Risk and Return

In this part of the class are the goals are:

- Understand risk and return
  - How are risk and return measured?
  - Historically what has been the relationship between risk and return?
    - Use the past a guide for reasonable estimates of what's possible in the future
- Use our knowledge of risk and return to determine how to construct a "good" portfolio
  - Which assets should we hold and how much of each?

- Determine the appropriate measure of return for a given level of risk. If we know the appropriate return for a given level of risk, we can use the information to:

    - Evaluate portfolio performance -- is a successful portfolio manager smart (dumb) or lucky (unlucky)?

    - Figure out whether or not an asset is over-priced, under-priced or correctly priced. This helps us identify investments opportunities.

Measuring Returns

$$\text{Return} = \frac{\text{End of the Period Price+Dividend}}{\text{Beginning of the Period Price}}$$

Compound annual return (geometric mean)

- The average performance of an asset that measures the change in wealth over more than one period.

Arithmetic mean

- Simple average of returns

Risk (standard deviation)

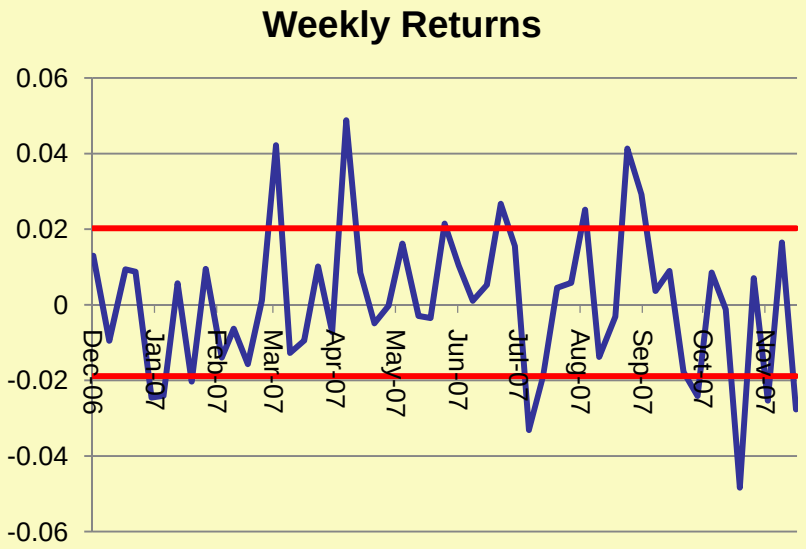
- The fluctuation of returns around the arithmetic average return of the investment. The higher the standard deviation, the greater the variability (and thus risk) of the investment returns.

Measuring Returns

General Motors (GM)

Price on 12/11/06	$37.36/share
Price on 12/3/07	$37.23/share
Dividends 2007	$ 1.12/share

$$2007\ \text{Return} = \frac{\$37.23 - \$37.36 + \$1.12}{37.36} = 2.65\%$$



Expected Return

Since the future share price is unknown, the expected return is used. The expected return is roughly a measure of the most likely return. Another way to think about the expected return is that half the time the actual return will be above the expected return and half the time the actual return will be below the expected return.

Expected returns can be estimated in two ways.

Historical Returns
Use the past returns as a proxy for future returns.

Forecasting
Historical returns provide the basis for forecasting. Forecasting uses additional information which may not be reflected in past returns --- changes in competitive structure of the industry, new technologies, changes in the regulatory environment etc.

Computing Historical Returns

$$\text{Average Return} = \frac{\sum_{t=1}^{N} r_t}{N} = \bar{r}$$

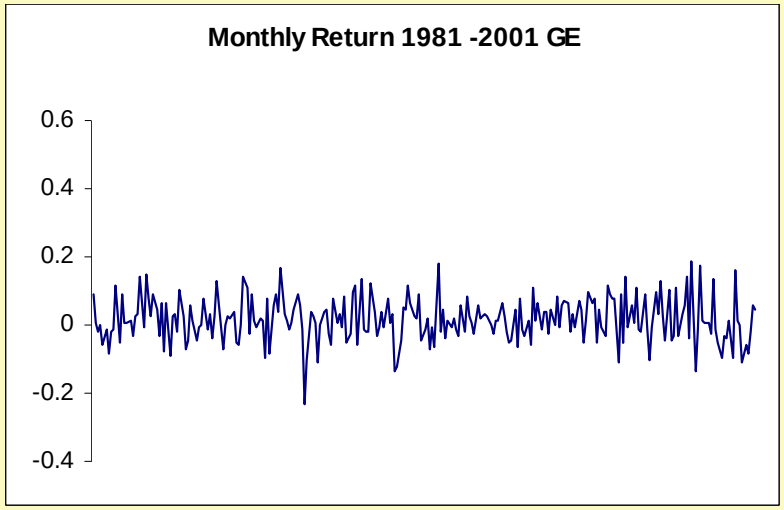
where r_t = realized return in period t

N = number of periods

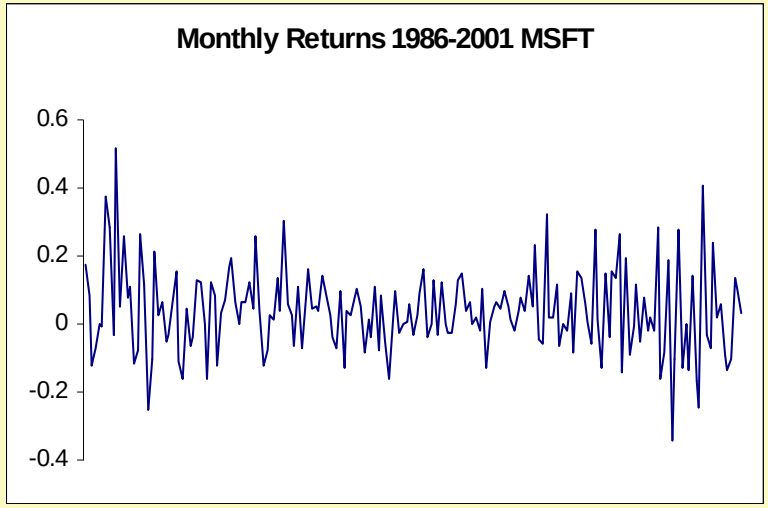
Historical returns are nice in that they are reproducible numbers based on hard data but there is still at lot of discretion involved.

