Chapter 10

Risk and Return: Lessons from Market History

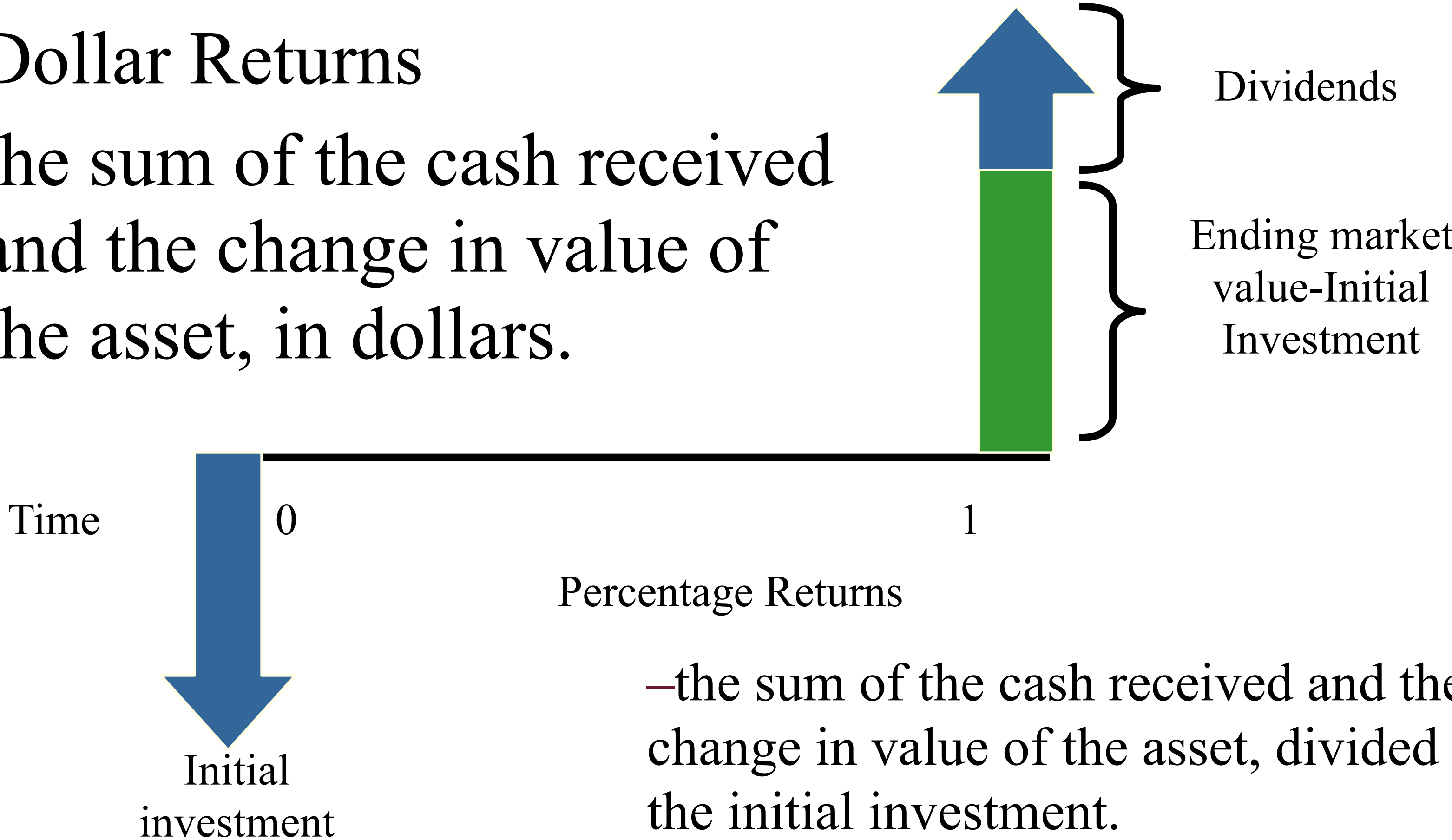
McGraw-Hill/Irwin

Key Concepts and Skills

- Know how to calculate the return on an investment
- Know how to calculate the standard deviation of an investment's returns
- Understand the historical returns and risks on various types of investments
- Understand the importance of the normal distribution
- Understand the difference between arithmetic and geometric average returns

10.1 Returns

- Dollar Returns
- the sum of the cash received and the change in value of the asset, in dollars.



Percentage Returns

–the sum of the cash received and the change in value of the asset, divided by the initial investment.

Returns

Dollar Return = Dividend + Change in Market Value

$$\text{percentage return} = \frac{\text{dollar return}}{\text{beginning market value}}$$

$$= \frac{\text{dividend} + \text{change in market value}}{\text{beginning market value}}$$

