	1257.61	26.59	2.1 %	−4.5 %	0 %
2012	1426.19	32.67	16 %	5.8 %	0.1 %
2013	1848.36	39.75	32.4 %	44.3 %	0 %
2014	2058.9	42.47	13.7 %	27.6 %	0 %
2015	2043.94	43.45	1.4 %	22.7 %	0 %
2016	2238.83	49.56	12 %	15.1 %	0.2 %
2017	2673.61	53.99	21.8 %	40.7 %	0.8 %

Total dividends paid by the 500 stocks in the portfolio, based on the number of shares of each stock in the index, adjusted until the end the year, assuming they were reinvested when paid.
Source: Standard & Poor's, Microsoft and U.S. Treasury Data

Figure 10.5 The Empirical Distribution of Annual Returns for U.S. Large Stocks (S&P 500), Small Stocks, Corporate Bonds, and Treasury Bills, 1926–2017
(from adopted text, Berk and DeMarzo, Corporate Finance, Pearson, 5e)



Average Annual Return

$$\bar{R} = \frac{1}{T}(R_1 + R_2 + \cdots + R_T) = \frac{1}{T}\sum_{t=1}^{T} R_t$$

- Where R_t is the realized return of a security in year t, for the years 1 through T
- Using the data from Table 10.2, the average annual return for the S&P 500 from 2005 to 2017 is as follows:

$$\bar{R} = \frac{1}{13}(0.049 + 0.158 + 0.055 - 0.37 + 0.265 + 0.151 + 0.021 + 0.160 + 0.324 + 0.137 + 0.014 + 0.120 + 0.218) = 10.0\%$$

- $\bar{R}$ is the **Arithmetic Average Return**

Table 10.3 Average Annual Returns for U.S. Small Stocks, Large Stocks (S&P 500), Corporate Bonds, and Treasury Bills, 1926–2017
(from adopted text, Berk and DeMarzo, Corporate Finance, Pearson, 5e)

Investment	Average Annual Return
Small stocks	18.7%
S&P 500	12.0%
Corporate bonds	6.2%
Treasury bills	3.4%

Arithmetic vs. Geometric Average Rates of Return

- We should use the arithmetic average return when we are tying to estimate an investment's expected return over a future horizon based on it past performance
- If past returns are independent draws from the same distribution, then the arithmetic average return provides an unbiased estimate of the true expected return
- But the arithmetic average rate of return fails to capture the effect of compounding (earning interest on interest)
- To capture the effect of compounding, we need to use the geometric average rate of return
- **Geometric Average Return**

$$= [(1 + R_1)(1 + R_2) \dots (1 + R_T)]^{1/T} - 1$$

The Variance and Volatility of Returns

- Variance Estimate *Using Realized Returns*

$$Var(R) = \frac{1}{T-1}\sum_{t=1}^{T}(R_t - \bar{R})^2$$

- The estimate of the standard deviation (volatility) is the square root of the variance
- Earlier, we calculated the average annual returns of the S&P 500 from 2005 to 2017 to be 10.0%. Therefore,

$$Var(R) = \frac{1}{T-1}\sum_{t}(R_t - \overline{R})^2$$

$$= \frac{1}{13-1}[(0.049 - 0.100)^2 + (0.158 - 0.100)^2 + \ldots + (0.218 - 0.100)^2]$$

$$= 0.029$$

$$\textit{The volatility or standard deviation is therefore}$$

$$SD(R) = \sqrt{Var(R)} = \sqrt{0.029} = 17.0\%$$

Table 10.5 Volatility Versus Excess Return of U.S. Small Stocks, Large Stocks (S&P 500), Corporate Bonds, and Treasury Bills, 1926–2017 (from adopted text, Berk and DeMarzo, Corporate Finance, Pearson, 5e)

Investment	Return Volatility (Standard Deviation)	Excess Return (Average Return in Excess of Treasury Bills)
Small stocks	39.2%	15.3%
S&P 500	19.8%	8.6%
Corporate bonds	6.4%	2.9%
Treasury bills (30-day)	3.1%	0.0%