Historical Returns

A long time horizon is probably more representative of the expected return but even this must be done with care. Do you think Microsoft's historical return is representative of the future return?



Return = 21%



Return = 57%

Returns for Different Types of Asset Classes

Stocks

- Large stocks
- Small stocks
- International stocks

Bonds

- Government bonds
- Corporate bonds
- Municipal bonds
- High-yield bonds
- International bonds

Cash equivalents

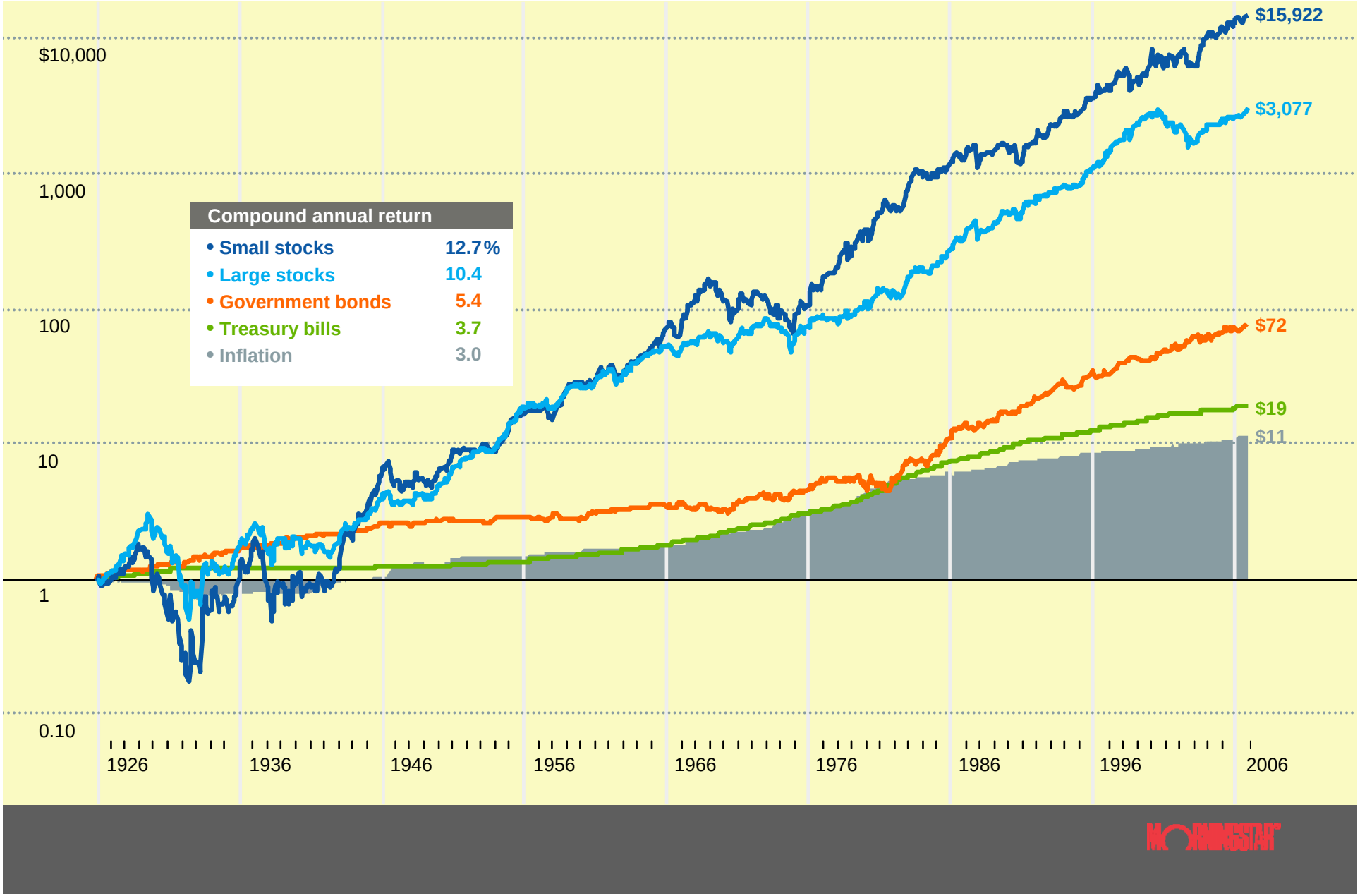
- Money market funds
- Treasury bills
- Certificates of deposit

