Lecture 7&8
Risk And Return

FINA 614

Risk, Return and Financial Markets

- We can examine returns in the financial markets to help us determine the appropriate returns on non-financial assets
- Lesson from capital market history
  - There is a reward for bearing risk
  - The greater the potential reward, the greater the risk
  - This is called the risk-return trade-off

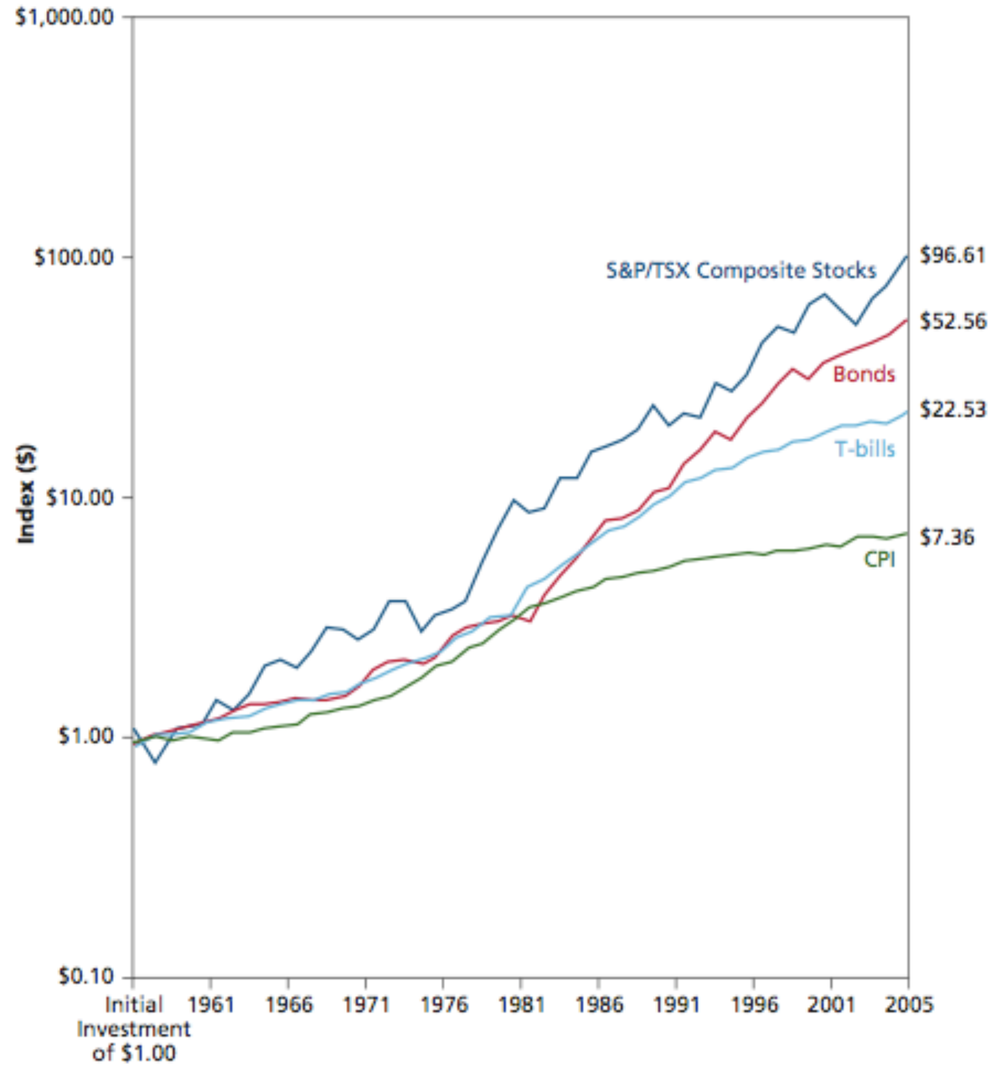
Dollar Returns

- Total dollar return = income from investment + capital gain (loss) due to change in price
- Example:
  – You bought a bond for $950 1 year ago. You have received two coupons of $30 each. You can sell the bond for $975 today. What is your total dollar return?
    - Income = 30 + 30 = 60
    - Capital gain = 975 – 950 = 25
    - Total dollar return = 60 + 25 = $85

Percentage Returns

- It is generally more intuitive to think in terms of percentages than dollar returns
- Dividend yield = income / beginning price
- Capital gains yield = (ending price – beginning price) / beginning price
- Total percentage return = dividend yield + capital gains yield

Figure 12.4 – If you invested $1 in 1957, how much would you have in 2005?



Average Returns 1957 – 2005

Investment	Arithmetic Average Return (%)	Risk Premium (%)
Canadian common stocks	10.97	4.35
U.S. common stocks (Cdn. $)	12.31	5.69
Long bonds	8.88	2.25
Small stocks	14.16	7.53
Inflation	4.21	−2.42
Treasury bills	6.62	0.00

Risk Premiums

- The “extra” return earned for taking on risk
- Treasury bills are considered to be risk-free
- The risk premium is the return over and above the risk-free rate

Average Returns and Risk Premiums 1957 – 2005

Investment	Arithmetic Average Return (%)	Risk Premium (%)
Canadian common stocks	10.97	4.35
U.S. common stocks (Cdn. $)	12.31	5.69
Long bonds	8.88	2.25
Small stocks	14.16	7.53
Inflation	4.21	–2.42
Treasury bills	6.62	0.00

Historical Risk Premiums 1957 – 2005

- Canadian common stocks: 10.97 – 6.62 = 4.35%
- US common stocks (C$): 12.31 – 6.62 = 5.69%
- Long-term bonds: 8.88 – 6.62 = 2.26%
- Small stocks: 14.16 – 6.62 = 7.54%

- Would small stocks be more risky than bonds?

Variance and Standard Deviation

- Variance and standard deviation measure the volatility of asset returns
- The greater the volatility, the greater the uncertainty
- Historical variance = sum of squared deviations from the mean / (number of observations – 1)
- Standard deviation = square root of the variance

Table 12.4 Historical Returns and Standard Deviations 1957 – 2005

Investment	Arithmetic Average Return (%)	Standard Deviation (%)
Canadian common stocks	10.97	16.17
U.S. common stocks (Cdn. $)	12.31	16.99
Long bonds	8.88	10.15
Small stocks	14.16	22.58
Inflation	4.21	3.22
Treasury bills	6.62	3.66

