Risk and Return
in Capital Markets

Gestão Financeira I
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Corporate Finance I
Corporate Finance

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LISBON
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ECONOMICS &
MANAGEMENT
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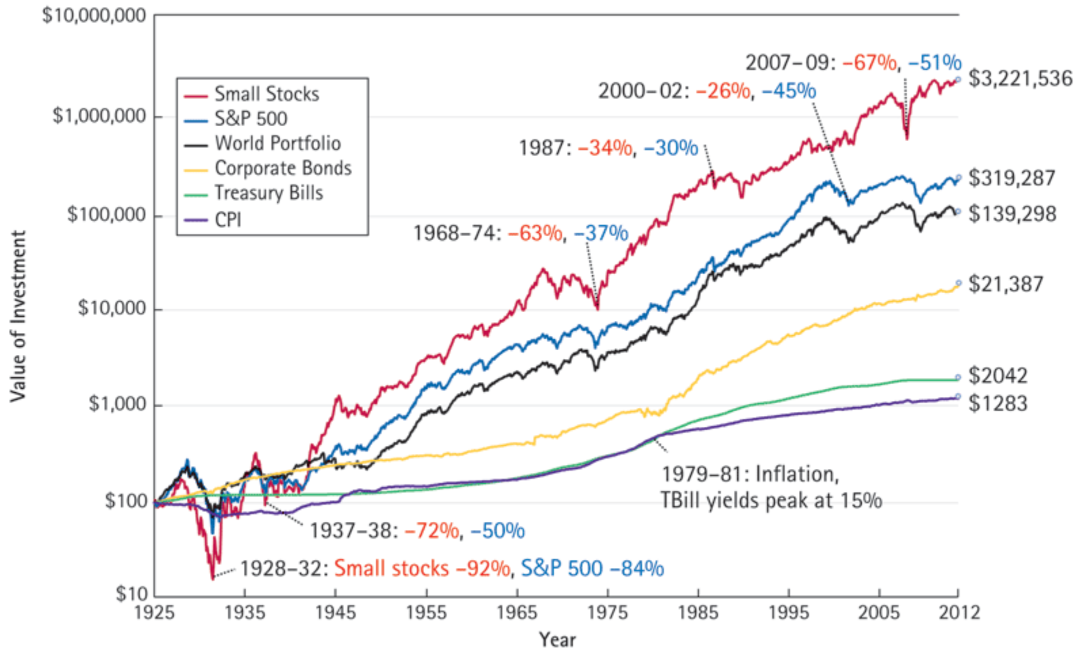
Outline

1. A First Look at Risk and Return
2. Historical Risks and Returns of Stocks
3. The Historical Tradeoff Between Risk and Return
4. Unsystematic Versus systematic Risk
5. Diversification in Stock Portfolios

A First Look at Risk and Return

- Consider how an investment would have grown if it were invested in each of the following from the end of 1929 until the beginning of 2012, in the USA:
  - Standard & Poor's 500 (S&P 500)
  - Small Stocks
  - World Portfolio
  - Corporate Bonds AAA
  - Treasury Bills



Source: Global Financial Data.

Realized Returns, in Percent (%) for Small Stocks, the S&P 500, Corporate Bonds, and Treasury Bills, Year-End 1925–1935

Year	Small Stocks	S&P 500	Corp Bonds	Treasury Bills
1926	7.20	11.14	6.29	3.19
1927	25.75	37.13	6.55	3.12
1928	46.87	43.31	3.38	3.82
1929	50.47	8.91	4.32	4.74
1930	45.58	25.26	6.34	2.35
1931	50.22	43.86	2.38	1.02
1932	8.70	8.86	12.20	0.81
1933	187.20	52.89	5.26	0.29
1934	25.21	2.34	9.73	0.15
1935	64.74	47.21	6.86	0.17

Source: Global Financial Data.

Negative returns (losses) are in red

Returns

- How do me 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

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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 × 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):

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

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?