Real assets

- Real estate
- Commodities
- Gold

Stocks, Bonds, Bills, and Inflation

1926–2006

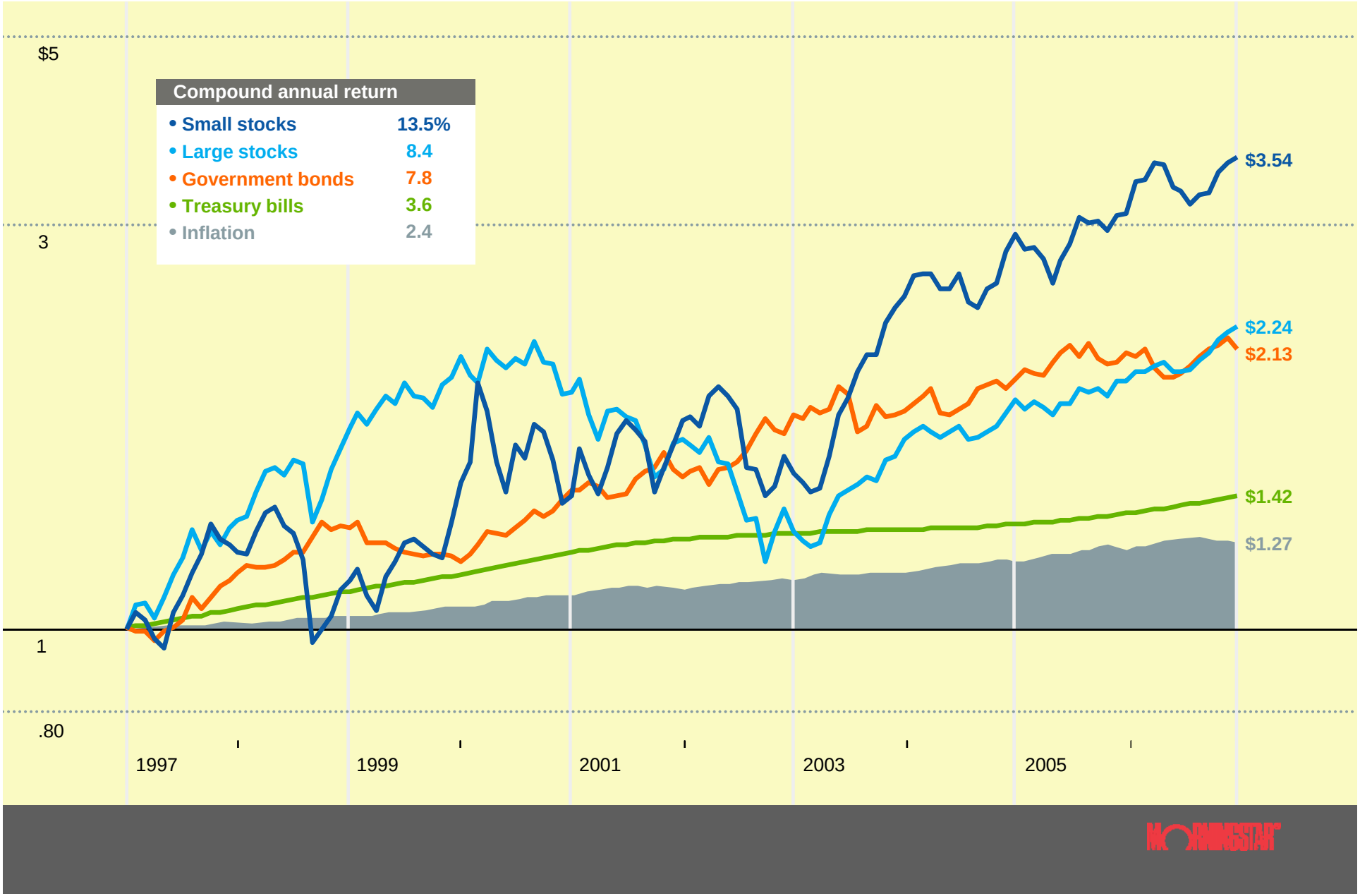


Stocks, Bonds, Bills, and Inflation

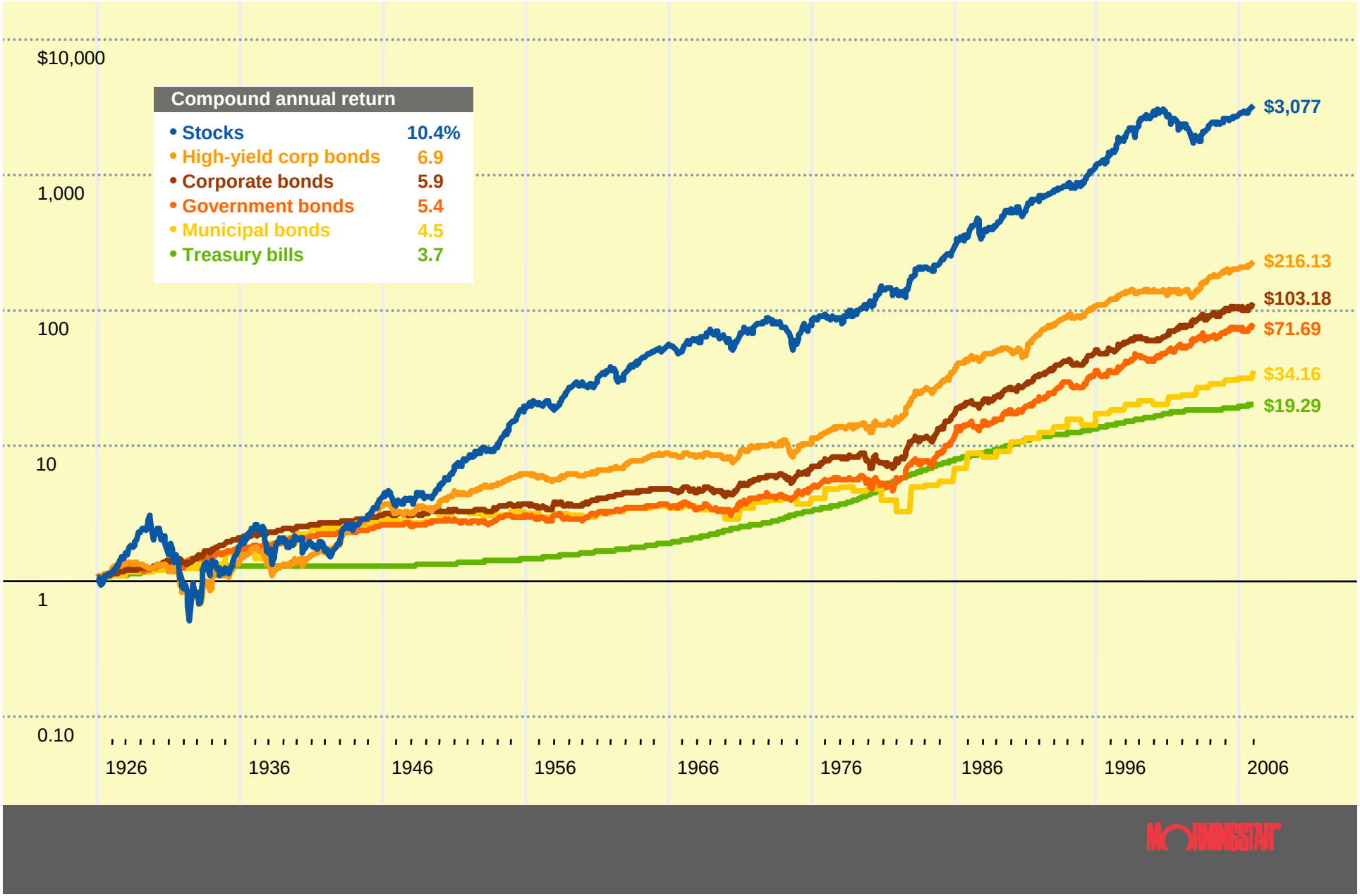
1987–2006

The Past 10 Years

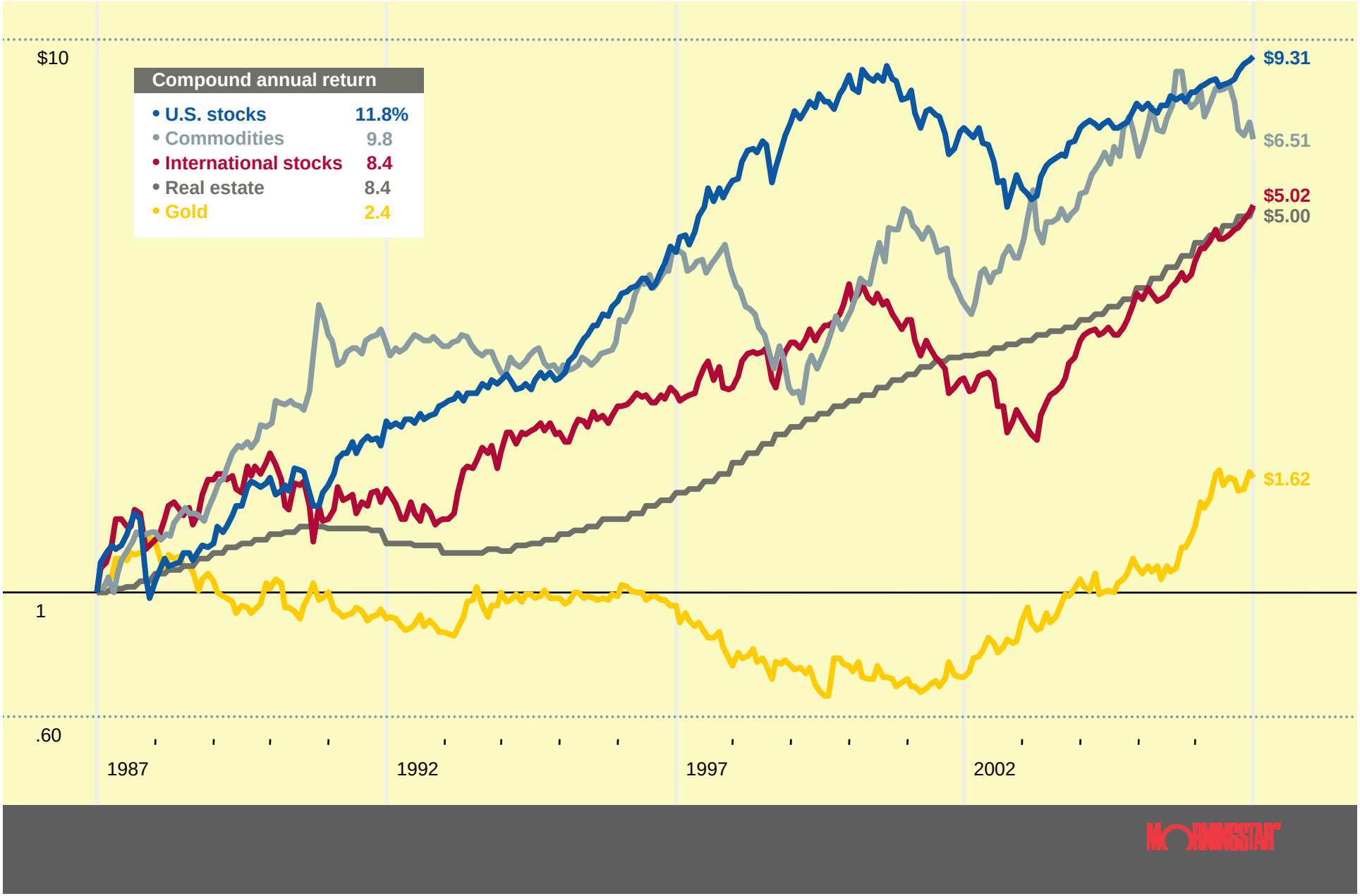
1997–2006



Bond Market Performance
1926–2006



Stocks, Commodities, Real Estate, and Gold
1987–2006



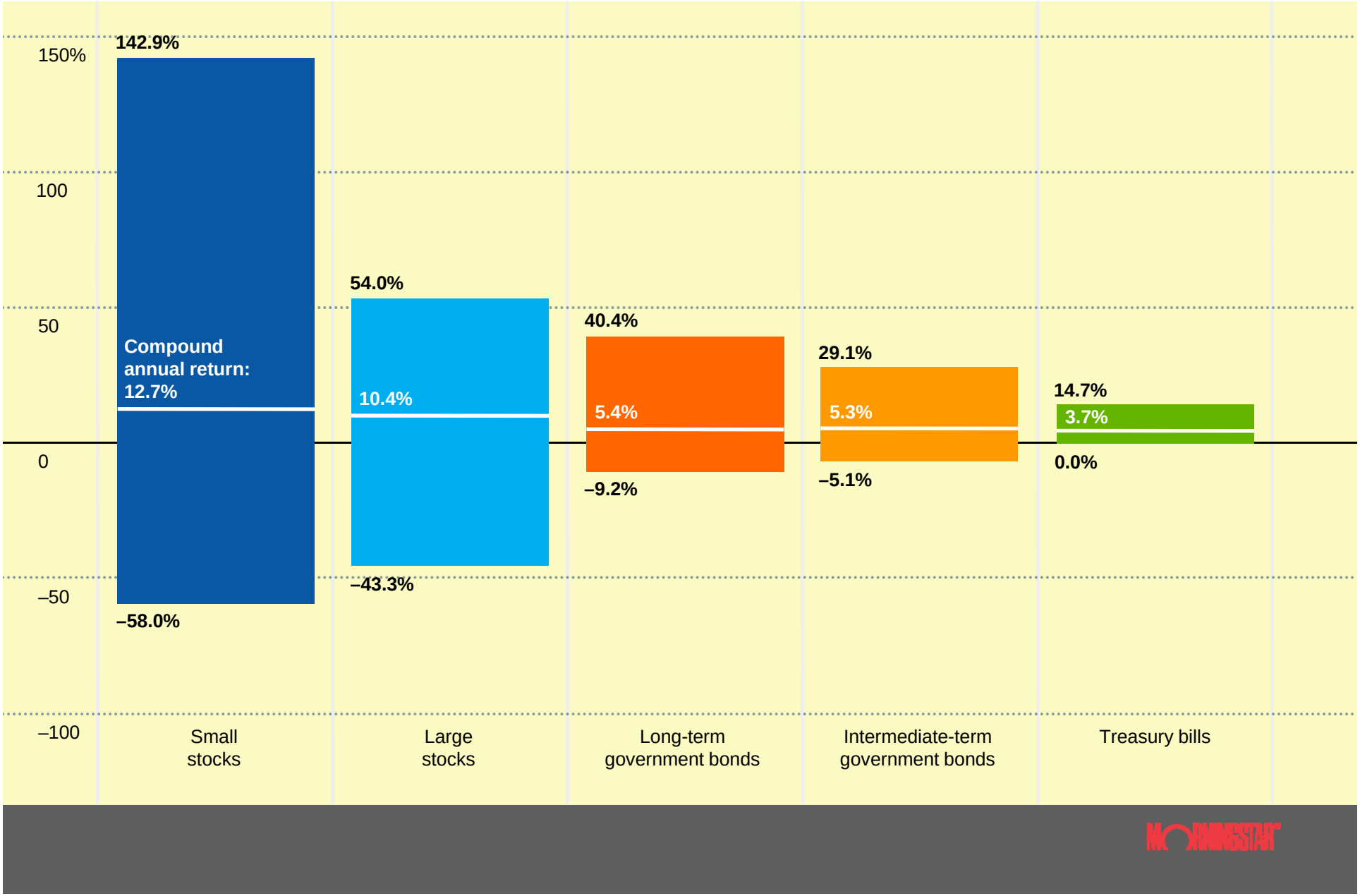
Measuring Risk