Figure 12.6 – Normal Distribution and a Portfolio of Large Common Stocks

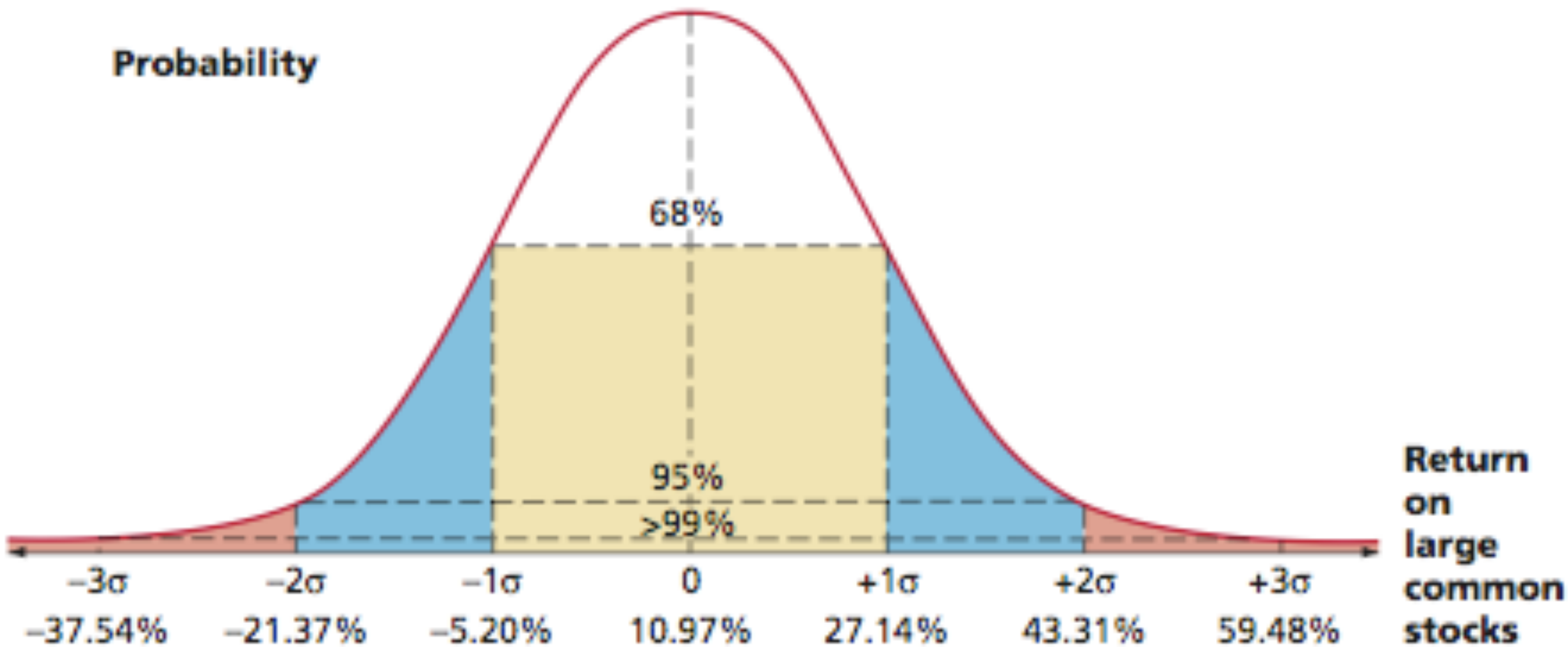
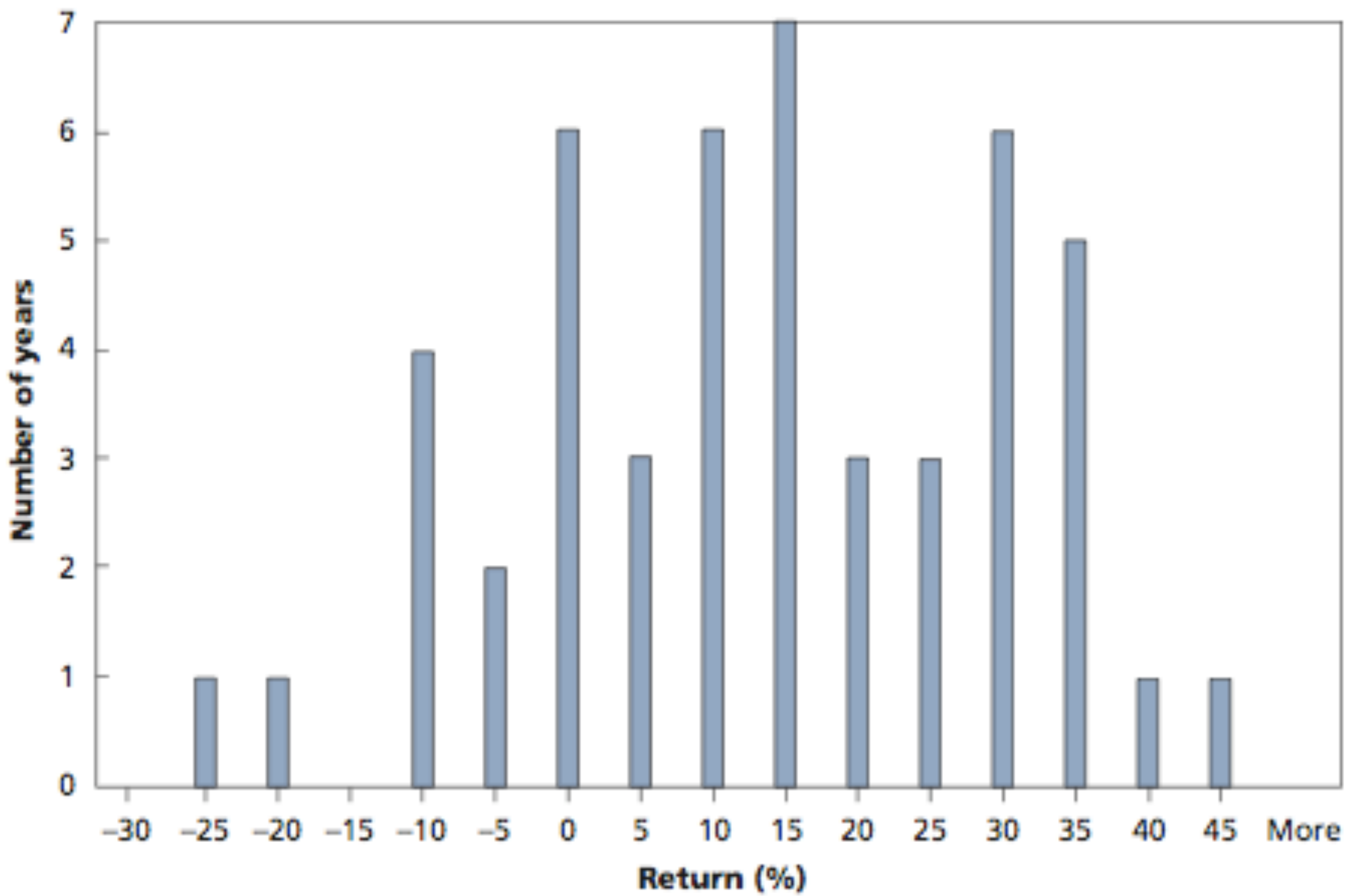


Figure 12.5 – Frequency distribution of Returns on Canadian Common Stocks



Calculating Geometric Average Continued

- What equivalent rate of return would you have to earn every year on average to achieve this same future wealth?

