



Risk and Return

Gestão Financeira II
Undergraduate Courses
2011-2012

Outline

- Common Measures of Risk and Return
- Historical Returns of Stocks and Bonds
- Historical Tradeoff between Risk and Return

Returns

- How do we measure the return from investment in one asset?
 - We compare initial value of the investment in the asset with the final value, at the end of the investment period.
- For **Stocks** we have:
 - **Dollar return**: $P_{t+1} + D_{t+1} - P_t$
 - **Percentage return**: $r_{t+1} = \frac{P_{t+1} + D_{t+1} - P_t}{P_t}$

where

P_t : price at beginning of period

P_{t+1} : price at end of period

D_{t+1} : dividend (cash flow) paid during period

Returns: Example

- Suppose you bought 100 shares of Wal-Mart one year ago at \$25. You received \$20 in dividends (20 cents per share 100 shares). At the end of the year, stock sells for \$30. How well did you do?
 - Investment $\$25 \times 100 = \$2,500$; At the end of the year, stock is worth \$3,000 and dividends of \$20
 - Dollar return: $520 = 20 + (3,000 - 2,500)$
 - Percentage return:

$$r_t = \frac{3,000 + 20 - 2,500}{2,500} = 20.8\% = 20\% + 0.8\%$$

Holding Period Returns

- The **holding period return** is the return that an investor would get when holding an investment over a period of n years (assumes immediate reinvestment of dividends):

$$\begin{aligned} & \text{Holding period return} \\ & = (1 + r_1) \times (1 + r_2) \times \cdots \times (1 + r_n) - 1 \end{aligned}$$

where r_i is the return during year i

Holding Period Returns: Example

- Suppose your investment provides the following returns over a four-year period:
 - Year 1: 10%
 - Year 2: -5%
 - Year 3: 20%
 - Year 4: 15%

Holding period return

$$= (1 + r_1) \times (1 + r_2) \times \cdots \times (1 + r_n) - 1$$

$$= 1.1 \times 0.95 \times 1.2 \times 1.15 - 1 = 0.4421 = 44.21\%$$

Average Return

- **Arithmetic average:** return earned in an average year over a particular period
- **Geometric average:** average compound return per year over a particular period
- Geometric average will be less than the arithmetic average unless all the returns are equal
- **Which is better?**
 - Geometric average is an excellent measure of past realized performance and good estimate of annual return to be obtained over extended periods of time in the future
 - Arithmetic average is best estimate of the expected return in a single period in the future

Average Return: Example

- What is the **geometric** average return?

$$(1+r)^4 = (1+r_1) \times (1+r_2) \times (1+r_3) \times (1+r_4)$$

$$r = \sqrt[4]{1.1 \times 0.95 \times 1.2 \times 1.15} - 1 = 9.58\%$$

- So, our investor made an average of 9.58% per year, realizing a holding period return of 44.21%
- **Arithmetic** average return is higher:

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

Return Statistics

- History of capital market returns can be summarized by describing the:

