Chapter 12

Financial Return and Risk Concepts

Learning Objectives

- LO 12.1 Compute the arithmetic average using return data for a single financial asset.
- LO 12.2 Compute the variance and standard deviation using return data for a single financial asset.
- LO 12.3 Describe sources of financial risk.
- LO 12.4 Compute expected return and expected variance using scenario analysis.
- LO 12.5 Summarize the historical rates of return and risk for different securities.

Learning Objectives

- LO 12.6 Explain the concept of market efficiency and the three different types of efficient markets.
- LO 12.7 Calculate the expected return on a portfolio of securities.
- LO 12.8 Discuss how the combining of securities into portfolios reduces the overall or portfolio risk using the concept of correlation.
- LO 12.9 Explain the difference between systematic and unsystematic risk.
- LO 12.10 Describe the Capital Asset Pricing Model and explain the role of beta as a risk measure.
- LO 12.11 (Learning Extension) Estimate beta and compute expected return using the Security Market Line

LO 12.1 Historical Return for a Single Asset

- Return: periodic income and price changes
- Dollar return = ending price – beginning price + income

Historical Return for a Single Asset

- Percentage return =
  Dollar return/beginning price
- Beginning price = $33.63
  Ending price = $34.31
  Dividend = $0.13
  Dollar return = $34.31-33.63+0.13 =$0.81
  Percentage return = $0.81/$33.63 = 0.024 or 2.4 percent

Historical Return for a Single Asset

- Can be daily, monthly or annual returns
- Or any other time period!

Arithmetic Average Return

- Look backward to see how well we've done:
- Average Return ($\bar{R}$) =

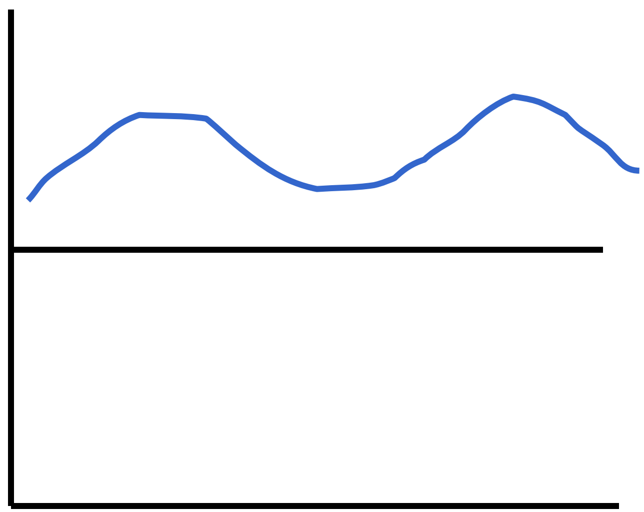
$$\frac{\text{Sum of returns}}{\text{number of periods}}$$

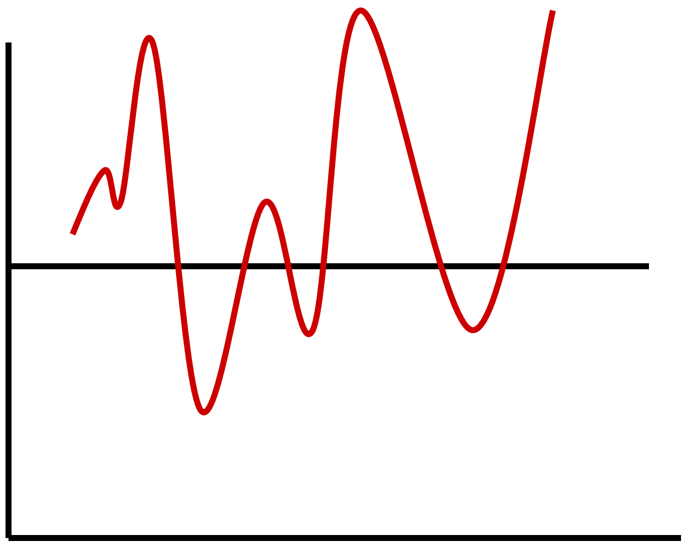
An Example

YEAR	STOCK A	STOCK B
1	6%	20%
2	12	30
3	8	10
4	-2	-10
5	18	50
6	6	20
Sum	48	120
Sum/6= Average = $\bar{R}$	8%	20%