$$= \text{dividend yield} + \text{capital gains yield}$$

Returns: Example

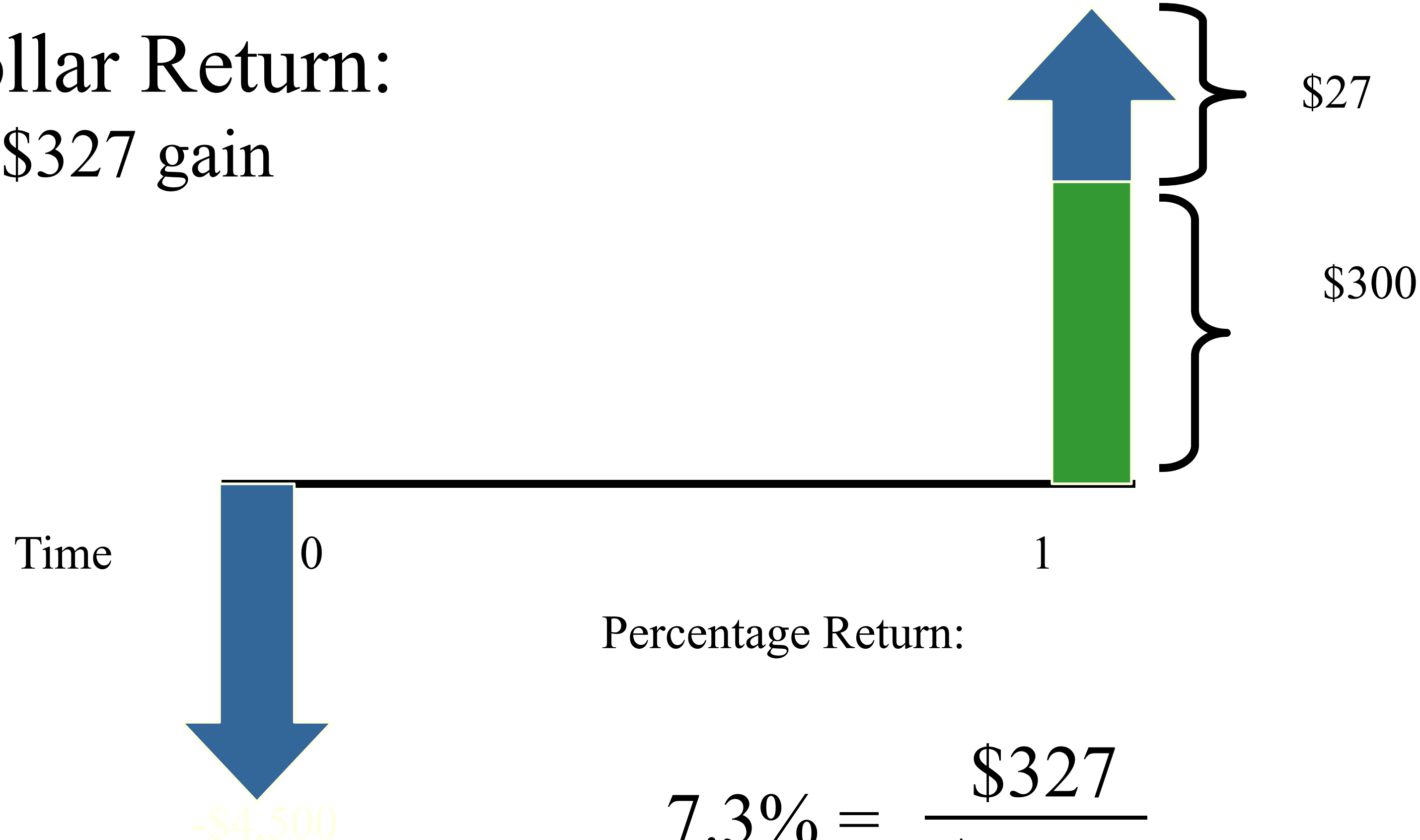
- Suppose you bought 100 shares of Wal-Mart (WMT) one year ago today at \$45. Over the last year, you received \$27 in dividends (27 cents per share × 100 shares). At the end of the year, the stock sells for \$48. How did you do?
- You invested \$45 × 100 = \$4,500. At the end of the year, you have stock worth \$4,800 and cash dividends of \$27. Your dollar gain was \$327 = \$27 + (\$4,800 – \$4,500).
- Your percentage gain for the year is:

$$7.3\% = \frac{\$327}{\$4,500}$$

Returns: Example

Dollar Return:

$327 gain



Percentage Return:

$$7.3\% = \frac{\$327}{\$4,500}$$

10.2 Holding Period Return

- The holding period return is the return that an investor would get when holding an investment over a period of *T* years, when the return during year *i* is given as R_i:

$$HPR = (1+R_1)\times(1+R_2)\times\ldots\times(1+R_T)-1$$

Holding Period Return: Example

- Suppose your investment provides the following returns over a four-year period:

Year	*Return*
1	10%
2	-5%
3	20%
4	15%

Your holding period return =

$$= (1+R_1)\times(1+R_2)\times(1+R_3)\times(1+R_4)-1$$

$$= (1.10)\times(.95)\times(1.20)\times(1.15)-1$$

$$= .4421 = 44.21\%$$

Historical Returns

- A famous set of studies dealing with rates of returns on common stocks, bonds, and Treasury bills was conducted by Roger Ibbotson and Rex Sinquefield.
- They present year-by-year historical rates of return starting in 1926 for the following five important types of financial instruments in the United States:
  - Large-company Common Stocks
  - Small-company Common Stocks
  - Long-term Corporate Bonds
  - Long-term U.S. Government Bonds
  - U.S. Treasury Bills