Variance measures a stock's risk. Stocks that have a wide range of possible returns have high variances and stocks which have a narrow range of possible returns have low variance.

Types of Risk

Asset Class Returns

Highs and lows: 1926–2006



Measuring Risk

Technically, the variance is the expected squared deviation from the expected return.

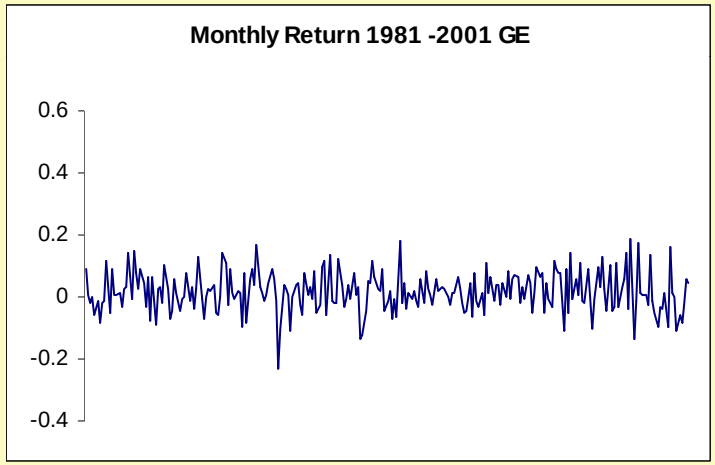
$$\text{Sample Variance} = \sum_{t=1}^{N} \frac{(r_t - \bar{r})^2}{N}$$