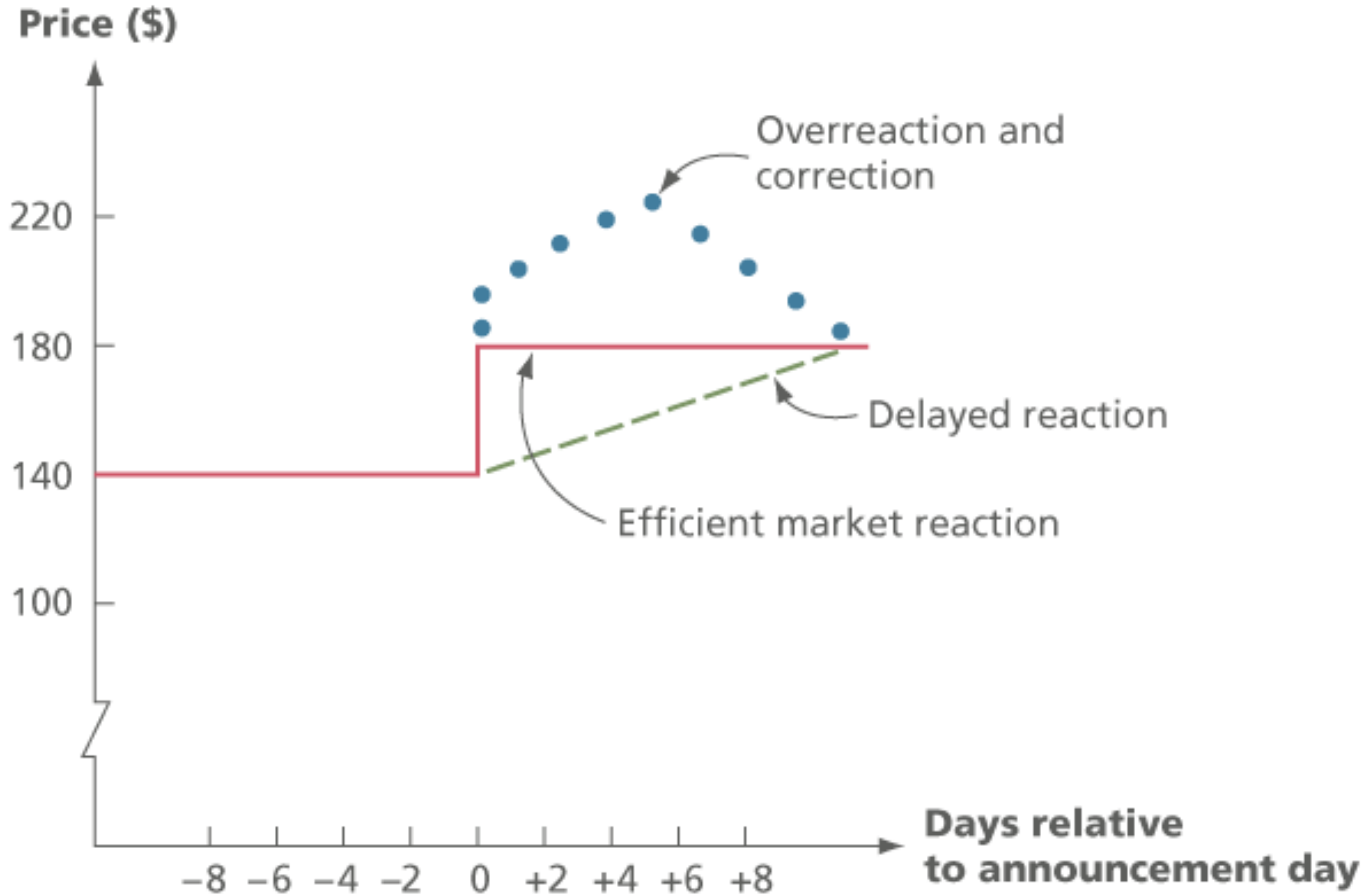
$$\$124.44 = \$100 \times (1 + R_G)^5$$

$$R_G = 1.2444^{1/5} - 1$$

$$R_G = 4.47\%$$

- Your average return was 4.47% each year. Notice that this is lower than the arithmetic average. This is because it includes the effects of compounding.

Figure 12.7 – Reaction to New Information



What Makes Markets Efficient?

- There are many investors out there doing research
  - As new information comes to market, this information is analyzed and trades are made based on this information
  - Therefore, prices should reflect all available public information
- If investors stop researching stocks, then the market will not be efficient

Common Misconceptions about EMH

- Efficient markets do not mean that you can't make money
- They do mean that, on average, you will earn a return that is appropriate for the risk undertaken and there is not a bias in prices that can be exploited to earn excess returns
- Market efficiency will not protect you from wrong choices if you do not diversify – you still don't want to put all your eggs in one basket

Strong Form Efficiency

- Prices reflect all information, including public and private
- If the market is strong form efficient, then investors could not earn abnormal returns regardless of the information they possessed
- Empirical evidence indicates that markets are NOT strong form efficient and that insiders could earn abnormal returns

Semistrong Form Efficiency

- Prices reflect all publicly available information including trading information, annual reports, press releases, etc.
- If the market is semistrong form efficient, then investors cannot earn abnormal returns by trading on public information
- Implies that fundamental analysis will not lead to abnormal returns

Weak Form Efficiency

- Prices reflect all past market information such as price and volume
- If the market is weak form efficient, then investors cannot earn abnormal returns by trading on market information
- Implies that technical analysis will not lead to abnormal returns
- Empirical evidence indicates that markets are generally weak form efficient

Expected Returns

- Expected returns are based on the probabilities of possible outcomes
- In this context, "expected" means average if the process is repeated many times
- The "expected" return does not even have to be a possible return

$$E(R) = \sum_{i=1}^{n} p_i R_i$$

Expected Returns – Example 1

- Suppose you have predicted the following returns for stocks C and T in three possible states of nature. What are the expected returns?
  - State Probability C T
  - Boom 0.3 0.15 0.25
  - Normal 0.5 0.10 0.20
  - Recession ??? 0.02 0.01
- R_C = .3(.15) + .5(.10) + .2(.02) = .099 = 9.9%
- R_T = .3(.25) + .5(.20) + .2(.01) = .177 = 17.7%

Variance and Standard Deviation

- Variance and standard deviation still measure the volatility of returns
- You can use unequal probabilities for the entire range of possibilities
- Weighted average of squared deviations

$$\acute{o}^{2} = \sum_{i=1}^{n} p_i (R_i - E(R))^2$$

Portfolio Expected Returns

- The expected return of a portfolio is the weighted average of the expected returns for each asset in the portfolio

$$E(R_P) = \sum_{j=1}^{m} w_j E(R_j)$$

- You can also find the expected return by finding the portfolio return in each possible state and computing the expected value as we did with individual securities

Example: Expected Portfolio Returns

- Consider the portfolio weights computed previously. If the individual stocks have the following expected returns, what is the expected return for the portfolio?
  - ABC: 19.65%
  - DEF: 8.96%
  - GHI: 9.67%
  - JKL: 8.13%
- $E(R_P)$ = .133(19.65) + .2(8.96) + .267(9.67) + .4(8.13) = 10.24%

Portfolio Variance

- Compute the portfolio return for each state:
  $R_P = w_1R_1 + w_2R_2 + \ldots + w_mR_m$
- Compute the expected portfolio return using the same formula as for an individual asset
- Compute the portfolio variance and standard deviation using the same formulas as for an individual asset

Example: Portfolio Variance

- Consider the following information
  - Invest 60% of your money in Asset A
  - State Probability A B
  - Boom .5 70% 10%
  - Bust .5 -20% 30%
- What is the expected return and standard deviation for each asset?
- What is the expected return and standard deviation for the portfolio?