- average arithmetic return $\bar{r} = \frac{r_1 + r_2 + \dots + r_T}{T}$

- standard deviation of those returns

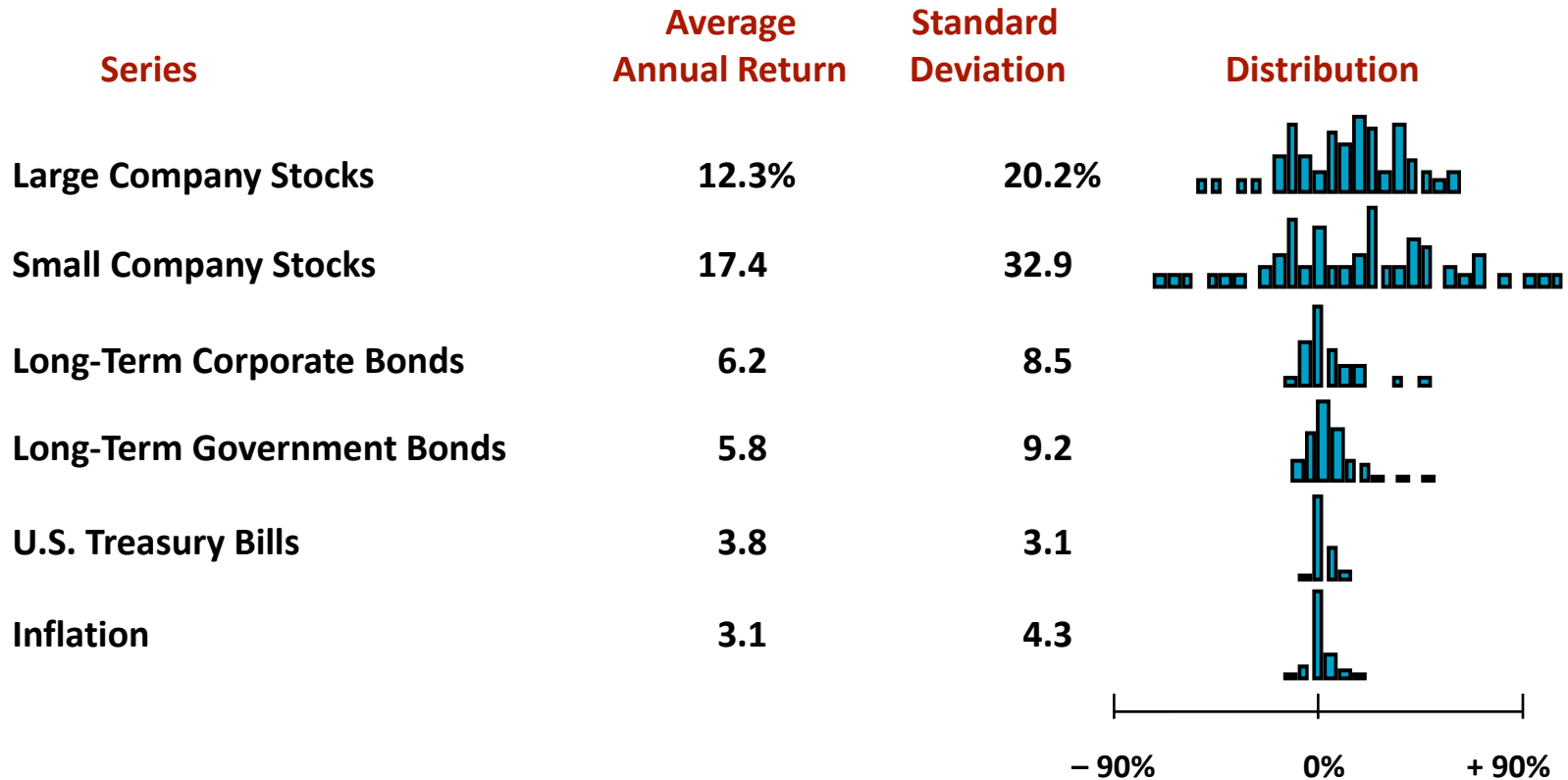
$$\sigma = \sqrt{Var} = \sqrt{\frac{(r_1 - \bar{r})^2 + (r_2 - \bar{r})^2 + \dots + (r_T - \bar{r})^2}{T - 1}}$$