The standard deviation or the volatility is the squared root of the variance

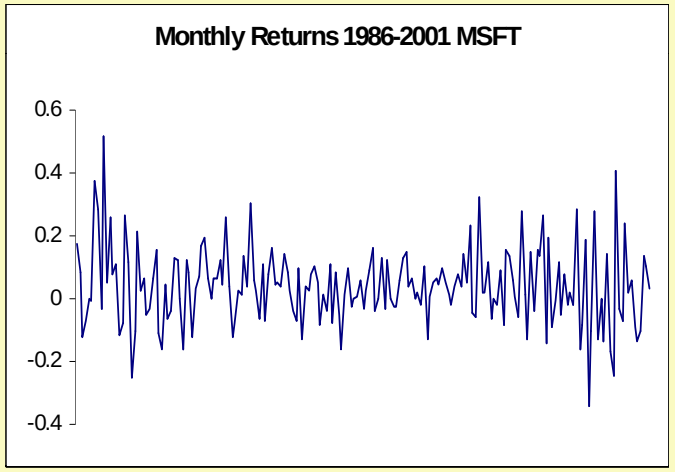
The standard deviation can be interpreted as saying that roughly 2/3's of the time the realized stock return is within a band which is the expected return ✂plus or minus one standard deviation.

Measuring Risk

A long time horizon is more representative but we still have to be careful. In 2006, the standard deviation of GE was 16% and the standard deviation of Microsoft was 25%