Using Past Returns to Predict the Future

- We can use a security's historical average return to estimate its actual expected return. However, the average return is just an estimate of the expected return.
- **Standard Error**
  - A statistical measure of the degree of estimation error
- Recall that for S&P 500 from 1926-2017 (a sample of 92 years of observations for annual realized returns)
  - N = 92
  - This sample has a mean *R* of 12.0% and a standard deviation *SD*(*R*) of 19.8% (See Table 10.3 & 10.5)
  - Standard Error of Average Return:

$$= \frac{SD}{\sqrt{N}} = \frac{19.8\%}{\sqrt{92}}$$

Using Past Returns to Predict the Future

- Standard Error of the Estimate of the Expected Return

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

- 95% Confidence Interval

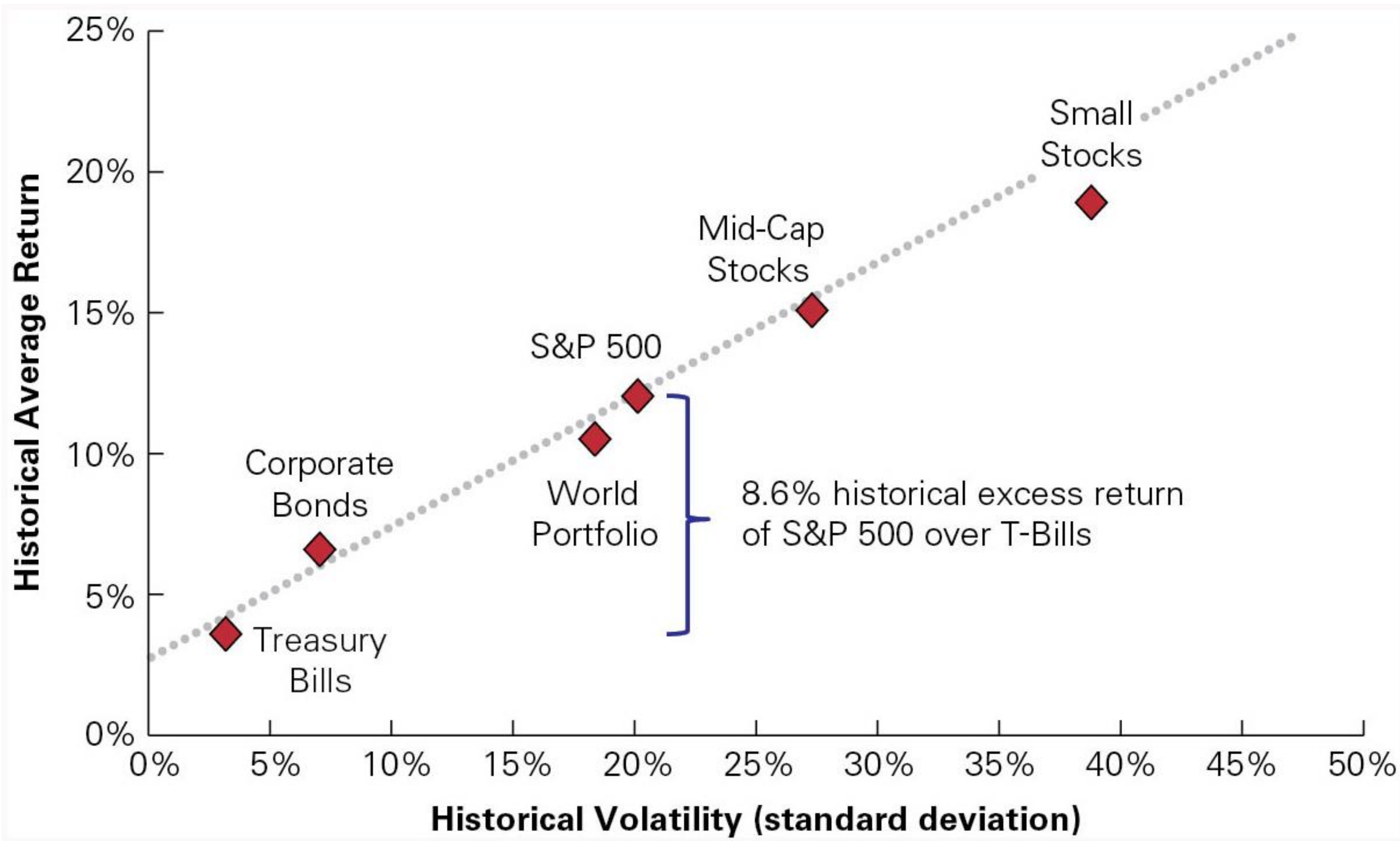
$$\boldsymbol{Historical\ Average\ Return \pm (2 \times Standard\ Error)}$$