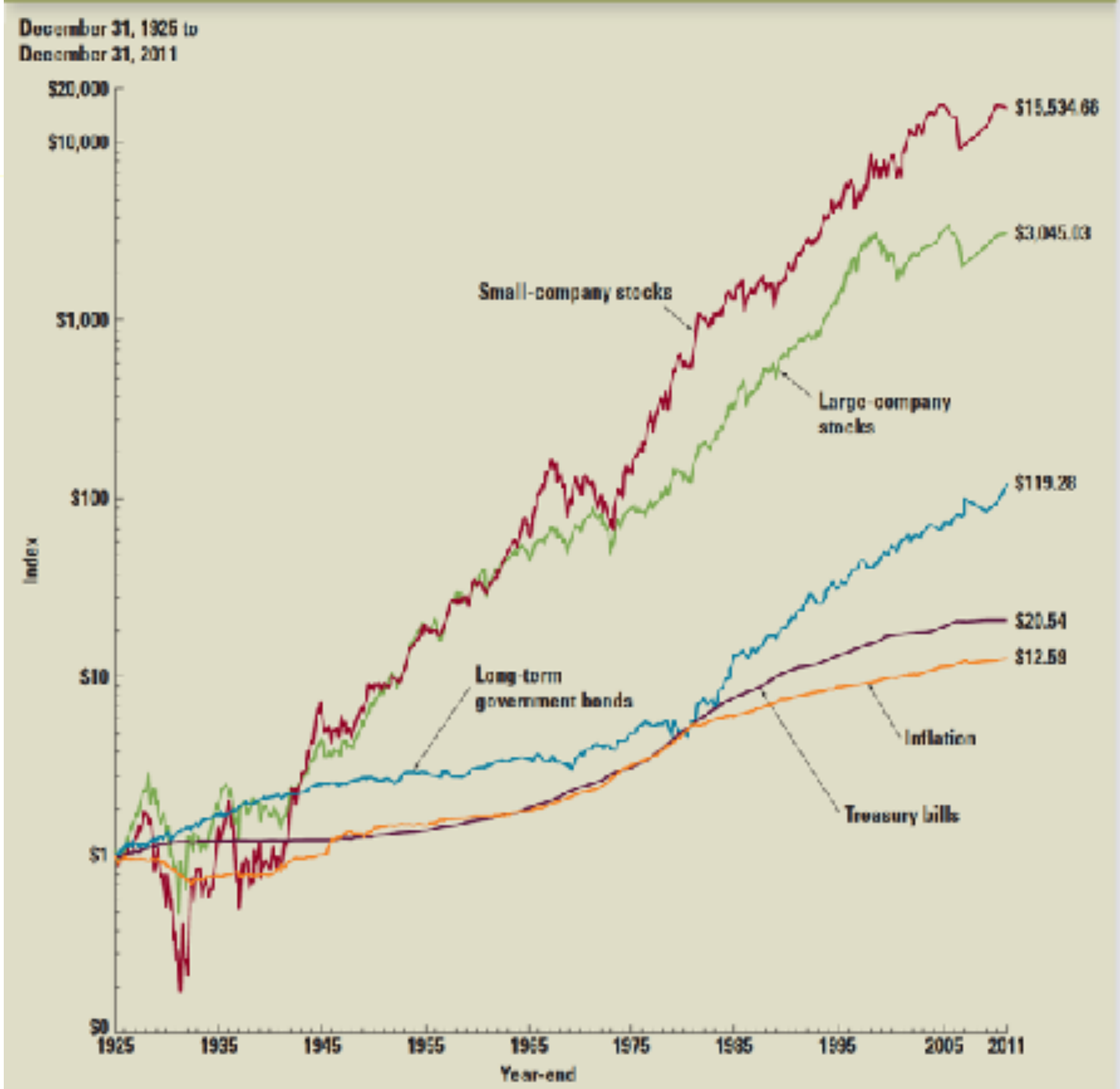


Figure 10.4 Wealth Indexes of Investments in the U.S. Capital Markets (Year-End 1925 = $1.00)

Redrawn from Stocks, Bonds, Bills and Inflation: 2012 Yearbook,™ annual updates to the work by Roger G. Ibbotson and Rex A. Sinquefield (Chicago: Morningstar).

Inflation

real interest: r
Nominal interest: R
Inflation rate: f

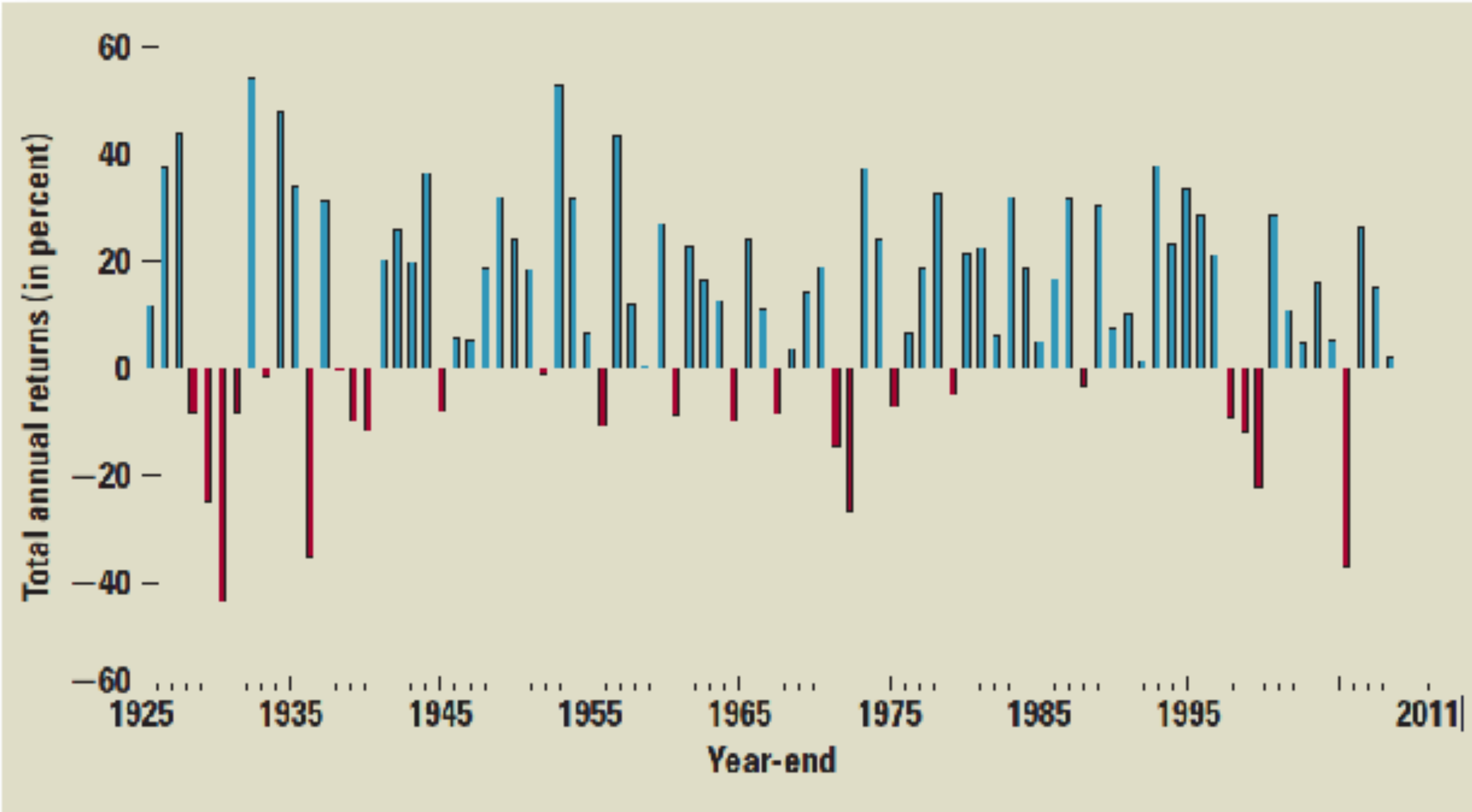
Fisher Formula: $1+r = (1+R)/(1+f)$

$1+r = 1.1/1.02 = 1.078$

Approximation for real return:

$1+r+f+rf = 1+R$

$r = R-f$



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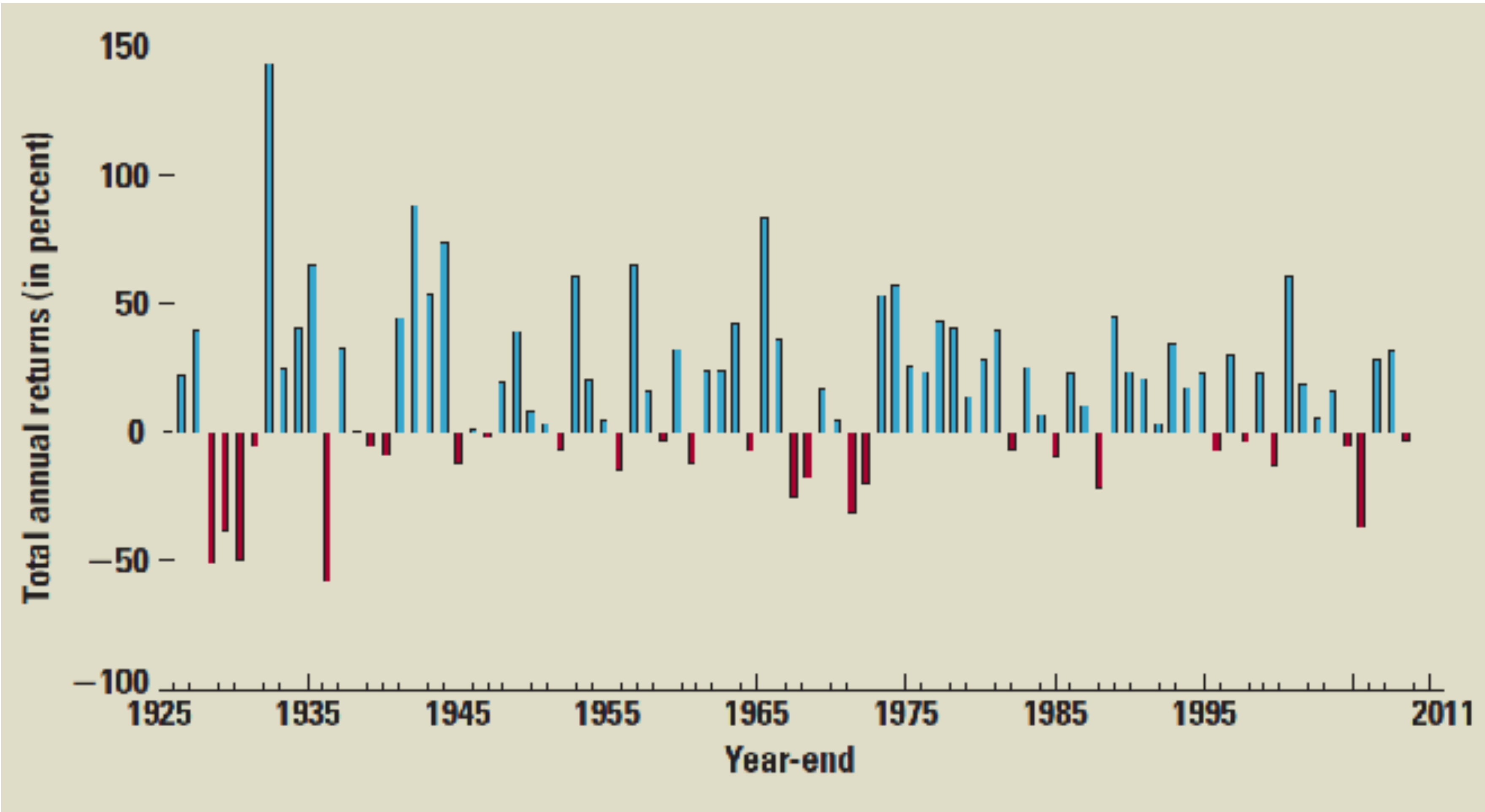
LARGE –COMPANY COMMON STOCKS