Portfolio
7.3%
12.8%

Another Way to Calculate Portfolio Variance

- Portfolio variance can also be calculated using the
- following formula:

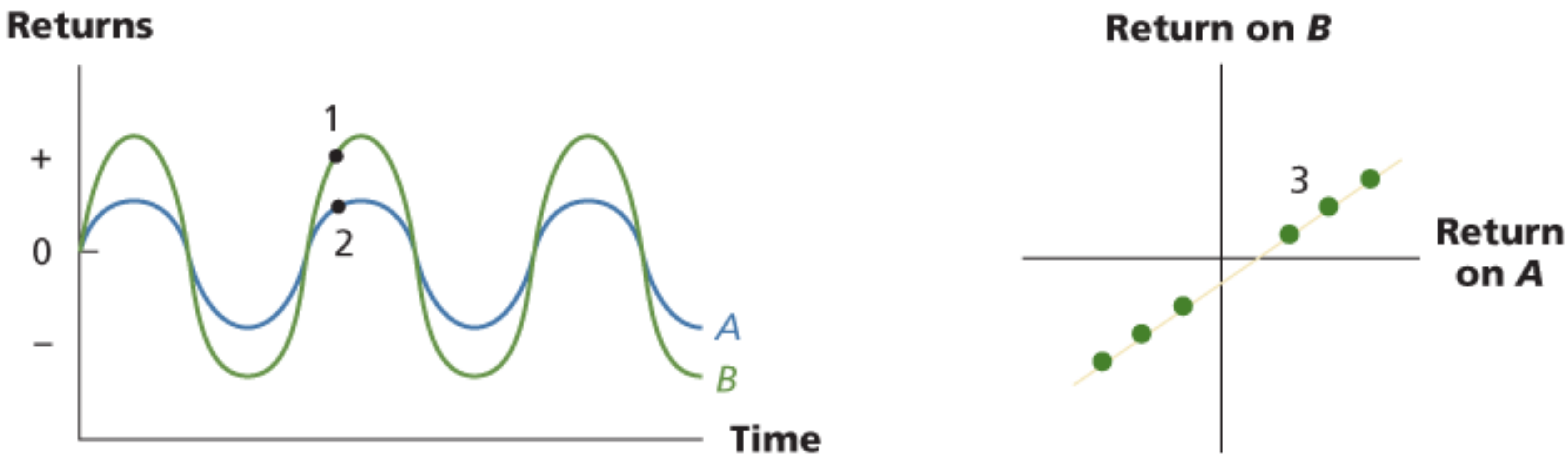
$$\sigma_P^2 = x_L^2\sigma_L^2 + x_U^2\sigma_U^2 + 2x_L x_U CORR_{L,U}\sigma_L\sigma_U$$

Assuming that the correlation between A and B is -1.00, we have

$$\sigma_P^2 = 0.6^2 \times 0.2025 + 0.4^2 \times 0.01 + 2 \times 0.6 \times 0.4 \times -1.00 \times 0.45 \times 0.1$$
$$\sigma_P^2 = 0.0529$$

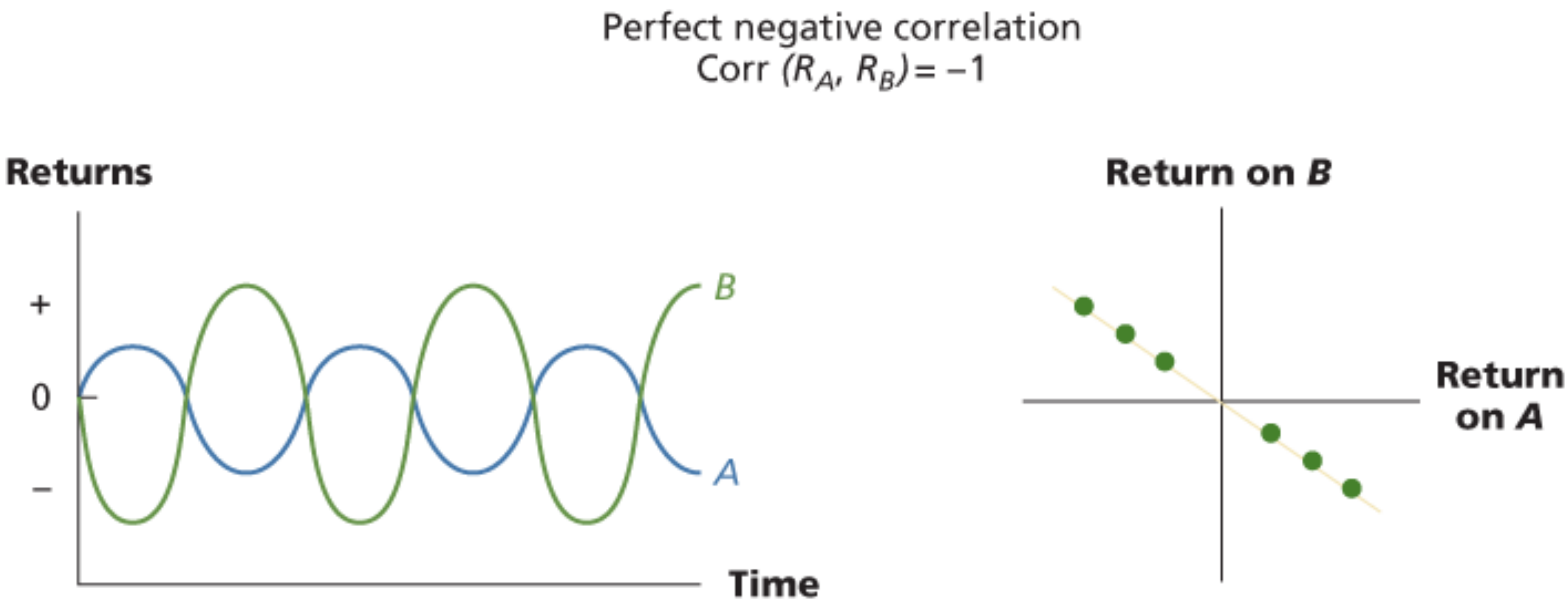
Figure 13.1 – Different Correlation Coefficients

Perfect positive correlation
Corr $(R_A, R_B)=1$



Both the return on Security *A* and the return on Security *B* are higher than average at the same time. Both the return on Security *A* and the return on Security *B* are lower than average at the same time.

Figure 13.1 – Different Correlation Coefficients



Security *A* has a higher-than-average return when Security *B* has a lower-than-average return, and vice versa.