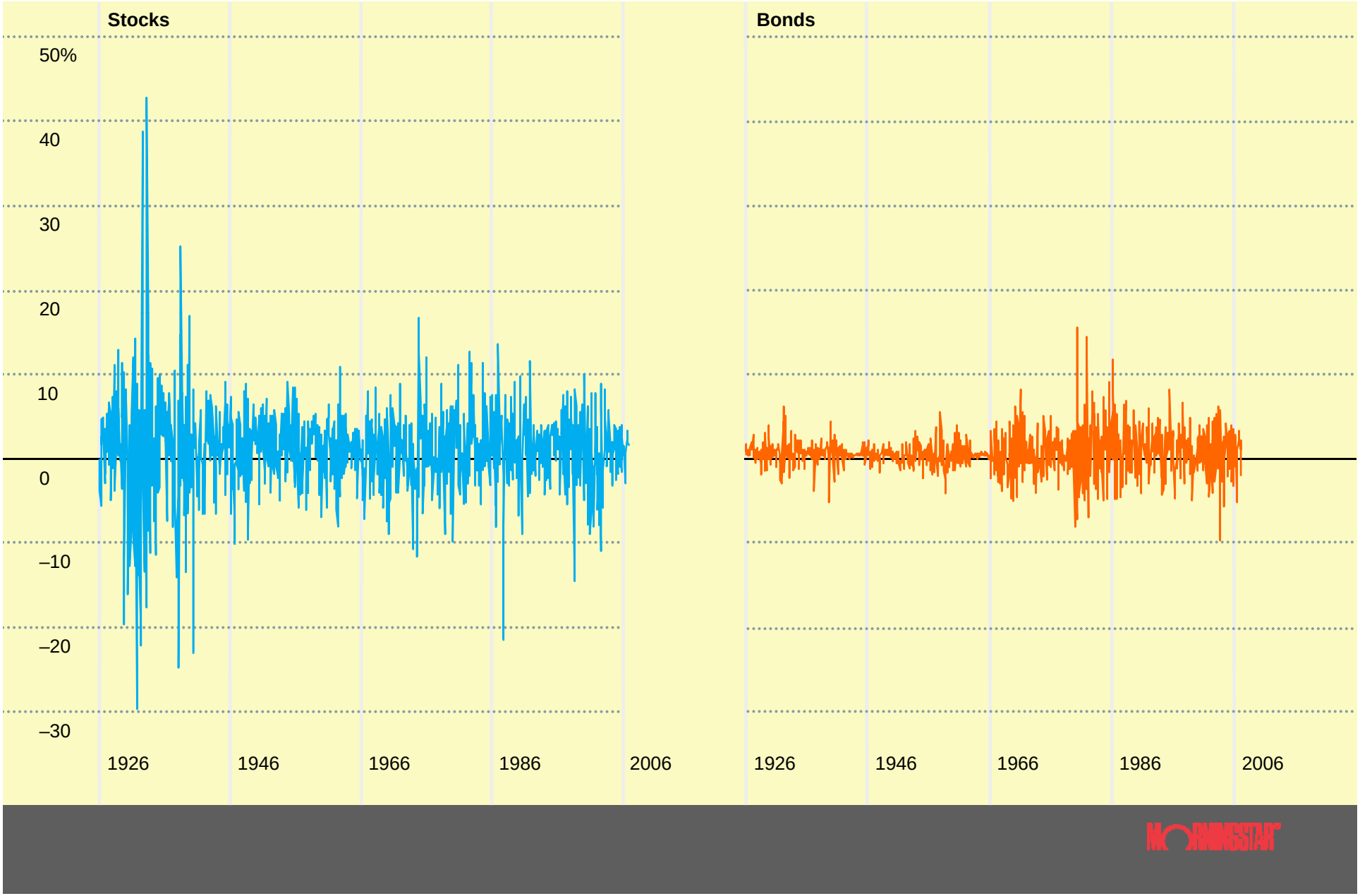
Standard Deviation = 22%



Standard Deviation = 43%

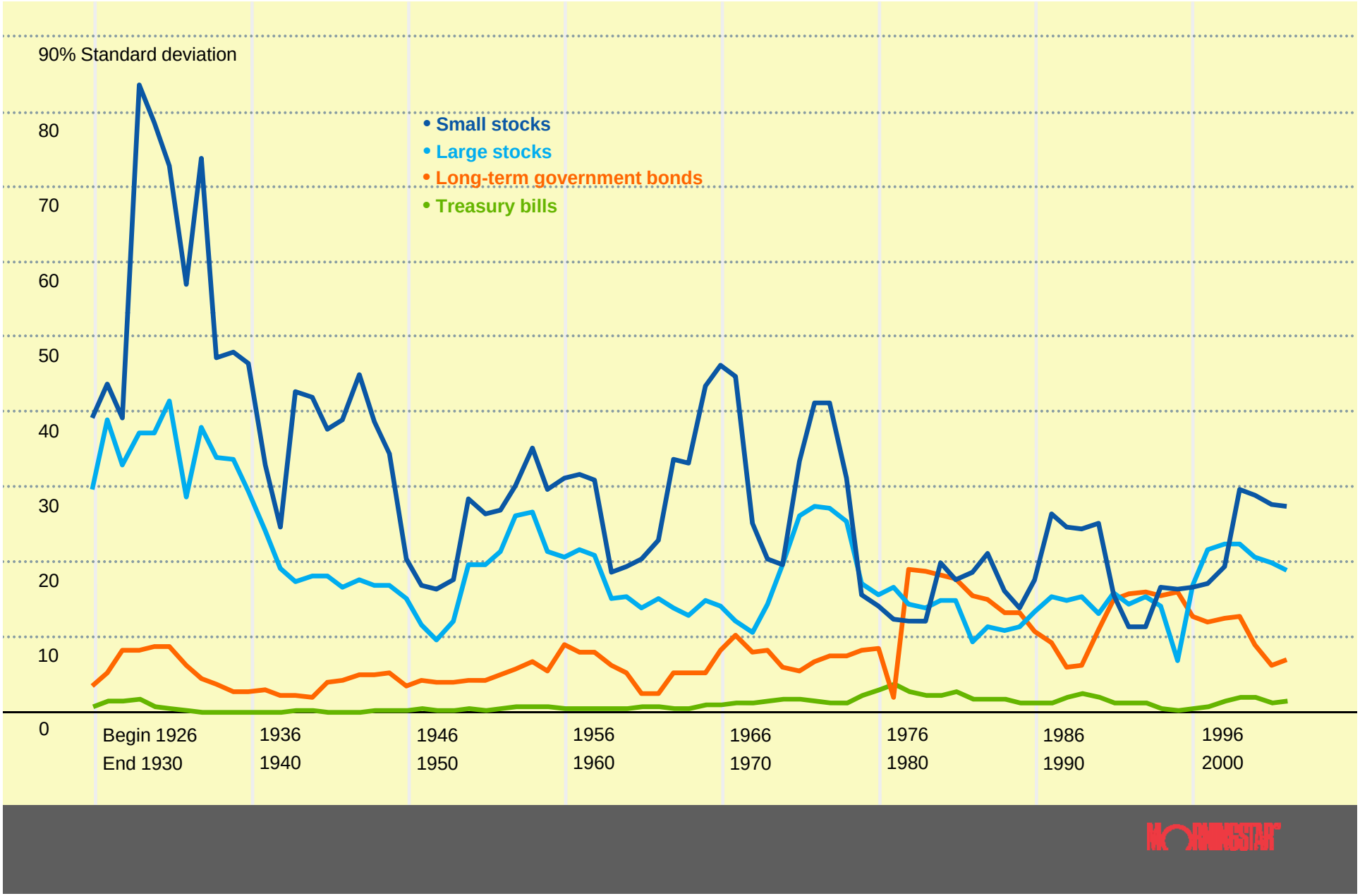
Stock and Bond Volatility Varies

1926–2006



Risk Changes Over Time

Five-year rolling periods 1926–2006

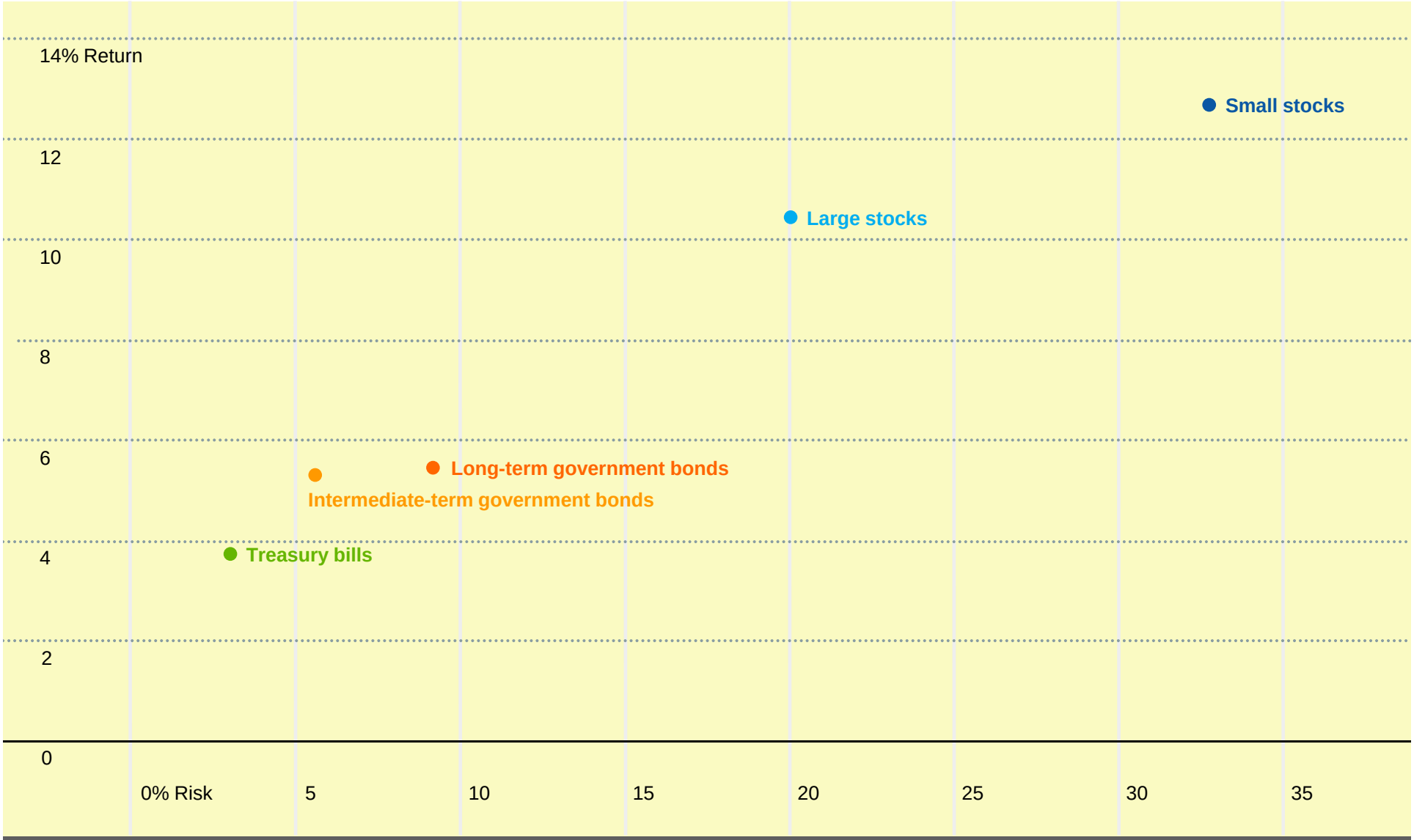


Long-Term Asset Class Performance
1926–2006

		Small stocks	Large stocks	Government bonds	Treasury bills
Annual	Compound annual return	12.7%	10.4%	5.4%	3.7%
	Standard deviation	32.7%	20.1%	9.2%	3.1%
12-month rolling periods	Highest return	316.4%	162.9%	54.4%	15.2%
	Lowest return	–75.9%	–67.6%	–17.1%	0.0%
	Average positive return	31.6%	21.8%	8.5%	3.8%
	Average negative return	–18.6%	–13.7%	–3.8%	0.0%
	Percent periods positive	72.7%	74.2%	77.5%	98.3%
	Percent periods negative	27.3%	25.8%	22.5%	1.7%