Returns for Two Stocks Over Time

Less variable returns……more variable returns





LO 12.2 Measuring Risk

- Risk: based on deviations over time around the average return

- Deviation = $R_t - \bar{R}$
- Sum of Deviations $\Sigma(R_t - \bar{R}) = 0$
- To measure risk, we need something else…try squaring the deviations

Variance $$\sigma^2 = \frac{\sum_{t=1}^{n}(R_t - \bar{R})^2}{(n-1)}$$

Measuring Risk

- Since the returns are squared: $\Sigma(R_t - \bar{R})^2$
- The units are squared, too:
- Percent squared ($\%^2$)
- Dollars squared ($\$^{2}$)
- Hard to interpret!

Measuring Risk: Standard deviation

The standard deviation (σ) helps this problem by taking the square root of the variance:

$$\sigma = \sqrt{\sigma^2}$$

YR	A's RETURN DIFFERENCE FROM THE AVERAGE	RETURN DIFFERENCE SQUARED
1	6%– 8% = –2%	$(-2\%)^2 = 4\%^2$
2	12 – 8 = 4	$(4)^2 = 16$
3	8 – 8 = 0	$(0)^2 = 0$
4	–2 – 8 = –10	$(-10)^2 = 100$
5	18– 8 = 10	$(10)^2 = 100$
6	6 – 8 = –2	$(-2)^2 = 4$
Sum		$224\%^2$
Sum/(6 – 1) = Variance		$44.8\%^2$
Standard deviation = $\sqrt{44.8}$ =		6.7%

Using Average Return and Standard Deviation

- **If the future will resemble the past and the periodic returns are normally distributed:**
- **68% of the returns will fall between $\bar{R}$ - σ and $\bar{R}$ + σ**
- **95% of the returns will fall between $\bar{R}$ - 2σ and $\bar{R}$ + 2σ**
- **95% of the returns will fall between $\bar{R}$ - 3σ and $\bar{R}$ + 3σ**

For Asset A

- 68% of the returns between 1.3% and 14.7%
- 95% of the returns between -5.4% and 21.4%
- 99% of the returns between -12.1% and 28.1%

Which of these is riskier?

	Asset A	Asset B
Avg. Return	8%	20%
Std. Deviation	6.7%	20%

Another view of risk:

Coefficient of Variation =

$$\frac{\textbf{Standard deviation}}{\textbf{Average return}}$$

It measures risk per unit of return

Which is riskier?

	Asset A	Asset B
Avg. Return	8%	20%
Std. Deviation	6.7%	20%
Coefficient of Variation	0.84	1.00

LO 12.3 Where Does Risk Come From: Risk Sources in Income Statement

Revenue	Business Risk Purchasing Power Risk Exchange Rate Risk
Less: Expenses	
Equals: Operating Income	
Less: Interest Expense	Financial Risk Interest Rate Risk
Equals: Earnings Before Taxes	
Less: Taxes	Tax Risk
Equals: Net Income	

LO 12.4 Measures of Expected Return and Risk

- **Looking forward to estimate future performance**
- **Using historical data: *ex-post***
- **Estimated or expected outcome: *ex-ante***

Steps to forecasting Return, Risk

- Develop possible future scenarios:
  - growth, normal, recession
- Estimate returns in each scenario:
  - growth: 20%
  - normal: 10%
  - recession: -5%
- Estimate the probability or likelihood of each scenario:

growth: 0.30 normal: 0.40 recession: 0.30

Expected Return

- $E(R) = \Sigma\, p_i \cdot R_i$
- $E(R) =$

  $.3(20\%) + .4(10\%) + .3(-5\%) = 8.5\%$
- Interpretation:

8.5% is the long-run average outcome if the current three scenarios could be replicated many, many times

Once E(R) is found, we can estimate risk measures:

- $\sigma^2 = \sum p_i[R_i - E(R)]^2$

$$= .3(20 - 8.5)^2 + .4(10 - 8.5)^2 + .3(-5 - 8.5)^2$$

= 95.25 percent squared

- **Standard deviation:**

$$\sigma = \sqrt{95.25\%^2} = 9.76\%$$

- **Coefficient of Variation = 9.76/8.5 = 1.15**

Do Investors Really do These Calculations?