- For the S&P 500 (1926–2017)

$$\mathbf{12.0\% \pm 2\left(\frac{19.8\%}{\sqrt{92}}\right) = 12.0\% \pm 4.1\%}$$

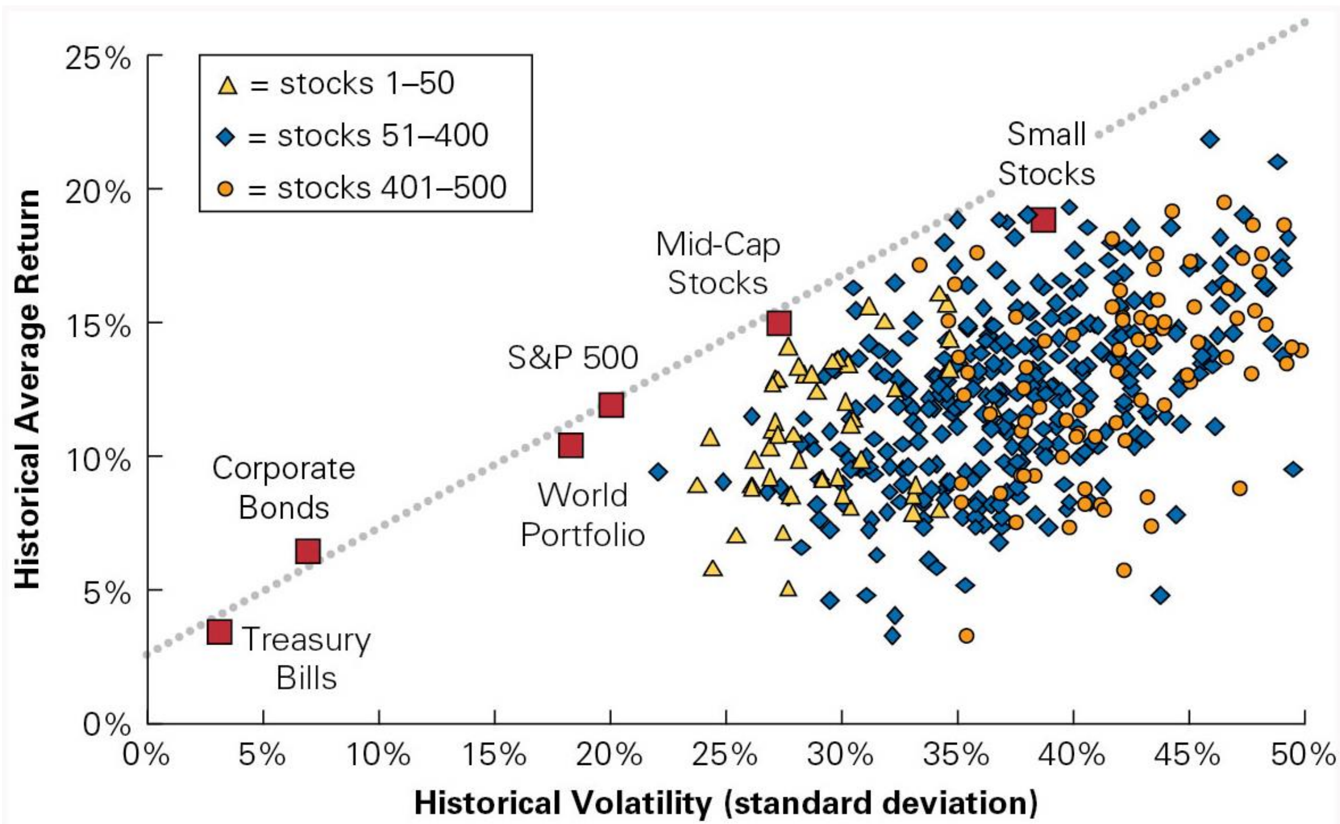
- Or a range from 7.9% to 16.1%

Figure 10.6 The Historical Tradeoff Between Risk and Return in Large Portfolios
(from adopted text, Berk and DeMarzo, Corporate Finance, Pearson, 5e)



Source: CRSP, Morgan Stanley Capital International