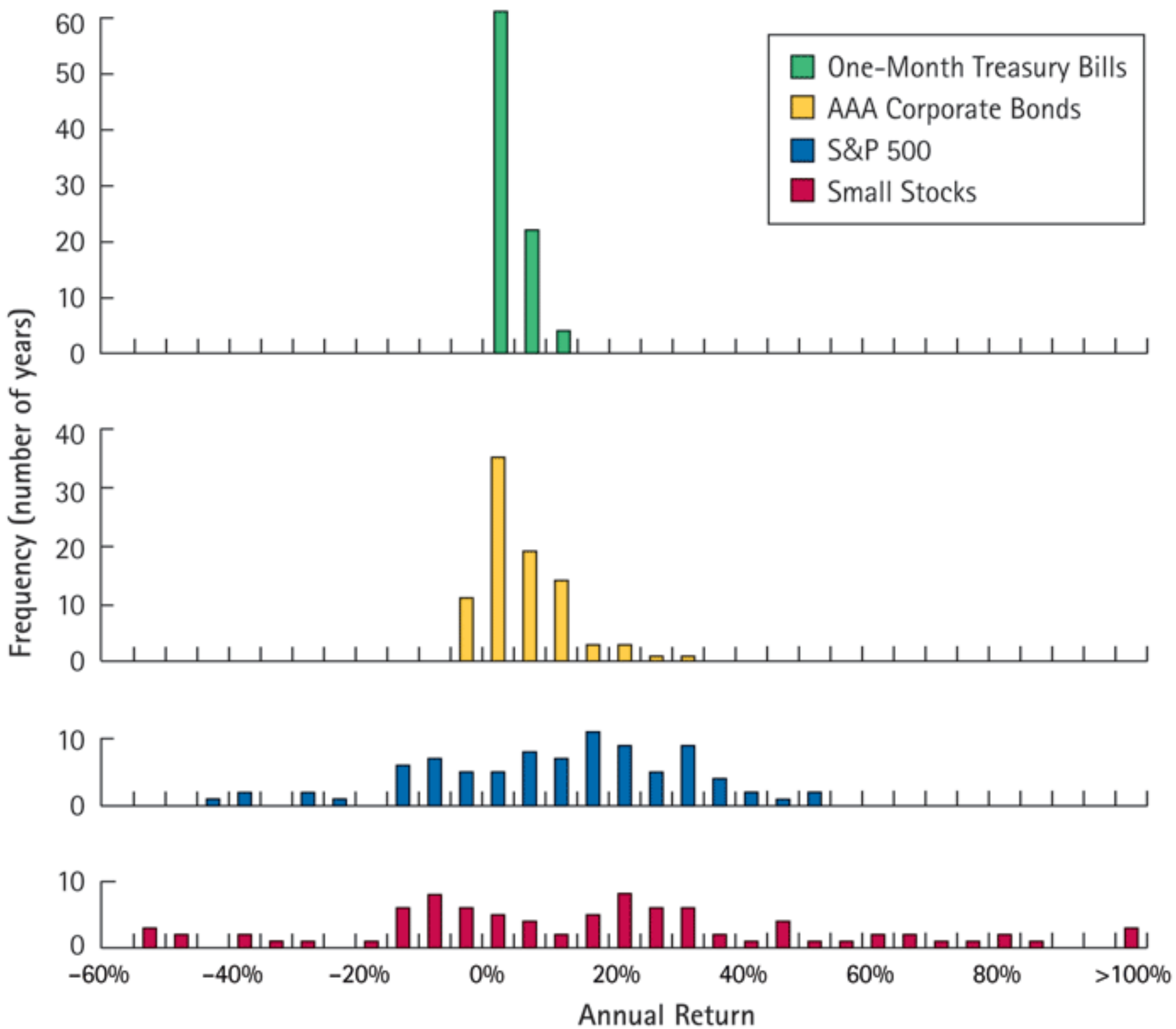
$$(1+r)^4 = (1+r_1)\times(1+r_2)\times(1+r_3)\times(1+r_4)$$