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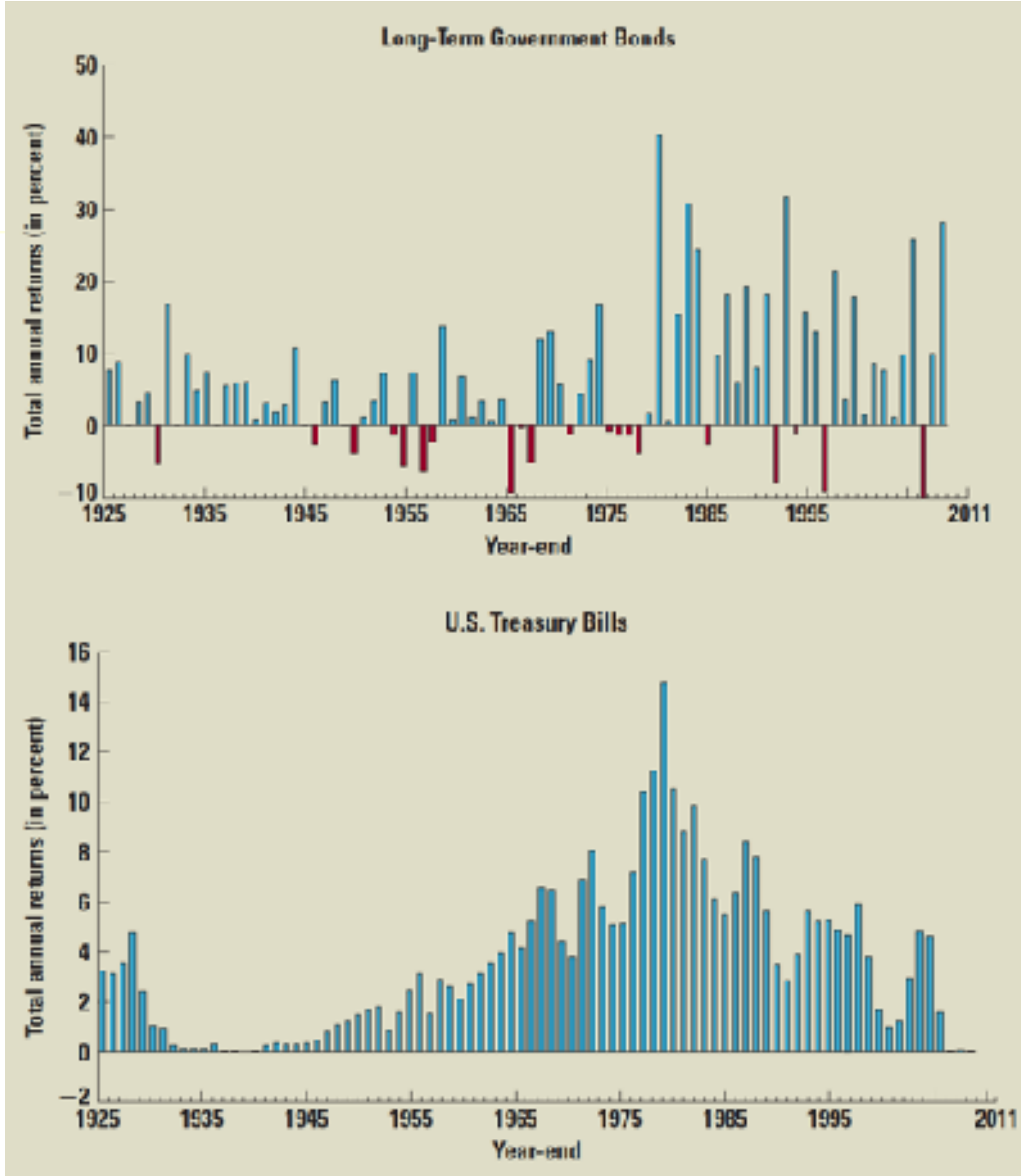
SMALL-COMPANY COMMON STOCKS



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10.3 Return Statistics

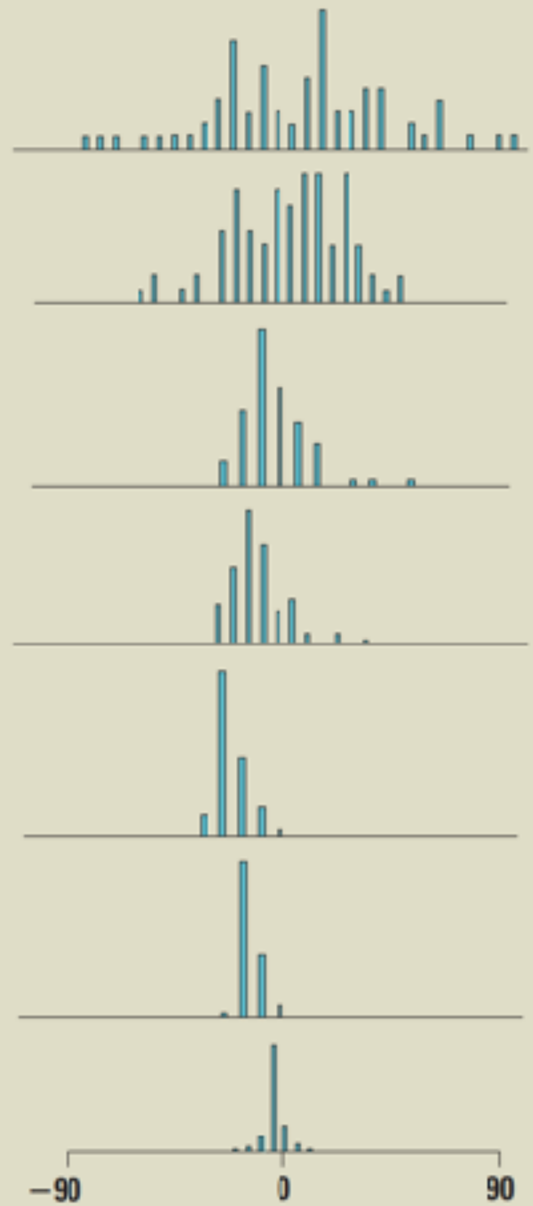
- The history of capital market returns can be summarized by describing the:
  - average return

$$\bar{R} = \frac{(R_1 + \ldots + R_T)}{T}$$

  - the standard deviation of those returns

$$SD = \sqrt{VAR} = \sqrt{\frac{(R_1 - \bar{R})^2 + (R_2 - \bar{R})^2 + \ldots (R_T - \bar{R})^2}{T - 1}}$$