- the frequency distribution of the returns

Return Statistics

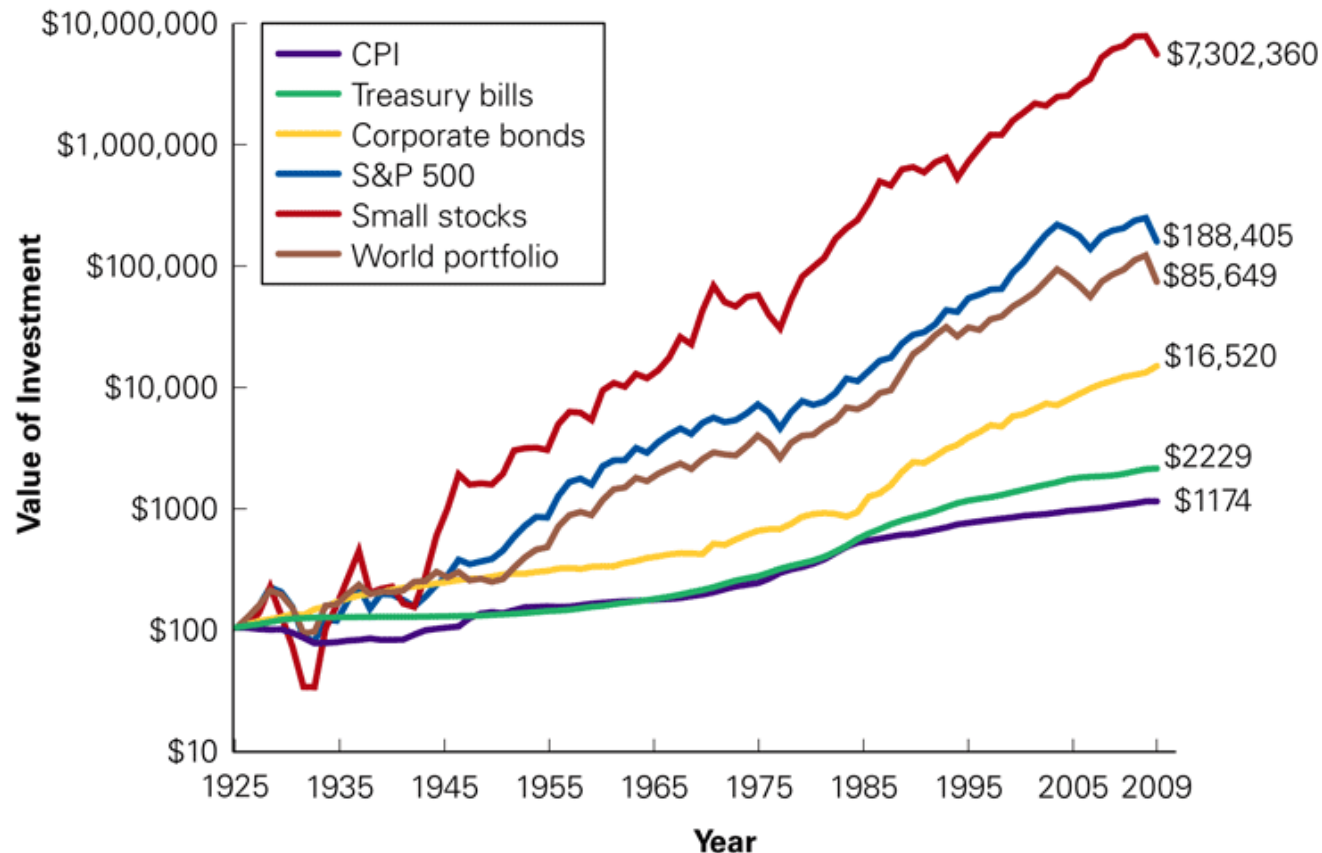
- Historical rates of returns on common stocks, bonds, and Treasury bills (Ibbotson and Sinquefeld).
- Year-by-year historical rates of return starting in 1926 in the United States:
 - Large-company Stocks
 - Small-company Stocks
 - Long-term Corporate Bonds
 - Long-term U.S. Government Bonds
 - U.S. Treasury Bills

Historical Returns U.S. 1926-2005



Source: © *Stocks, Bonds, Bills, and Inflation 2006 Yearbook™*, Ibbotson Associates, Inc., Chicago (annually updates work by Roger G. Ibbotson and Rex A. Sinquefeld). All rights reserved.