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

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

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

Historical Returns U.S. 1926-2012: returns frequency distribution



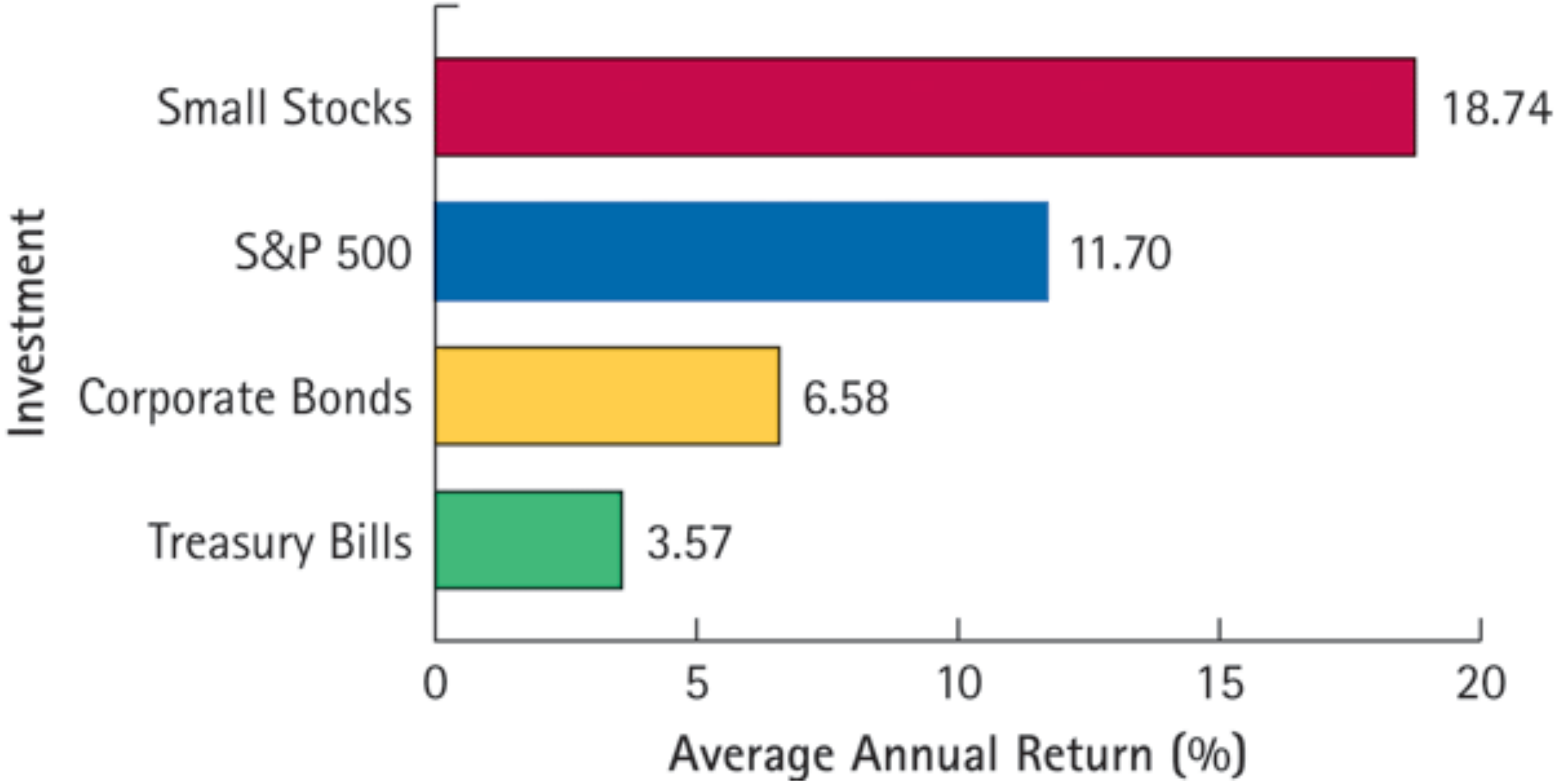
Return Statistics: average return and volatility

- History of capital market returns can be summarized by describing the:
  - average arithmetic return $\bar{r} = \frac{r_1 + r_2 + \cdots + r_T}{T}$
  - standard deviation of those returns

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

  - the frequency distribution of the returns

Historical Returns U.S. 1926-2012: average annual returns



Historical Risk of Stocks

- The Variance and Volatility of Returns:
  - Variance

$$Var(R) = \frac{1}{T-1}\left((R_1 - \bar{R})^2 + (R_2 - \bar{R})^2 + \ldots + (R_T - \bar{R})^2\right)$$

  - Standard Deviation

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

Computing Historical Volatility: example

- Using the data below, what is the standard deviation of the S&P 500's returns for the years 2005-2009?