- Market anticipation of Fed’s actions
- Identify consensus; where does our forecast differ?
- Simulation and Monte Carlo analysis

LO 12.5 Historical Returns and Risk of Different Assets

Two good investment rules to remember:

- Risk drives expected returns
- Developed capital markets, such as those in the U.S., are, to a large extent, efficient markets.

Historical Returns and Risk of Different Assets, 1928-2018

Source: *http://www.stern.nyu.edu/~adamodar/* and author calculations.

Asset	Treasury Bills	Treasury Bonds	Common Stocks	Inflation Rate
Average Annual Return	3.43%	5.10%	11.36%	3.06%
Standard Deviation	3.04%	7.70%	19.58%	3.81%

LO 12.6 Efficient Markets

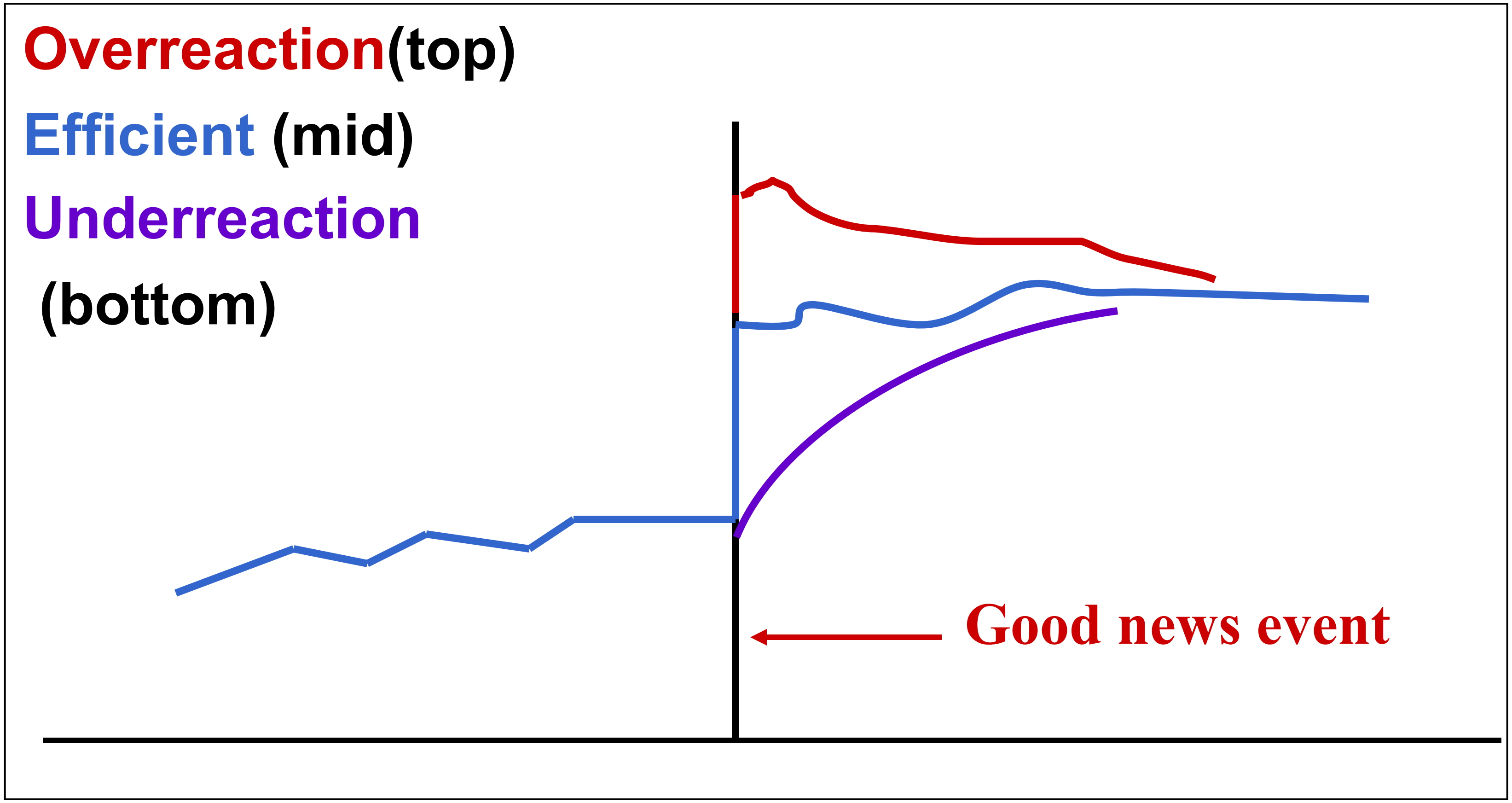
What's an efficient market?