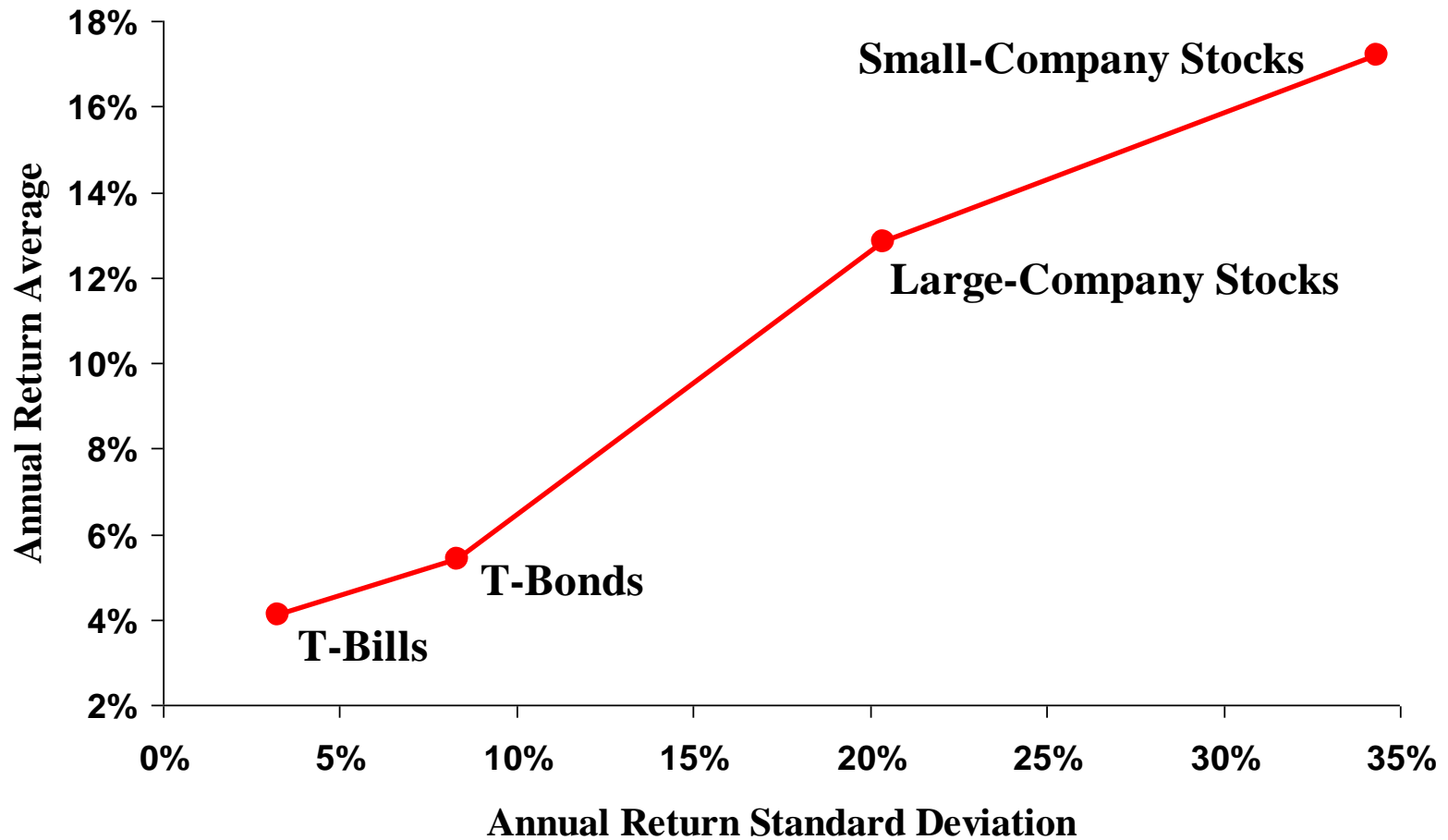
Cumulative Returns U.S. 1925-2009



Risk Premium

- *Risk Premium* is the added return (over and above the risk-free rate) resulting from bearing risk
- Stock markets offer long-run excess of stock return over the risk-free return:
 - Average excess return from large company common stocks: $8.5\% = 12.3\% - 3.8\%$
 - Average excess return from small company common stocks: $13.6\% = 17.4\% - 3.8\%$
 - Average excess return from long-term corporate bonds: $2.4\% = 6.2\% - 3.8\%$
- Given the superior performance of stocks over such long period, why does anyone hold bonds?