2005	2006	2007	2008	2009
4.9%	15.8%	5.5%	–37.0%	26.5%

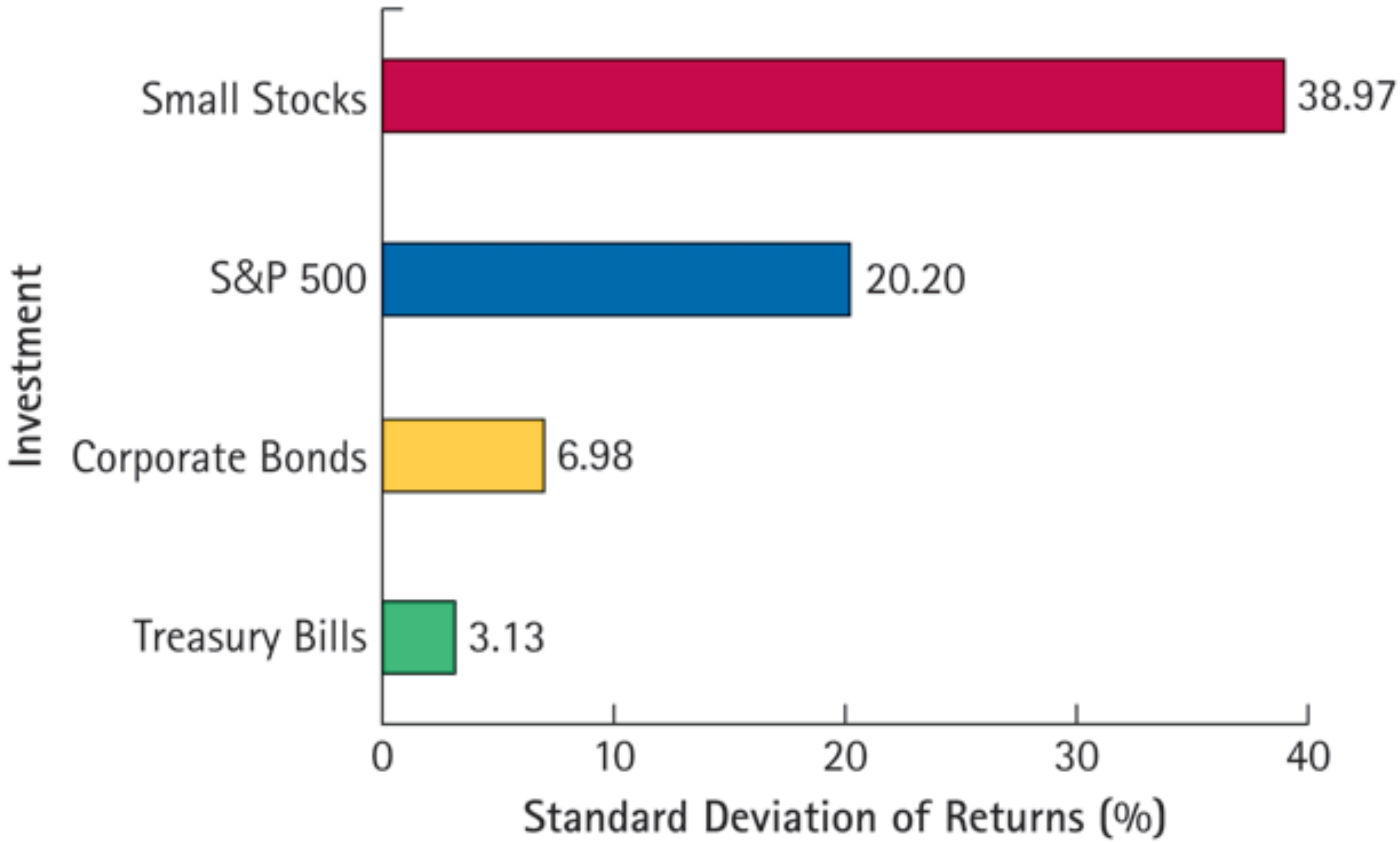
$$Var(R) = \frac{1}{T-1}\left[(R_1 - \bar{R})^2 + (R_2 - \bar{R})^2 + \ldots + (R_T - \bar{R})^2\right]$$

$$= \frac{1}{5-1}\left[(.049-.031)^2 + (.158-.031)^2 + (.055-.031)^2 + \left(-0.370-.031\right)^2 + \left(.265-.031\right)^2\right]$$

$$= .058$$

$$SD(R) = \sqrt{Var(R)} = \sqrt{.058} = 0.241, \text{or } 24.1\%$$

Volatility (Standard Deviation) of U.S. Small Stocks, Large Stocks (S&P 500), Corporate Bonds, and Treasury Bills, 1926–2012