Figure 13.1 – Different Correlation Coefficients

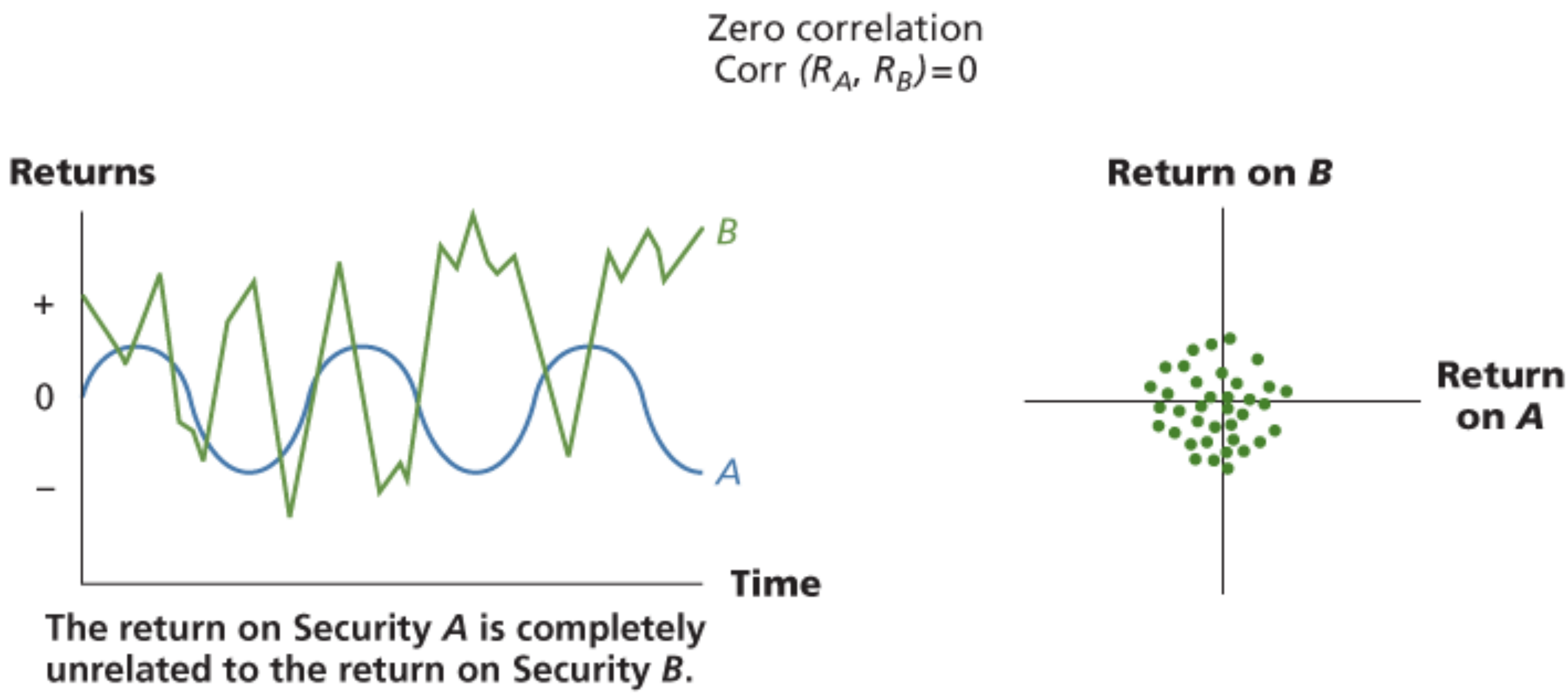
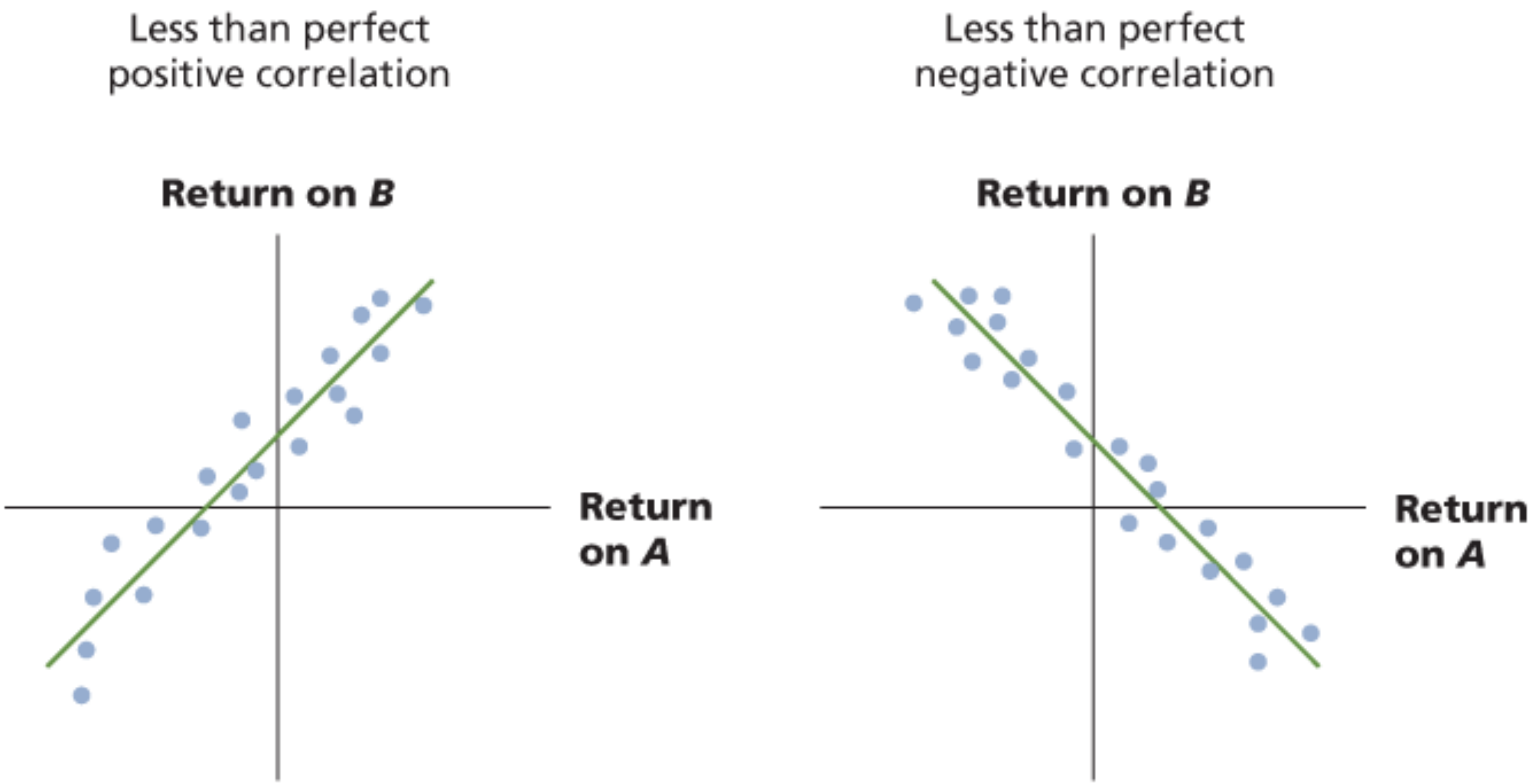


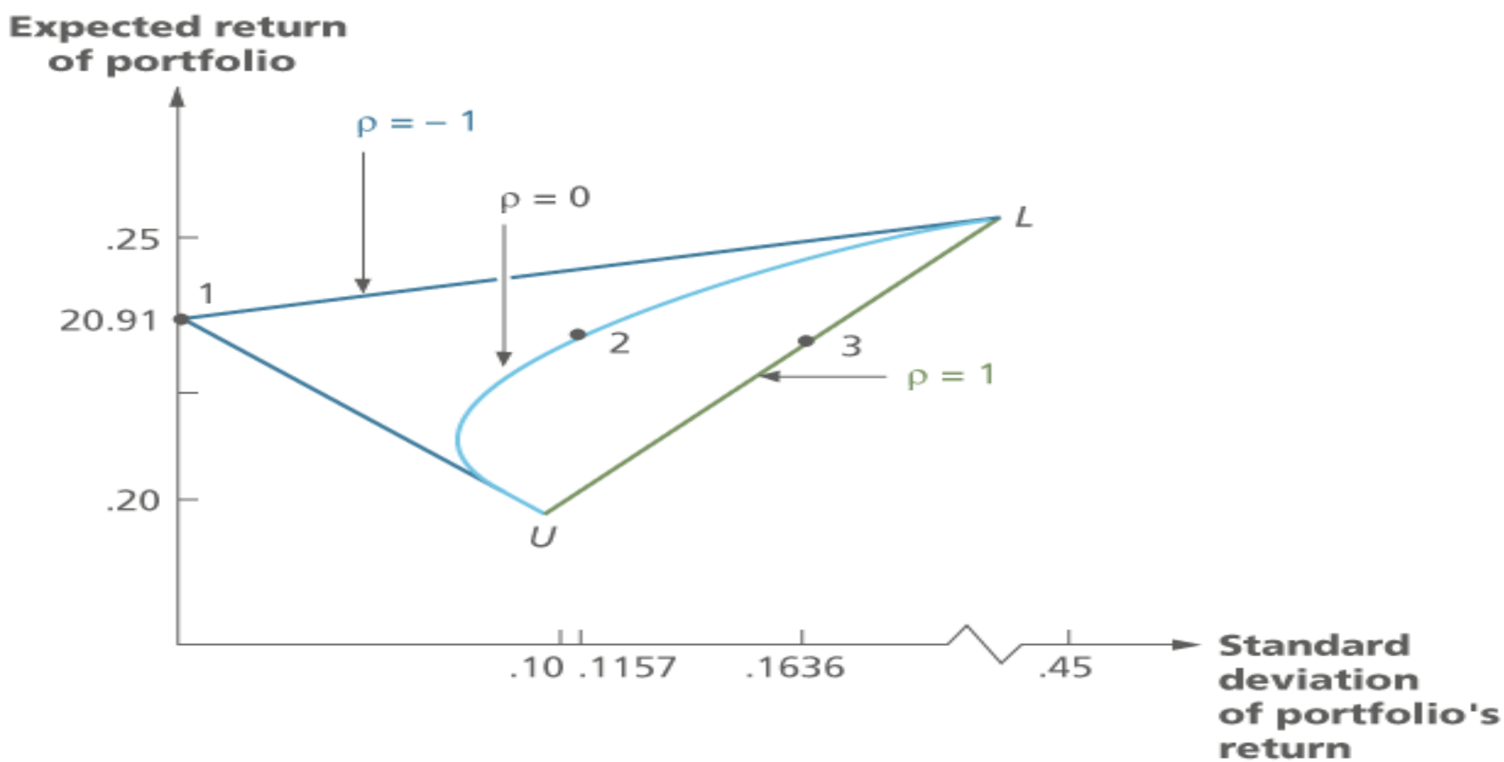
Figure 13.2 – Graphs of Possible Relationships Between Two Stocks