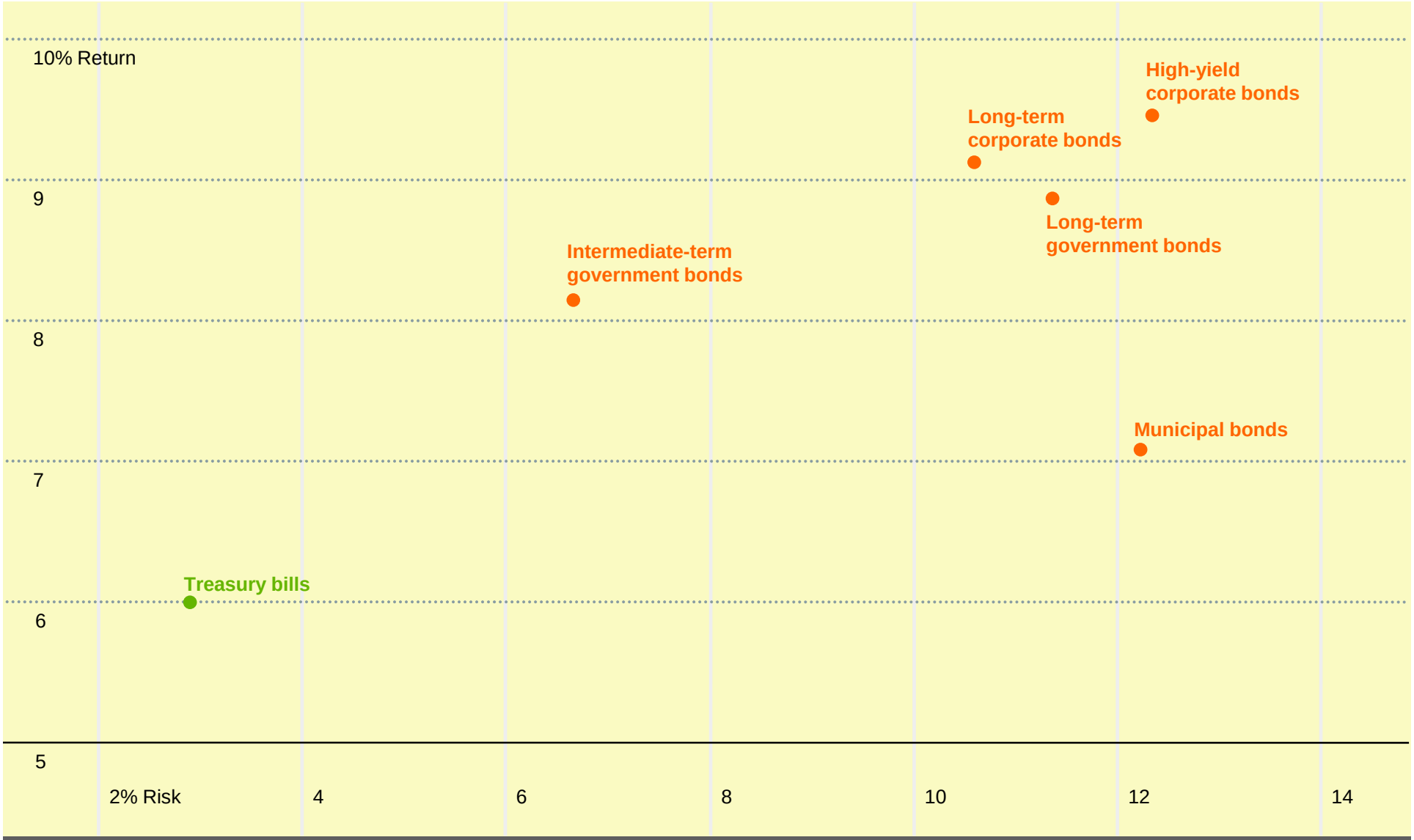
Risk Versus Return

Stocks, bonds, and bills 1926–2006



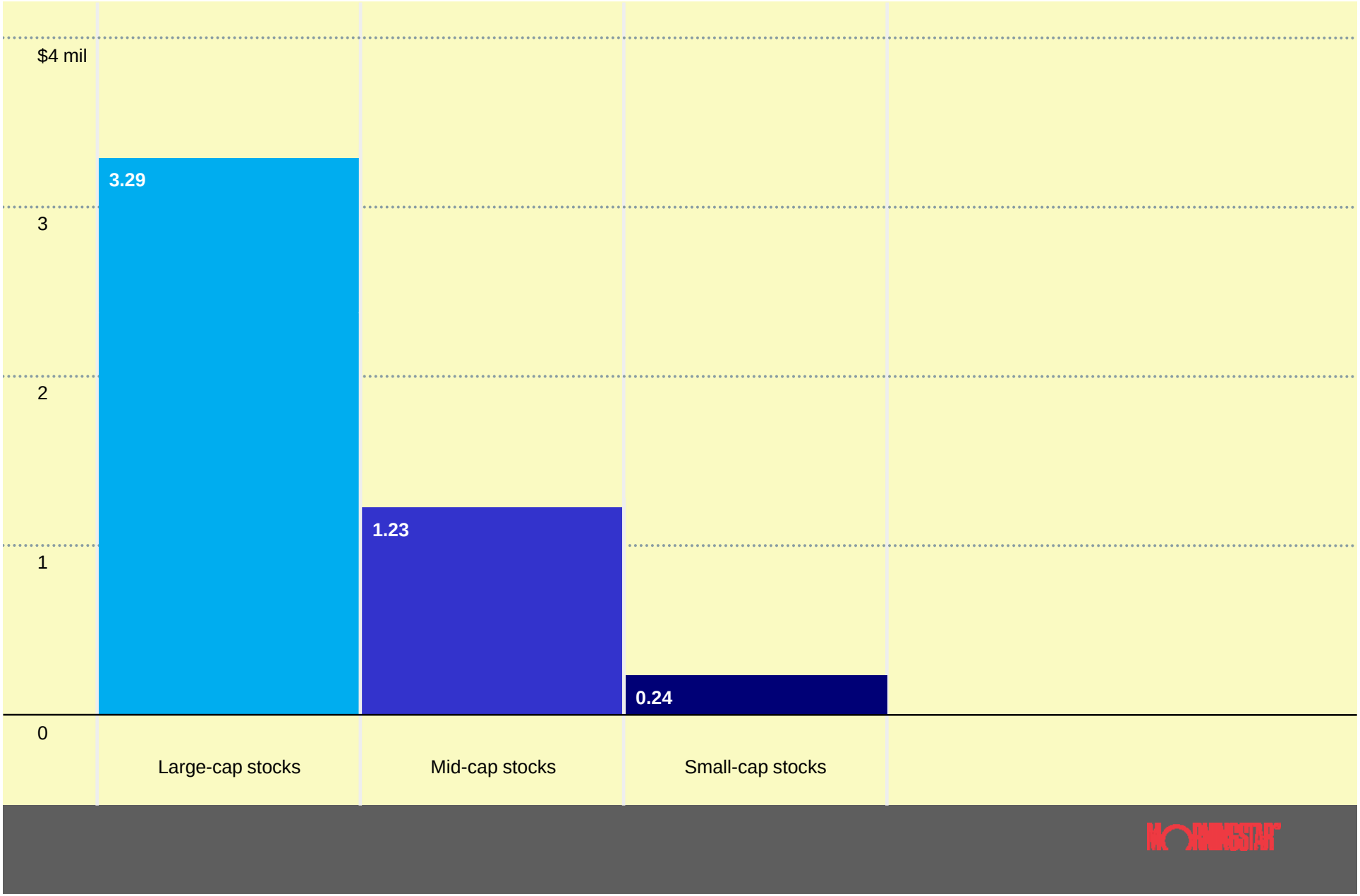
Past performance is no guarantee of future results. Risk and return are measured by standard deviation and compound annual return, respectively. This is for illustrative purposes only and not indicative of any investment. An investment cannot be made directly in an index.

Bonds: Risk Versus Return
1970–2006



Liquidity Risk

Average stock trading volume for the year 2006



More Lingo:

Risk Premium	=	Difference between the risk free rate and the expected return
Excess Return	=	Difference between the risk free rate and the actual realized return