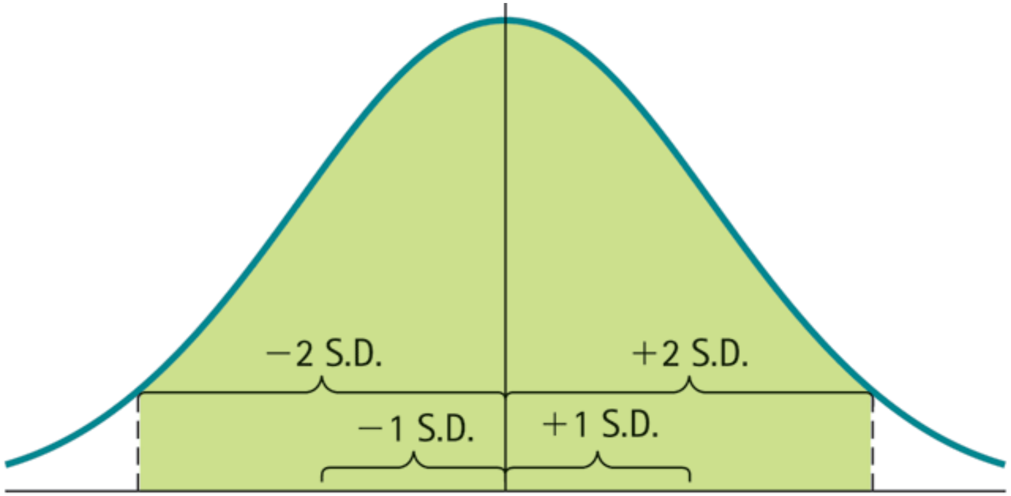
How to model the distribution of returns: sometimes using the Normal distribution

- The Normal Distribution
  - 95% Prediction Interval

$$\text{Average} \pm (2 \text{ x standard deviation})$$

$$\bar{R} \pm (2 \text{ x } SD(R))$$

- About two-thirds of all possible outcomes fall within one standard deviation above or below the average



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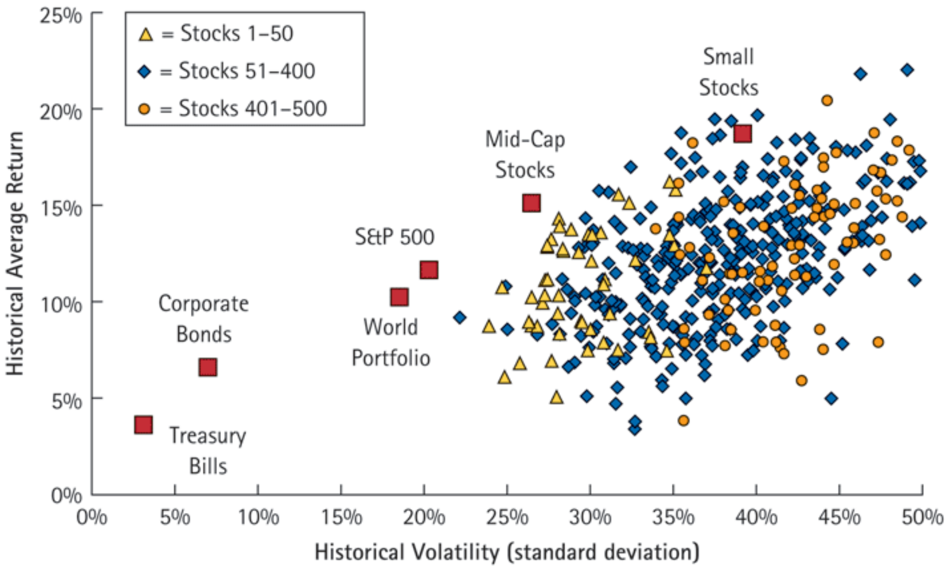
Historical Trade-off between risk and return

- The Returns of Large Portfolios
  - Investments with higher volatility, as measured by standard deviation, tend to have higher average returns



Source: Global Financial Data and authors' calculations.