Figure 10.7 Historical Volatility and Return for 500 Individual Stocks, Ranked Annually by Size
(from adopted text, Berk and DeMarzo, Corporate Finance, Pearson, 5e)



Source: CRSP

APPENDIX

A Review of Expectations, Variances, and Covariances

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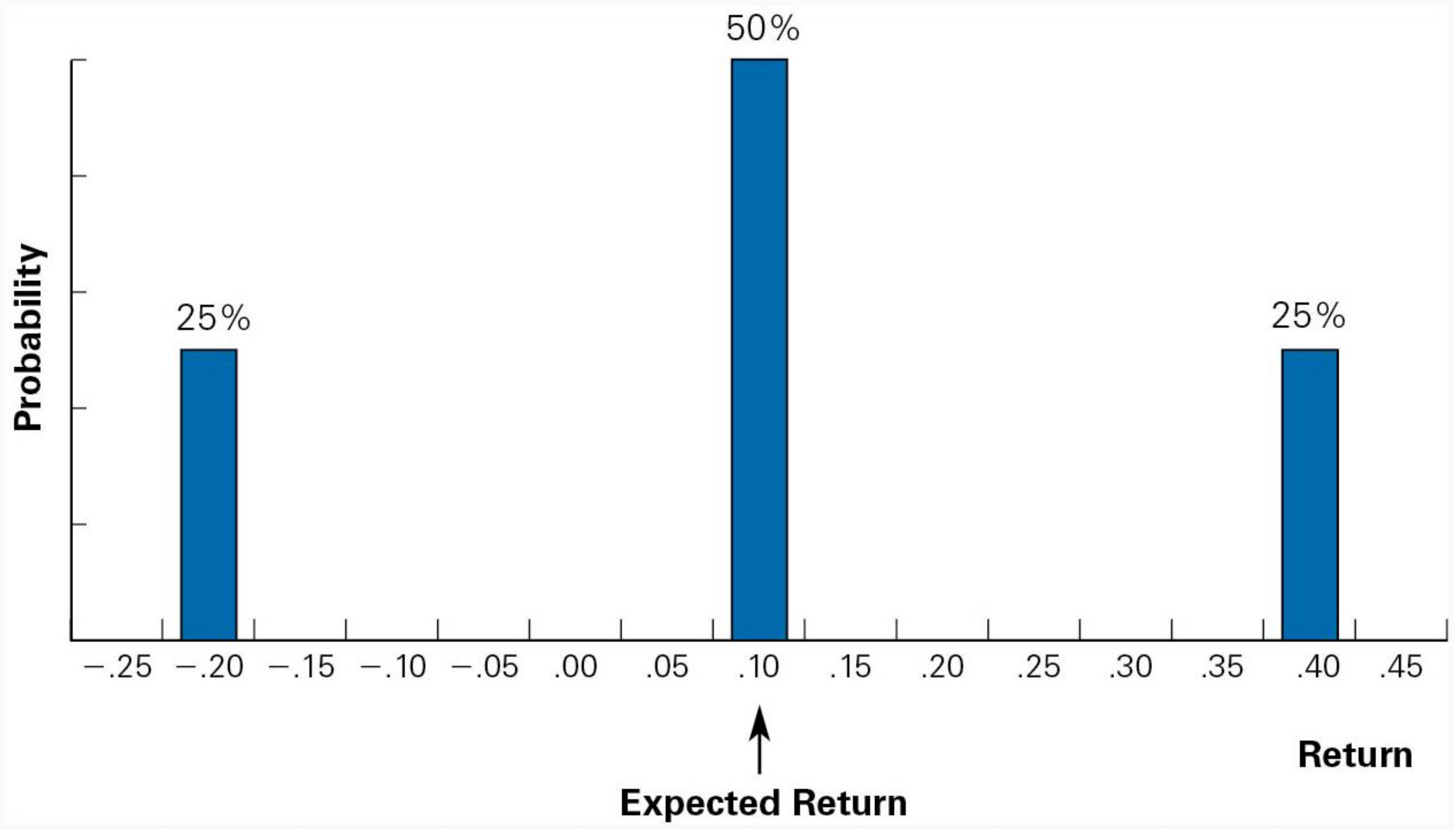
Probability Distributions