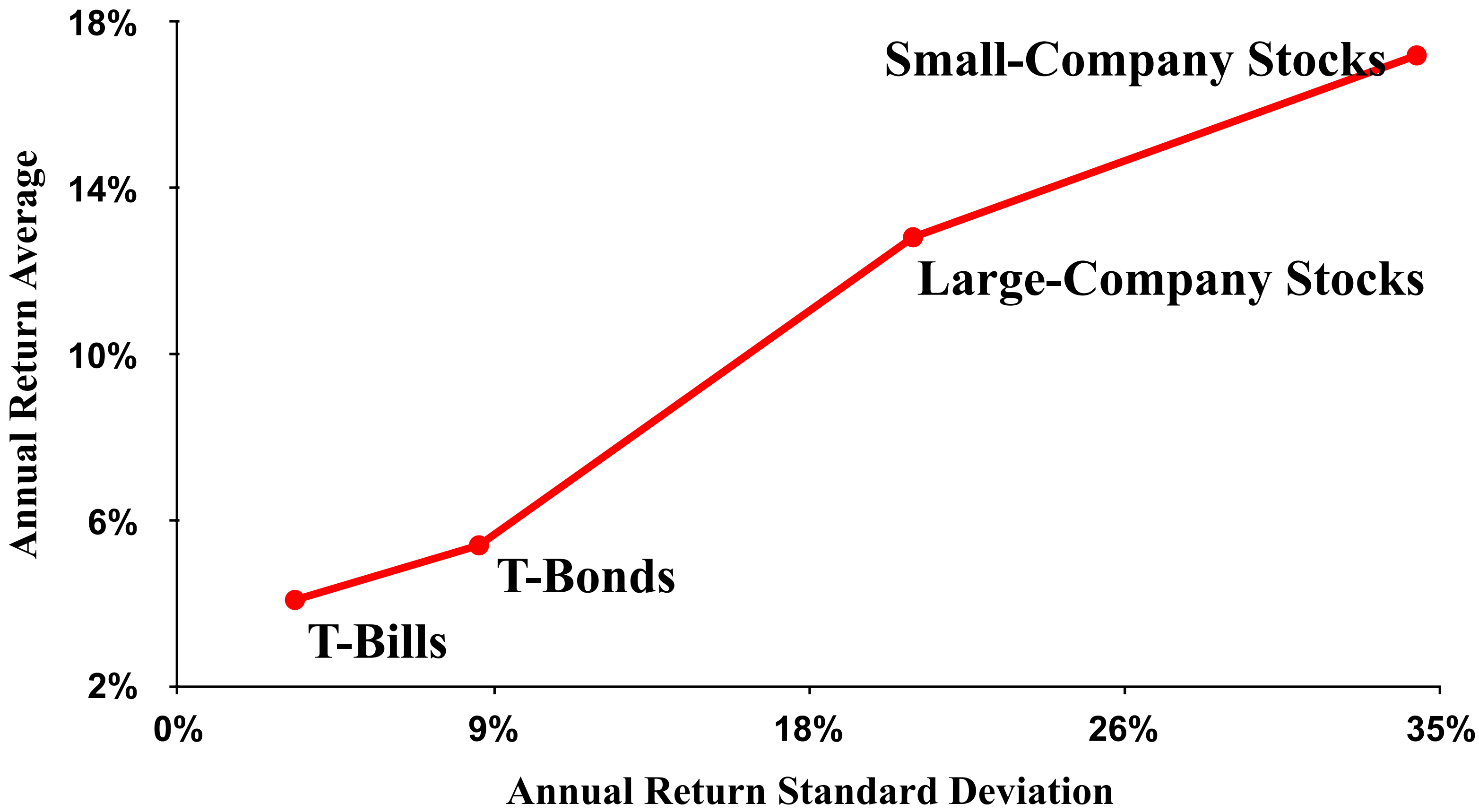
Series	Arithmetic Mean (%)	Standard Deviation (%)	Distribution (%)
Small-company stocks*	16.5	32.5	
Large-company stocks	11.8	20.3	
Long-term corporate bonds	6.4	8.4	
Long-term government bonds	6.1	9.8	
Intermediate-term government bonds	5.5	5.7	
U.S. Treasury bills	3.6	3.1	
Inflation	3.1	4.2	



10.4 Average Stock Returns and Risk-Free Returns

- The *Risk Premium* is the added return (over and above the risk-free rate) resulting from bearing risk.
- One of the most significant observations of stock market data is the long-run excess of stock return over the risk-free return.
  - The average excess return from large company common stocks for the period 1926 through 2011 was:
    8.2% = 11.8% – 3.6%
  - The average excess return from small company common stocks for the period 1926 through 2011 was:
    12.9% = 16.5% – 3.6%
  - The average excess return from long-term corporate bonds for the period 1926 through 2011 was:
    2.5% = 6.1% – 3.6%