- **Operationally efficient versus informationally efficient**
- **Many investors/traders**
- **News occurs randomly**
- **Prices adjust quickly to news on average reflecting the impact of the news and market expectations**

More….

- After adjusting for risk differences, investors cannot consistently earn above-average returns
- Expected events don’t move prices; only unexpected events (“surprises”) move prices or events which differ from the market’s consensus

Price Reactions in Efficient/Inefficient Markets



Types of Efficient Markets

- Strong-form efficient market
- Semi-strong form efficient market
- Weak-form efficient market

Percentage of Large-capitalization Mutual Funds Underperforming the S&P 500 Index

Source: Aye Soe, CFA, Berlinda Liu, CFA, and Hamish Preston, *SPIVA® U.S. Scorecard, Year-End 2018*, S&P Dow Jones Indices

Time Frame:	2018	3-years: 2016-2018	5- years: 2014-2018	10-years: 2009-2018
	64.5	79.0	82.1	85.1
	This means only about 1/3 fund funds did better than the index	…and only about 20% did better over the past 3 years	…and even less over the past 5 years.	…and only about 15% (less than one in six funds) had higher returns than the index in the prior

Implications of “Efficient Markets”

- Market price changes show corporate management the reception of announcements by the firm
- Investors: consider indexing rather than stock-picking
- Invest at your desired level of risk
- Diversify your investment portfolio

LO 12.7 Portfolio Returns

- Portfolio: a combination of assets or investments

Expected Return on A Portfolio:

- $E(R_i)$ = expected return on asset i
- w_i = weight or proportion of asset i in the portfolio