- When an investment is risky, it may earn different returns.
- Each possible return has some likelihood of occurring.
- This information is summarized with a probability distribution, which assigns a probability, P_R , that each possible return, R, will occur.
  - Assume BFI stock currently trades for $100 per share.
  - In one year, there is a 25% chance the share price will be
  - $140, a 50% chance it will be $110, and a 25% chance it will be $80.

Table 10.1 Probability Distribution of Returns for BFI
(from adopted text, Berk and DeMarzo, Corporate Finance, Pearson, 5e)

		Probability Distribution	
Current Stock Price ($)	Stock Price in One Year ($)	Return, R	Probability, p_R
	140	0.40	25%
100	110	0.10	50%
	80	−0.20	25%

Figure 10.3 Probability Distribution of Returns for BFI
(from adopted text, Berk and DeMarzo, Corporate Finance, Pearson, 5e)



Expected Return

- Expected (Mean) Return
  - Calculated as a weighted average of the possible returns, where the weights correspond to the probabilities.

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

$$E[R_{BF}] = 25\%(-0.20) + 50\%(0.10) + 25\%(0.40) = 10\%$$

Variance and Standard Deviation

- Variance
  - The expected squared deviation from the mean.

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

- Standard Deviation
  - The square root of the variance.

$$SD(R) = \sqrt{\mathrm{Var}(R)}$$

- Both are measures of the risk of a probability distribution.

Variance and Standard Deviation

- For BFI, the variance and standard deviation are

$$\mathrm{Var}[R_{BF}] = 25\% \times (-0.20 - 0.10)^2 + 50\% \times (0.10 - 0.10)^2$$
$$+25\% \times (0.40 - 0.10)^2 = 0.045$$
$$SD(R) = \sqrt{\mathrm{Var}(R)} = \sqrt{0.045} = 21.2\%$$

- In finance, the standard deviation of a return is also referred to as its **volatility**.
- The standard deviation is easier to interpret because it is in the same units as the returns themselves.

Covariance

- Covariance
  - The expected product of the deviations of two returns from their means

$$\mathrm{Cov}(R_i, R_j) = E[(R_i - E[R_i])(R_j - E[R_j])]$$
$$= \sum_R P_R \times (R_i - E[R_i])(R_j - E[R_j])$$

- Covariance between Returns R_i and R_j
  - If the covariance is positive, the two returns tend to move together.
  - If the covariance is negative, the two returns tend to move in opposite directions.

Mean Estimate Using Realized Returns

$$\bar{R} = \frac{1}{T}(R_1 + R_2 + \cdots + R_T) = \frac{1}{T}\sum_{t=1}^{T} R_t$$

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

Variance Estimate Using Realized Returns

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

- The estimate of the standard deviation is the square root of the variance.

Covariance Estimate Using Realized Returns

$$\mathrm{Cov}(R_i, R_j) = \frac{1}{T-1} \sum_t \left(R_{i,t} - \bar{R}_i\right)\left(R_{j,t} - \bar{R}_j\right)$$