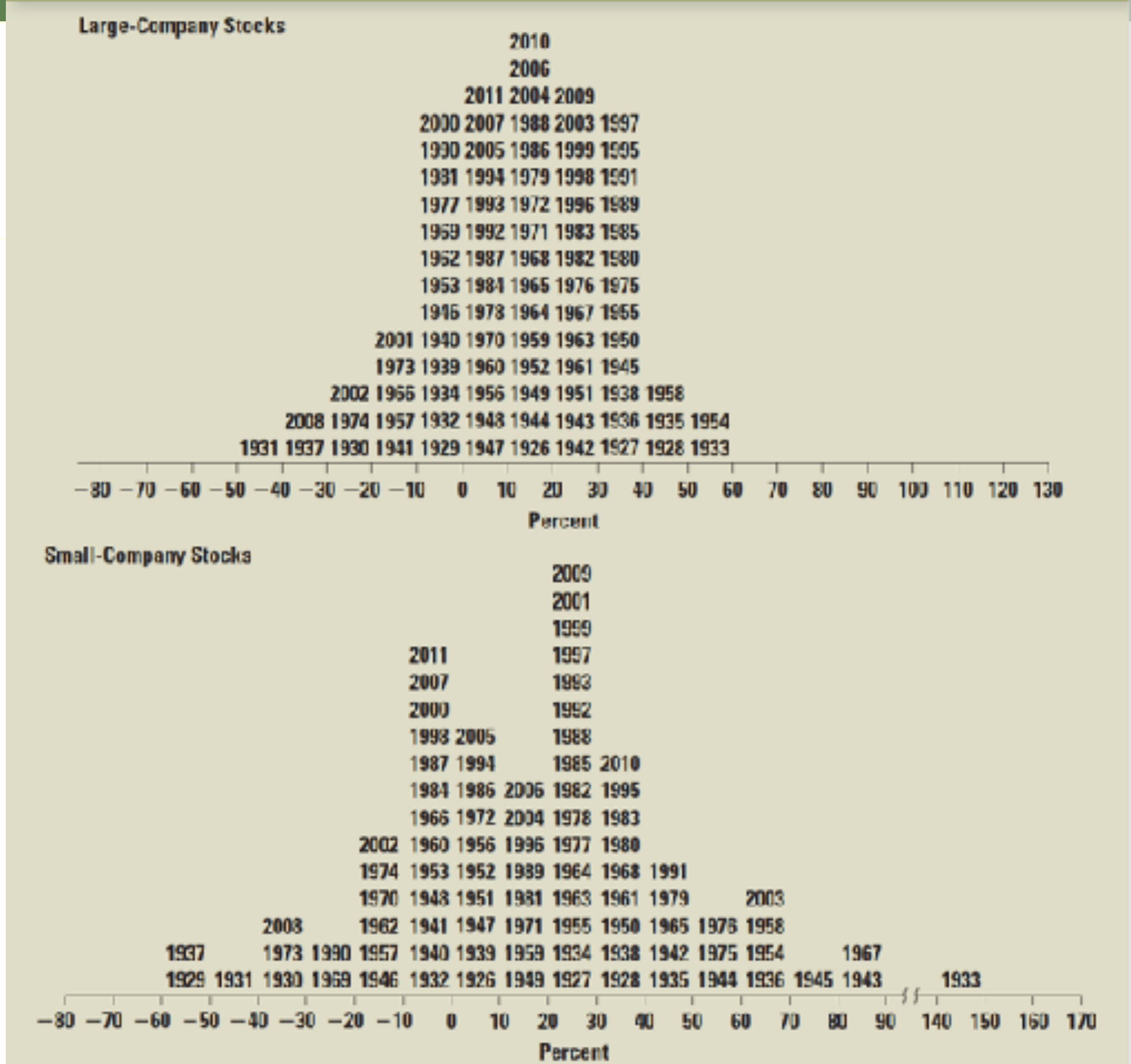
The Risk-Return Tradeoff



10.5 Risk Statistics

- There is no universally agreed-upon definition of risk.
- The measures of risk that we discuss are variance and standard deviation.
  - The standard deviation is the standard statistical measure of the spread of a sample, and it will be the measure we use most of this time.
  - Its interpretation is facilitated by a discussion of the normal distribution.

Figure 10.9 Histogram of Returns on Common Stocks, 1926–2011



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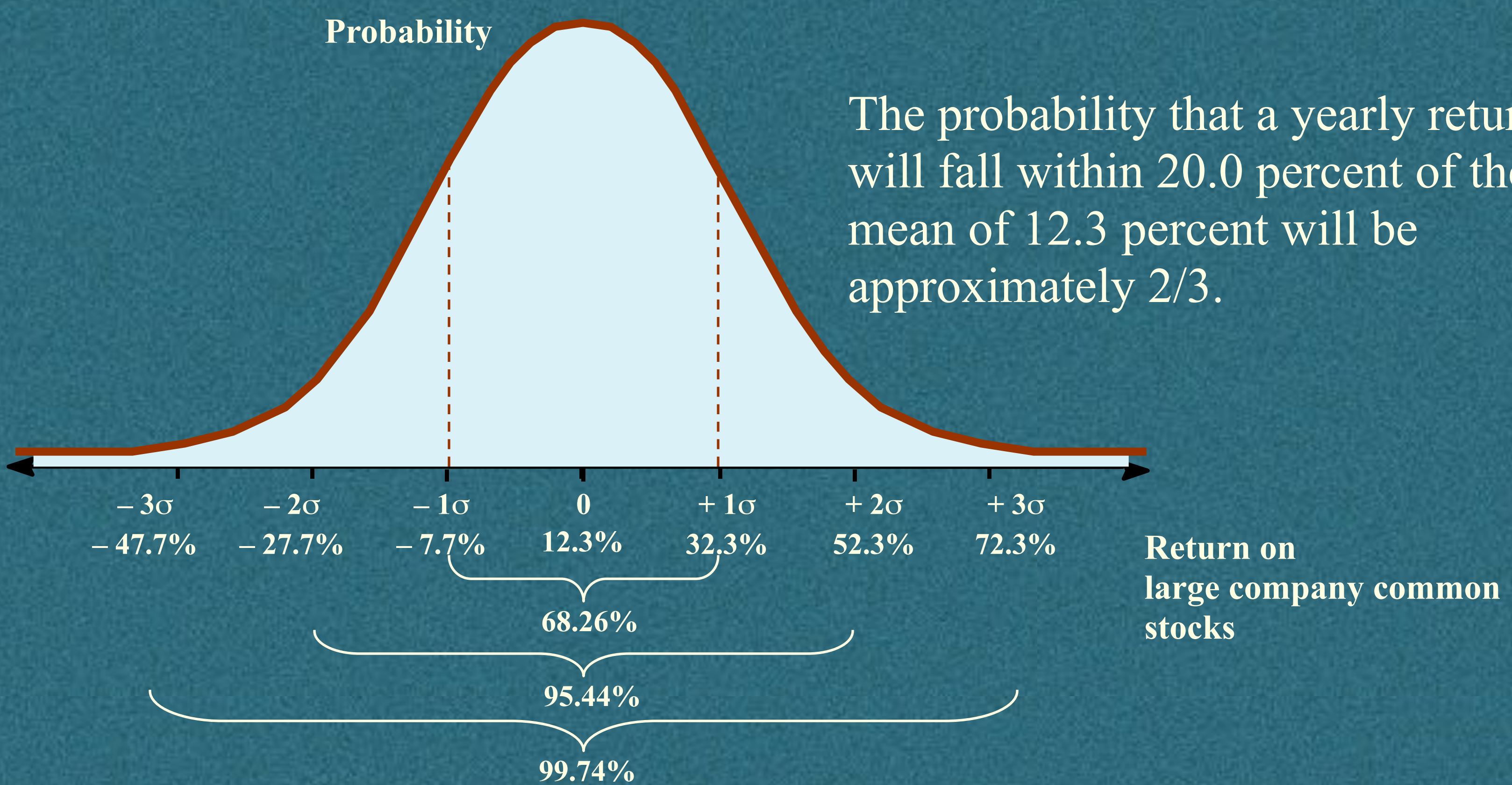
Normal Distribution

- A large enough sample drawn from a normal distribution looks like a bell-shaped curve.



The probability that a yearly return will fall within 20.0 percent of the mean of 12.3 percent will be approximately 2/3.

Normal Distribution

- The 20.0% standard deviation we found for large stock returns from 1926 through 2011 can now be interpreted in the following way:
  - If stock returns are approximately normally distributed, the probability that a yearly return will fall within 20.0 percent of the mean of 12.3% will be approximately 2/3.