$$E(R_p) = \Sigma\ w_i \cdot E(R_i)$$

If $E(R_A) = 8\%$ and $E(R_B) = 20\%$

- **More conservative portfolio:**

$E(R_p) = .75\ (8\%) + .25\ (20\%) = 11\%$

- **More aggressive portfolio:**

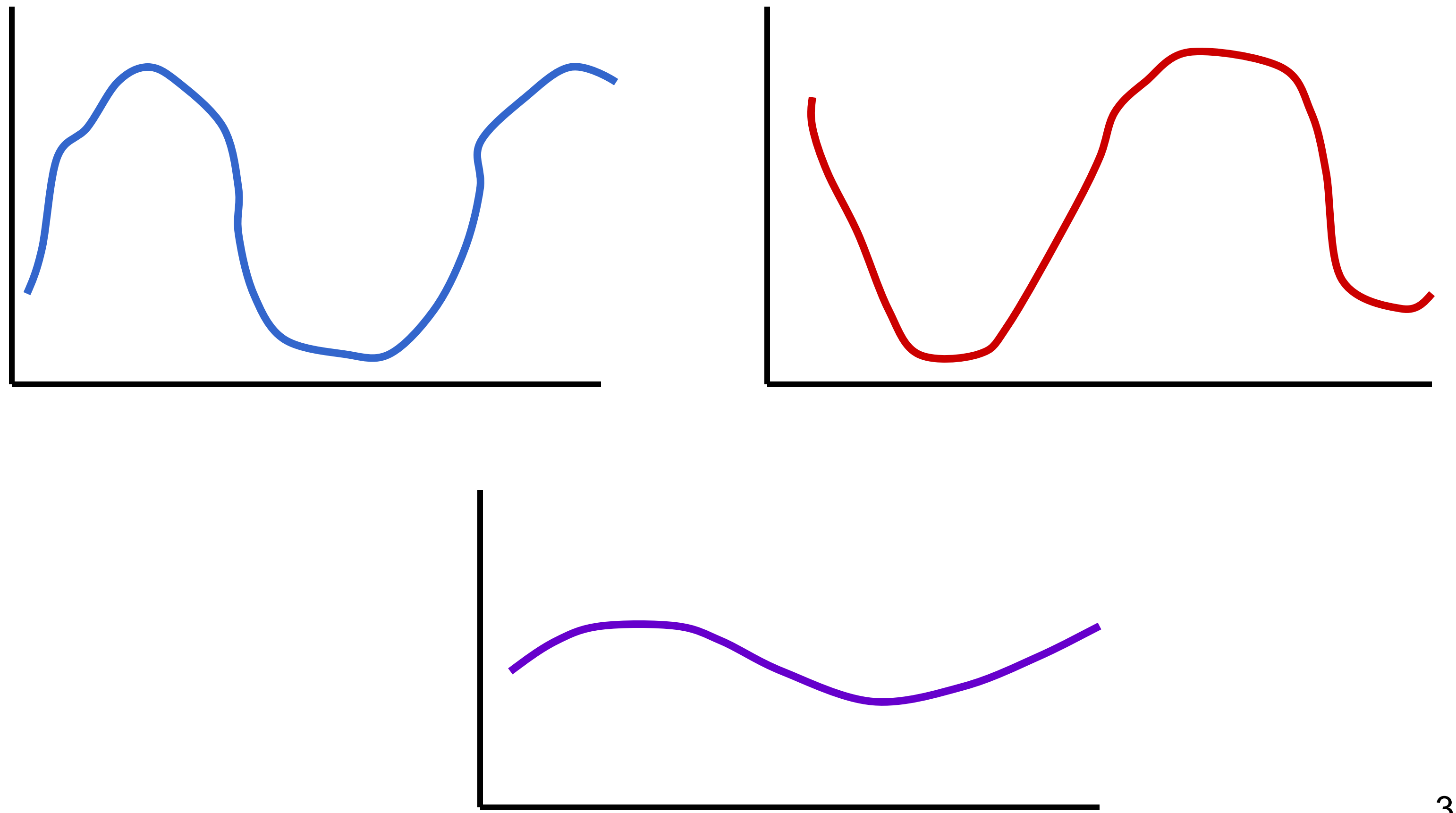
$E(R_p) = .25\ (8\%) + .75\ (20\%) = 17\%$

LO 12.8 Portfolio Risk

The risk of the portfolio may be less than the risk of its component assets

Merging 2 Assets into 1 Portfolio

Two risky assets (red, blue) can create a low-risk portfolio (purple)

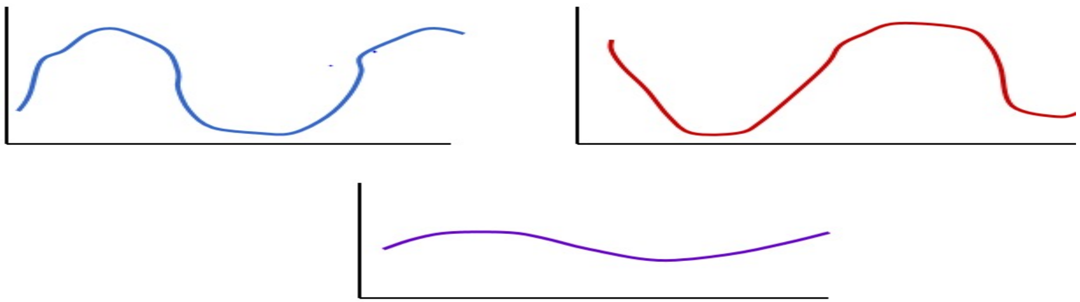


The Role of Correlations

- Correlation: a measure of how returns of two assets move together over time
- Correlation > 0; the returns tend to move in the same direction
- Correlation < 0; the returns tend to move in opposite directions