Diversification

- There are benefits to diversification whenever the correlation between two stocks is less than perfect ($p < 1.0$)
- If two stocks are perfectly positively correlated, then there is simply a risk-return trade-off between the two securities.

Diversification – Figure 13.4



Terminology

- Feasible set (also called the opportunity set) – the curve that comprises all of the possible portfolio combinations
- Efficient set – the portion of the feasible set that only includes the efficient portfolio (where the maximum return is achieved for a given level of risk, or where the minimum risk is accepted for a given level of return)
- Minimum Variance Portfolio – the possible portfolio with the least amount of risk

Expected versus Unexpected Returns

- Realized returns are generally not equal to expected returns
- There is the expected component and the unexpected component
  - At any point in time, the unexpected return can be either positive or negative
  - Over time, the average of the unexpected component is zero

Announcements and News

- Announcements and news contain both an expected component and a surprise component
- It is the surprise component that affects a stock's price and therefore its return
- This is very obvious when we watch how stock prices move when an unexpected announcement is made or earnings are different than anticipated

Efficient Markets

- Efficient markets are a result of investors trading on the unexpected portion of announcements
- The easier it is to trade on surprises, the more efficient markets should be
- Efficient markets involve random price changes because we cannot predict surprises

Systematic Risk

- Risk factors that affect a large number of assets
- Also known as non-diversifiable risk or market risk
- Includes such things as changes in GDP, inflation, interest rates, etc.

Unsystematic Risk

- Risk factors that affect a limited number of assets
- Also known as unique risk and asset-specific risk
- Includes such things as labor strikes, shortages, etc.

Returns

- Total Return = expected return + unexpected return
- Unexpected return = systematic portion + unsystematic portion
- Therefore, total return can be expressed as follows:
- Total Return = expected return + systematic portion + unsystematic portion

Diversification

- Portfolio diversification is the investment in several different asset classes or sectors
- Diversification is not just holding a lot of assets
- For example, if you own 50 internet stocks, you are not diversified
- However, if you own 50 stocks that span 20 different industries, then you are diversified

Table 13.8 – Portfolio Diversification

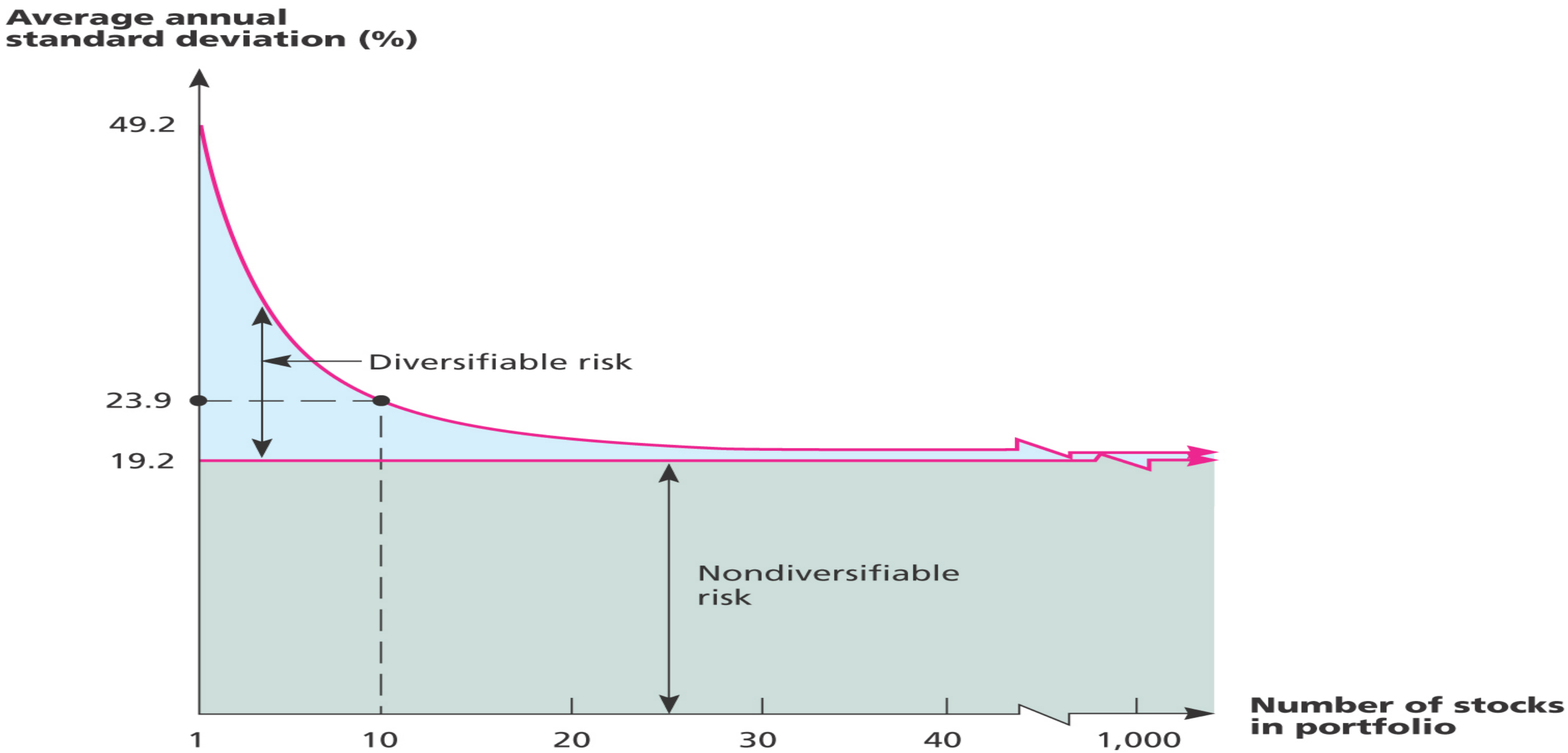
(1) Number of Stocks in Portfolio	(2) Average Standard Deviation of Annual Portfolio Returns	(3) Ratio of Portfolio Standard Deviation to Standard Deviation of a Single Stock
1	49.24%	1.00
2	37.36	.76
4	29.69	.60
6	26.64	.54
8	24.98	.51
10	23.93	.49
20	21.68	.44
30	20.87	.42
40	20.46	.42
50	20.20	.41
100	19.69	.40
200	19.42	.39
300	19.34	.39
400	19.29	.39
500	19.27	.39
1,000	19.21	.39

These figures are from Table 1 in M. Statman, "How Many Stocks Make a Diversified Portfolio?" *Journal of Financial and Quantitative Analysis* 22 (September 1987), pp. 353–64. They were derived from E. J. Elton and M. J. Gruber, "Risk Reduction and Portfolio Size: An Analytic Solution," *Journal of Business* 50 (October 1977), pp. 415–37.