Series	Arithmetic Mean (%)	Standard Deviation (%)	Distribution (%)
Small-company stocks'	16.5	32.5	
Large-company stocks	11.8	20.3	
Long-term corporate bonds	6.4	8.4	
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Intermediate-term government bonds	5.5	5.7	
U.S. Treasury bills	3.6	3.1	
Inflation	3.1	4.2	

Example – Return and Variance

Year	Actual Return	Average Return	Deviation from the Mean	Squared Deviation
1	.15	.105	.045	.002025
2	.09	.105	-.015	.000225
3	.06	.105	-.045	.002025
4	.12	.105	.015	.000225
Totals			.00	.0045

Variance = .0045 / (4-1) = .0015 Standard Deviation = .03873

10.6 More on Average Returns

- Arithmetic average – return earned in an average period over multiple periods
- Geometric average – average compound return per period over multiple periods
- The geometric average will be less than the arithmetic average unless all the returns are equal.

Geometric Return: Example

- Recall our earlier example:

Year	Return
1	10%
2	-5%
3	20%
4	15%

Geometric average return =

$$(1+R_g)^4 = (1+R_1)\times(1+R_2)\times(1+R_3)\times(1+R_4)$$

$$R_g = \sqrt[4]{(1.10)\times(.95)\times(1.20)\times(1.15)} - 1$$

$$= .095844 = 9.58\%$$

So, our investor made an average of 9.58% per year, realizing a holding period return of 44.21%.

$$1.4421 = (1.095844)^4$$

- Note that the geometric average is not the same as the arithmetic average:

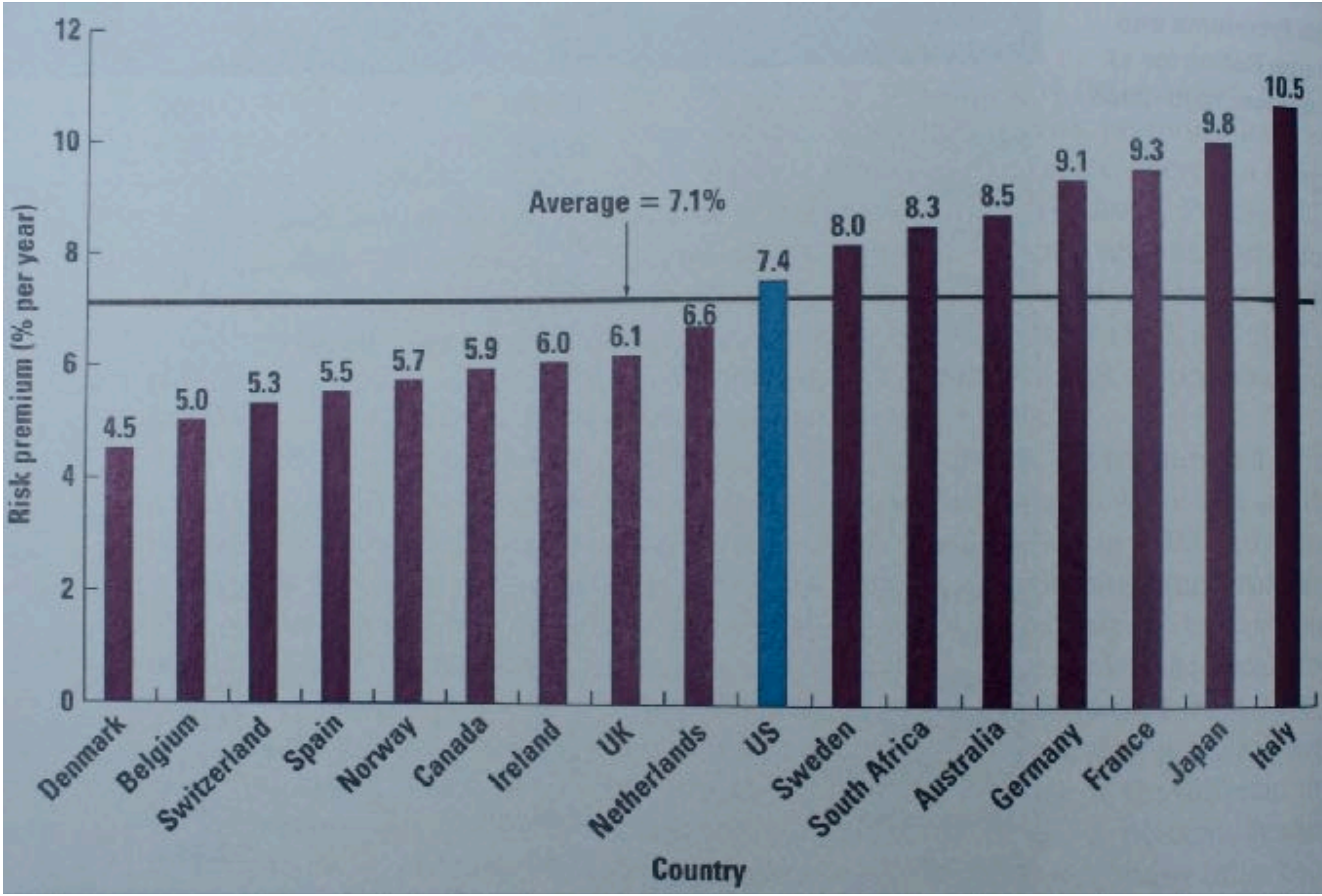
Year	Return
1	10%
2	-5%
3	20%
4	15%

$$\text{Arithmetic average return} = \frac{R_1 + R_2 + R_3 + R_4}{4}$$

$$= \frac{10\% - 5\% + 20\% + 15\%}{4} = 10\%$$

Perspectives on the Equity Risk Premium

- Over 1926-2007, the U.S. equity risk premium has been quite large:
  - Earlier years (beginning in 1802) provide a smaller estimate at 5.4%
  - Comparable data for 1900 to 2005 put the international equity risk premium at an average of 7.1%, versus 7.4% in the U.S.
- Going forward, an estimate of 7% seems reasonable, although somewhat higher or lower numbers could also be considered rational



Risk premium (% per year)
12
10
8
6
4
2
0
Average = 7.1%
4.5
5.0
5.3
5.5
5.7
5.9
6.0
6.1
6.6
7.4
8.0
8.3
8.5
9.1
9.3
9.8
10.5
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