Diversification

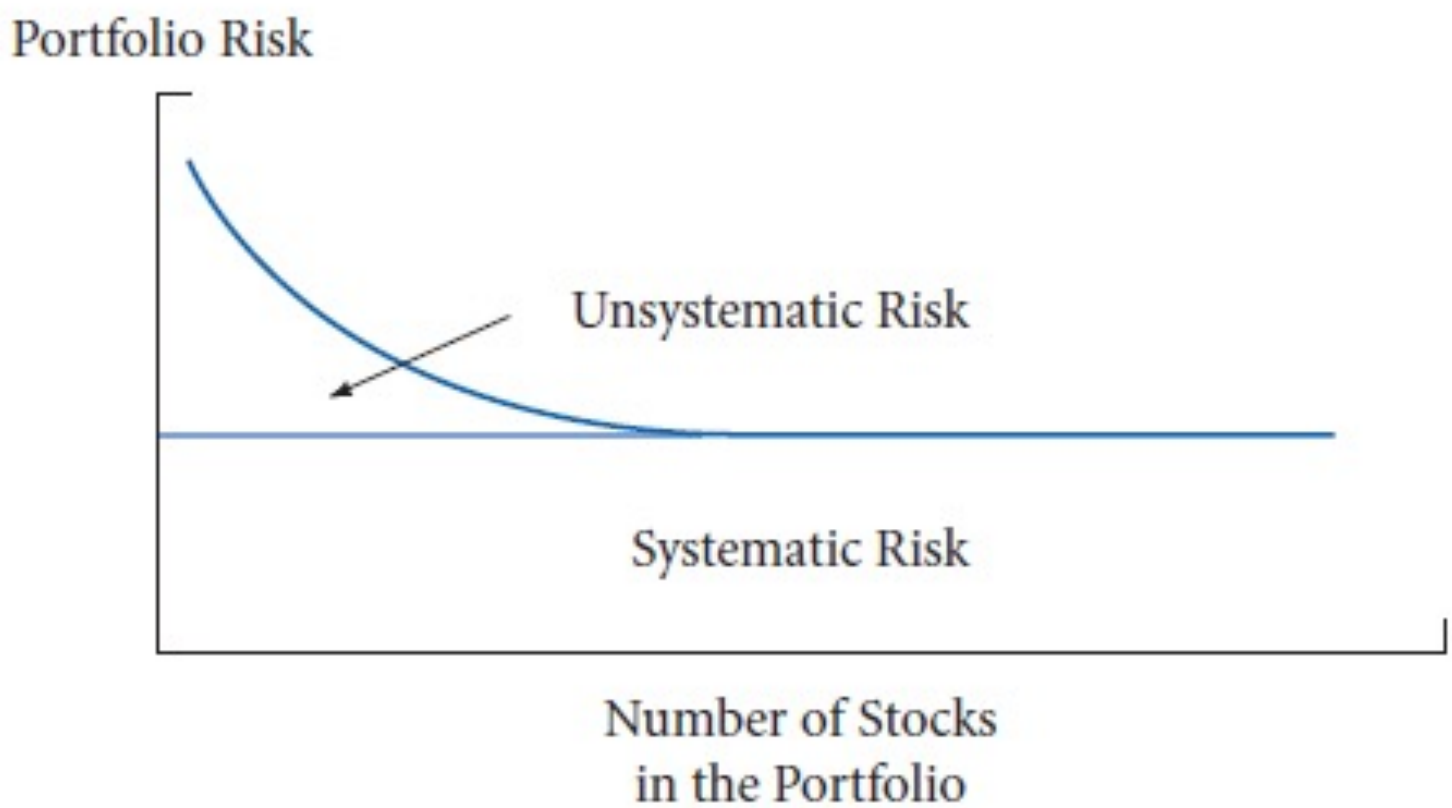
- If correlation between two assets (or between a portfolio and an asset) is low or negative, the resulting portfolio may have lower variance than either asset.
- Splitting funds among several investments reduces the affect of one asset's poor performance on the overall portfolio