The Principle of Diversification

- Diversification can substantially reduce the variability of returns without an equivalent reduction in expected returns
- This reduction in risk arises because worse than expected returns from one asset are offset by better than expected returns from another
- However, there is a minimum level of risk that cannot be diversified away and that is the systematic portion

Figure 13.6 – Portfolio Diversification



Diversifiable (Unsystematic) Risk

- The risk that can be eliminated by combining assets into a portfolio
- Synonymous with unsystematic, unique or asset-specific risk
- If we hold only one asset, or assets in the same industry, then we are exposing ourselves to risk that we could diversify away
- The market will not compensate investors for assuming unnecessary risk

Total Risk

- Total risk = systematic risk + unsystematic risk
- The standard deviation of returns is a measure of total risk
- For well diversified portfolios, unsystematic risk is very small
- Consequently, the total risk for a diversified portfolio is essentially equivalent to the systematic risk

Systematic Risk Principle

- There is a reward for bearing risk
- There is not a reward for bearing risk unnecessarily
- The expected return on a risky asset depends only on that asset's systematic risk since unsystematic risk can be diversified away

Measuring Systematic Risk

- How do we measure systematic risk?
  - We use the beta coefficient to measure systematic risk
- What does beta tell us?
  - A beta of 1 implies the asset has the same systematic risk as the overall market
  - A beta < 1 implies the asset has less systematic risk than the overall market
  - A beta > 1 implies the asset has more systematic risk than the overall market

Figure 13.7 – High and Low Betas

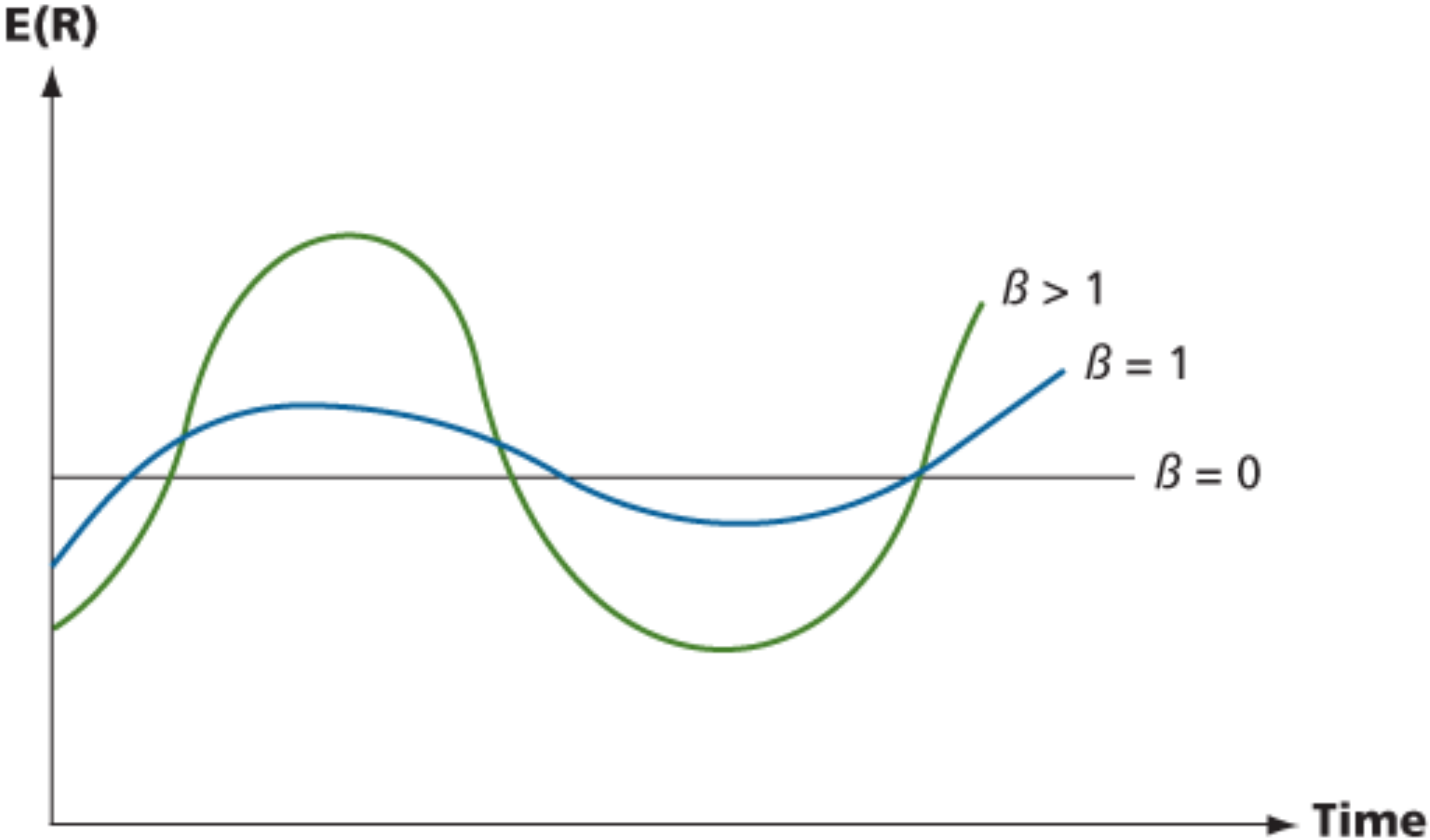


Table 13.10 – Beta Coefficients for Selected Companies

	Beta coefficient
Bank of Nova Scotia	0.56
Investors Group	0.84
Meridian Gold	0.89
Talisman Energy	0.99
Suncor Energy	1.01
Rogers Communications	1.43
Teck Cominco	1.94
Nortel Networks	3.28