Figure 11.6 The Historical Tradeoff Between Risk and Return in Large Portfolios, 1926–2011

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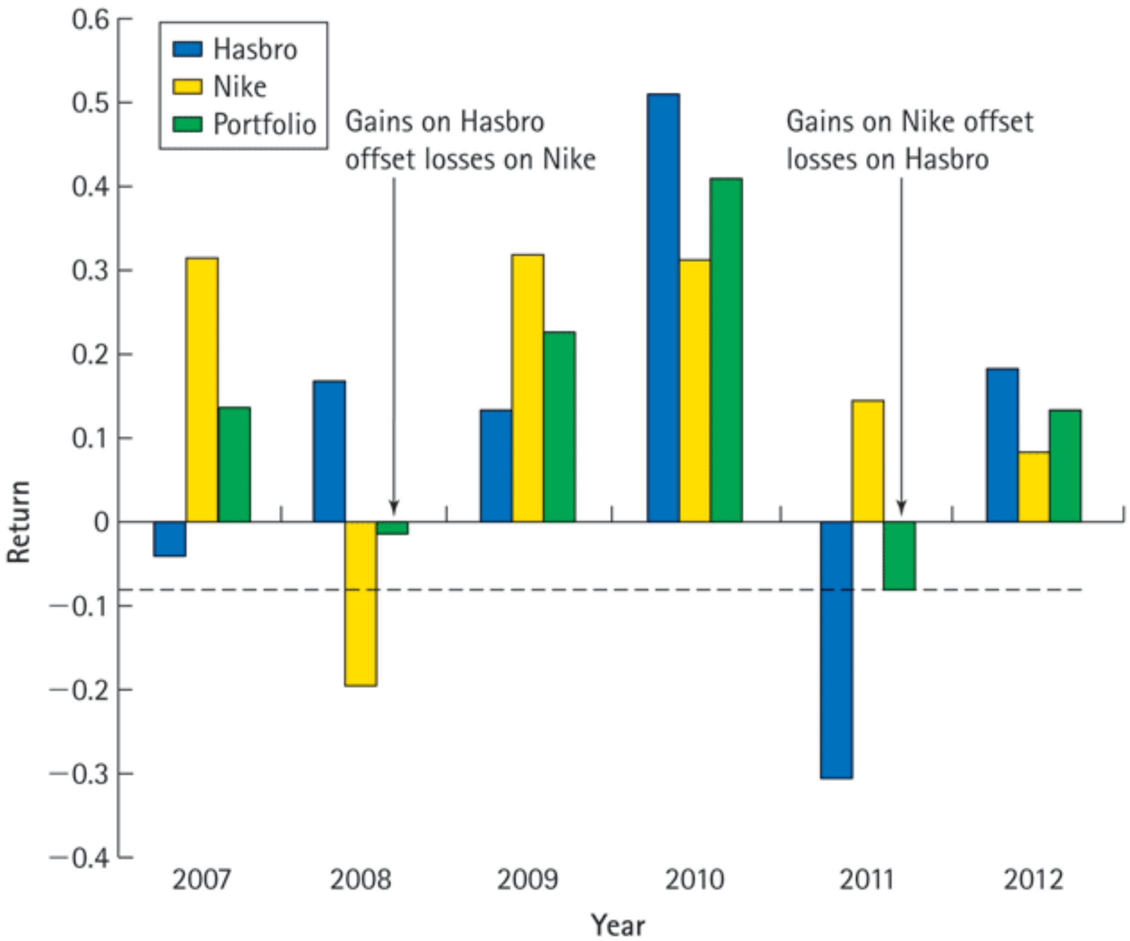
Historical Trade-off between risk and return

- The Returns of Individual Stocks
  - Larger stocks have lower volatility overall
  - Even the largest stocks are typically more volatile than a portfolio of large stocks
  - The standard deviation of an individual security doesn't explain the size of its average return
  - All individual stocks have lower returns and/or higher risk than the portfolios in Figure 11.6

Diversification

- Unsystematic Versus Systematic Risk
  - Stock prices are impacted by two types of news:
    1. Company or Industry-Specific News (unsystematic risk)
    2. Market-Wide News (systematic)
  - Unsystematic Risk (or idiosyncratic, or diversifiable, or specific)
  - Systematic Risk (or market, or non-diversifiable)

The Effect of Diversification on Portfolio Volatility



- Diversifiable Risk and the Risk Premium
  - The risk premium for diversifiable risk is zero
    - Investors are not compensated for holding unsystematic risk
- The Importance of Systematic Risk
  - The risk premium of a security is determined by its systematic risk and does not depend on its diversifiable risk