LO 12.9 The Two Types of Risk

- Diversification shows there are two types of risk:
  - Risk that can be diversified away (diversifiable or unsystematic risk)
  - Risk that cannot be diversified away (undiversifiable or systematic or market risk)

As additional securities are added to the portfolio, unsystematic risk goes to zero.



LO 12.10 Capital Asset Pricing Model

- Focuses on systematic or market risk
- An asset's risk depend upon whether it makes the portfolio more or less risky
- The systematic risk of an asset determines its expected returns

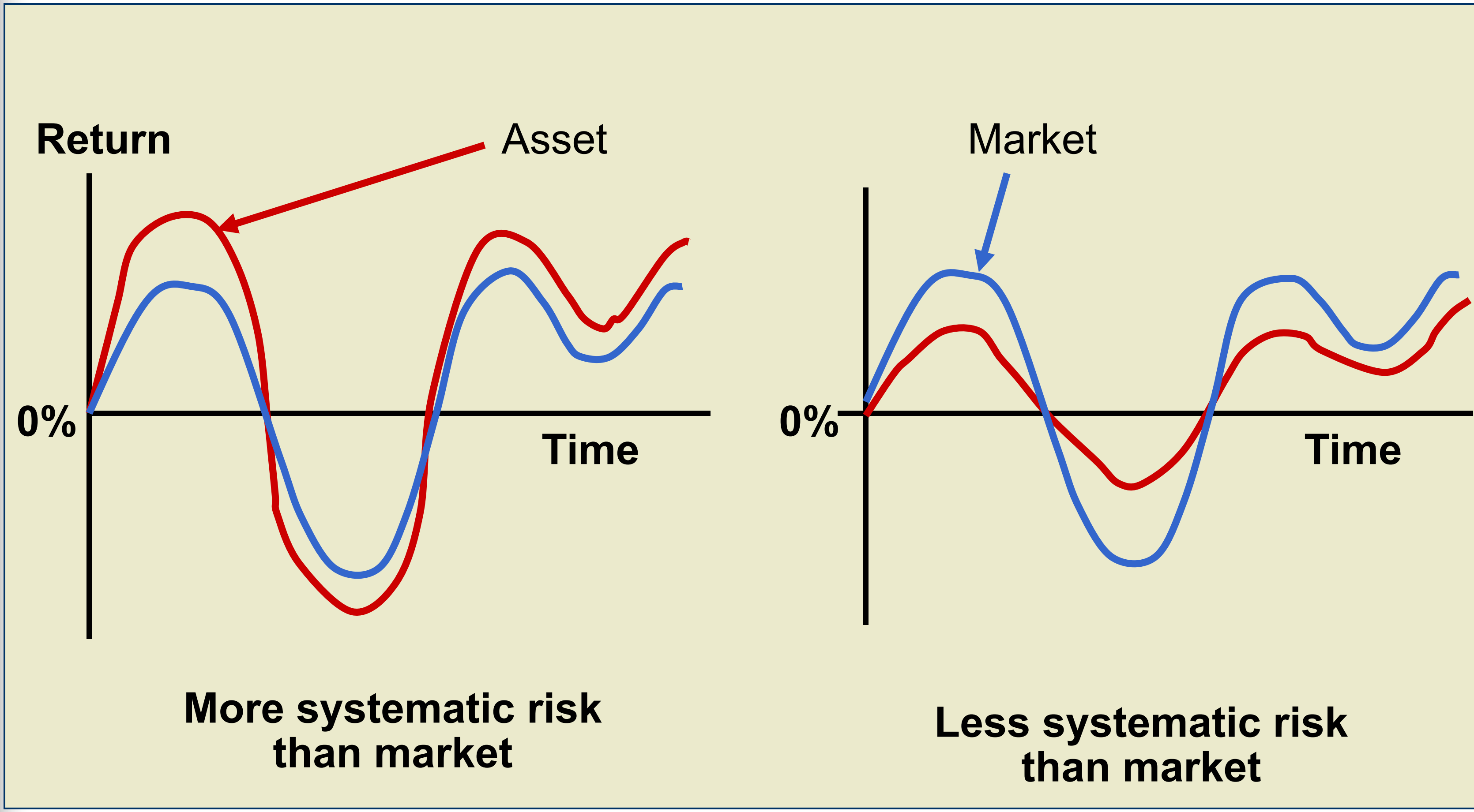
The Market Portfolio

- Contains all assets--it represents the "market"
- The total risk of the market portfolio (its variance) is all systematic risk
- Unsystematic risk is diversified away

The Market Portfolio and Asset Risk

- We can measure an asset's risk relative to the market portfolio
- Measure to see if the asset is more or less risky than the "market"
- More risky: asset's returns are usually higher (lower) than the market's when the market rises (falls)
- Less risky: asset's returns fluctuate less than the market's over time

Blue = market returns over time
Red = asset returns over time



Implications of the CAPM

- Expected return of an asset depends upon its systematic risk
- Systematic risk (beta β) is measured relative to the risk of the market portfolio

Beta example: $\beta < 1$

- If an asset's β is 0.5: the asset's returns are half as variable, on average, as those of the market portfolio
- If the market changes in value by 10%, on average this assets changes value by 10% x 0.5 = 5%

$\beta > 1$