Risk-Return Trade-off



Risk

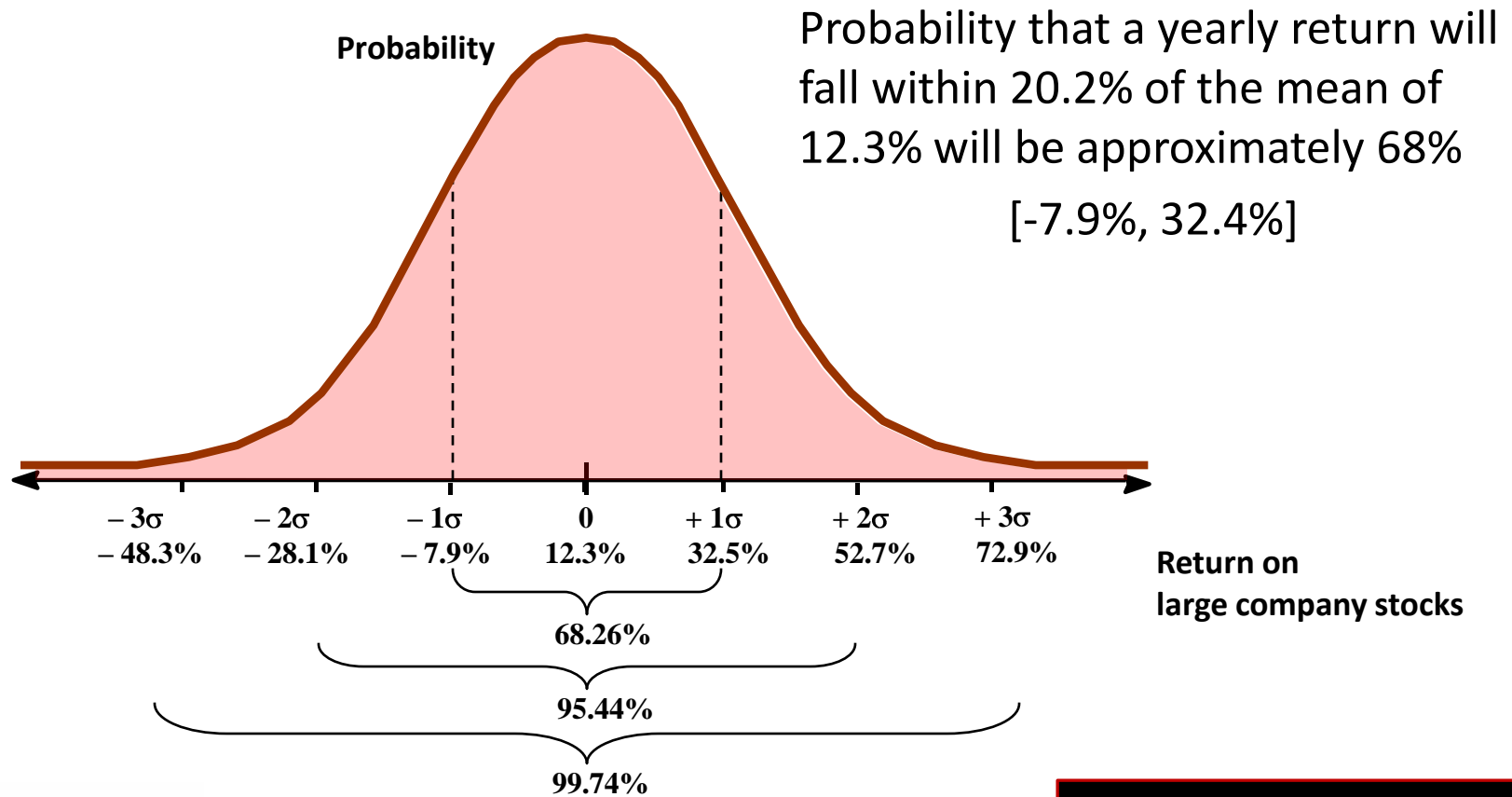
- **Risk** is uncertainty about the future
 - Stocks do better on average, but investors know that in any year, stocks may do much worse
- Summarize risk through **standard deviation, σ** , a measure of dispersion

| 1926-2005 | Standard Deviation |
|----------------------------|---------------------------|
| Stocks | 20.2% |
| T-bills | 3.1% |
| Long-term Government Bonds | 9.2% |
| Corporate Bonds | 8.5% |
| Inflation | 4.3% |

Source: Ibbotson, CRSP

Normal Distribution

- Suppose stock returns are normally distributed



What about the Future Returns and Risk?

- No one knows the future, but we form **expectations** about it.
- We will want a measure of **Expected Return**, based on probability distributions.
- We will want a measure of Expected Risk, such as the **Variance** or the **Standard Deviation of Expected Returns**.
- In the end, we typically use past (historical) returns to predict the future. We'll see more when presenting portfolios.