- If an asset's β is 1.4: the asset's returns are 40 percent more variable, on average, as those of the market portfolio
- If the market changes in value by 10%, on average this assets changes value by 10% x 1.4 = 14%

Sample Beta Values

accessed from http://finance.yahoo.com

Firm	Beta (4/2019 value)	Beta (4/2016 value)
Caterpillar (CAT)	1.40	1.24
Coca-Cola (KO)	0.37	0.80
General Electric (GE)	1.01	1.27
Delta Airlines (DAL)	1.01	1.09
FirstEnergy (FE)	0.36	0.25

Learning Extension 12
Estimating Beta

- **Beta is derived from the regression line:**

$$R_i = a + \beta R_{MKT} + e$$

Ways to estimate Beta

- Once data on asset and market returns are obtained for the same time period:
- use spreadsheet software
- statistical software
- financial/statistical calculator
- do calculations by hand

Sample Calculation

Estimate of beta:

$$\frac{n\Sigma(R_{MKT}R_i) - (\Sigma R_{MKT})(\Sigma R_i)}{n\,\Sigma R_{MKT}^2 - (\Sigma R_{MKT})^2}$$

The sample calculation

Estimate of beta =

$$\frac{n\Sigma(R_{MKT}R_i) - (\Sigma R_{MKT})(\Sigma R_i)}{n\,\Sigma R_{MKT}^2 - (\Sigma R_{MKT})^2}$$

$$\frac{6(34.77) - (3.00)(0.20)}{6(38.68) - (3.00)(3.00)}$$

$$= 0.93$$

Security Market Line

- **CAPM states the expected return/risk tradeoff for an asset is given by the Security Market Line (SML):**

- **$E(R_i) = RFR + [E(R_{MKT}) - RFR]\beta_i$**

An Example

- $E(R_i)= RFR + [E(R_{MKT})- RFR]\beta_i$
- If T-bill rate = 4%, expected market return = 8%, and beta = 0.75:
- $E(R_{stock})= 4\% + (8\% - 4\%)(0.75) = 7\%$

Portfolio beta

- The beta of a portfolio of assets is a weighted average of its component asset's betas
- $beta_{portfolio} = \Sigma\, w_i \cdot beta_i$