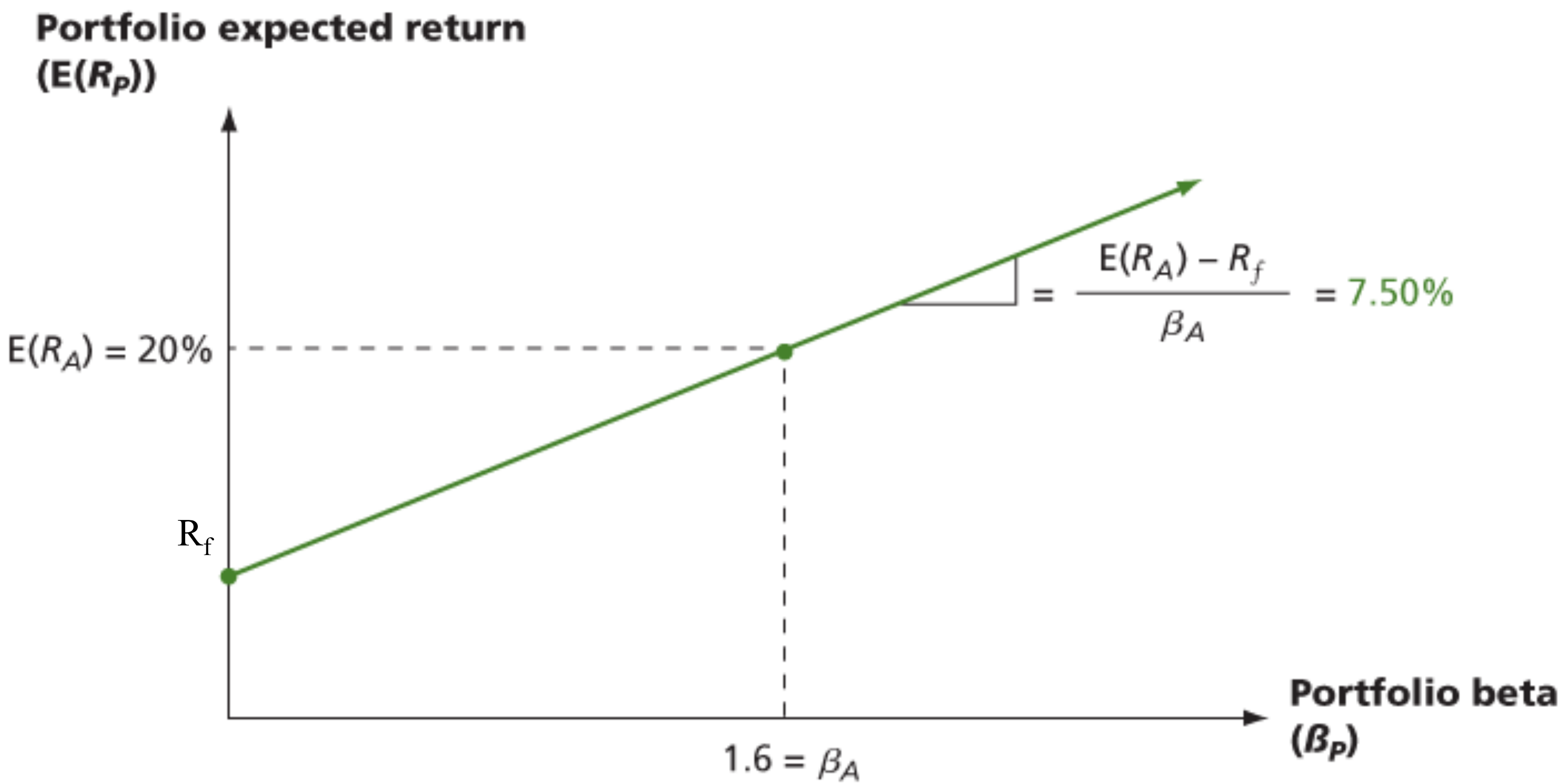
Total versus Systematic Risk

- Consider the following information:

	Standard Deviation	Beta
– Security C	20%	1.25
– Security K	30%	0.95

- Which security has more total risk?
- Which security has more systematic risk?
- Which security should have the higher expected return?

Figure 13.8A – Portfolio Expected Returns and Betas



Reward-to-Risk Ratio: Definition and Example

- The reward-to-risk ratio is the slope of the line illustrated in the previous example
  - Slope = $(E(R_A) - R_f) / (\beta_A - 0)$
  - Reward-to-risk ratio for previous example = (20 – 8) / (1.6 – 0) = 7.5
- What if an asset has a reward-to-risk ratio of 8 (implying that the asset plots above the line)?
- What if an asset has a reward-to-risk ratio of 7 (implying that the asset plots below the line)?

Market Equilibrium

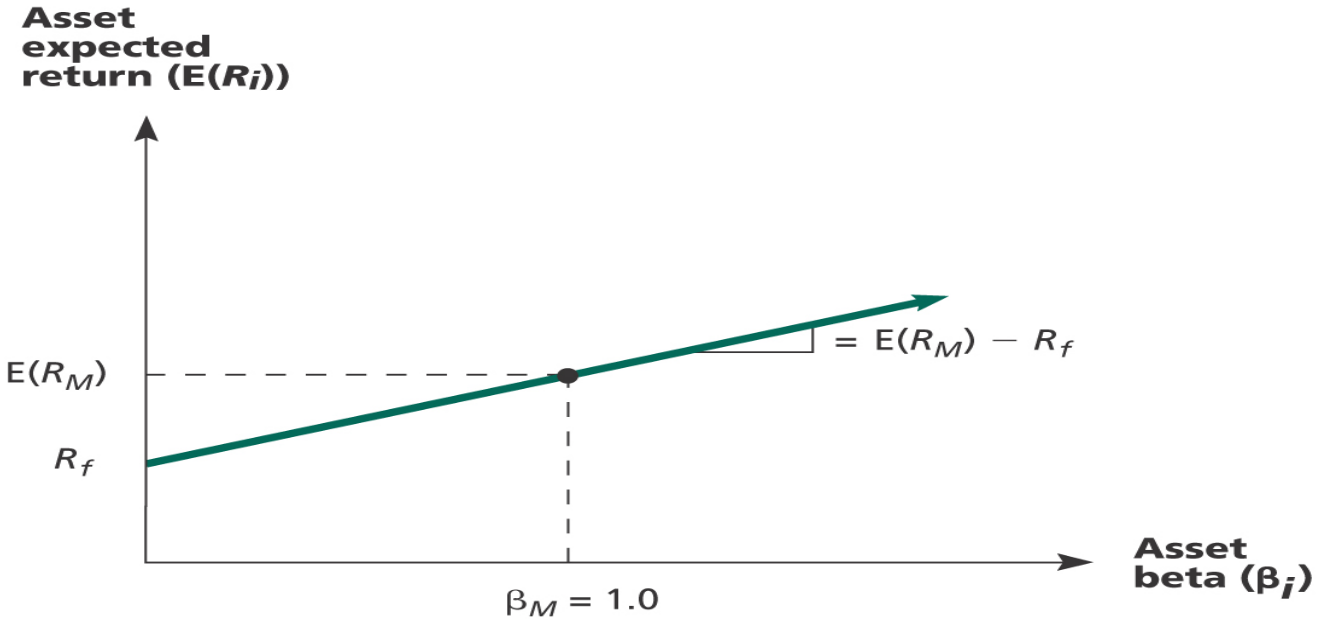
- In equilibrium, all assets and portfolios must have the same reward-to-risk ratio and they all must equal the reward-to-risk ratio for the market

$$\frac{E(R_A) - R_f}{\beta_A} = \frac{E(R_M - R_f)}{\beta_M}$$

Security Market Line

- The security market line (SML) is the representation of market equilibrium
- The slope of the SML is the reward-to-risk ratio: $(E(R_M) – R_f) / \beta_M$
- But since the beta for the market is ALWAYS equal to one, the slope can be rewritten
- Slope = $E(R_M) – R_f$ = market risk premium

Figure 13.11 – Security Market Line



The slope of the security market line is equal to the market risk premium; i.e., the reward for bearing an average amount of systematic risk. The equation describing the SML can be written:

$$E(R_i) = R_f + \beta_i \times [E(R_M) - R_f]$$

which is the capital asset pricing model (CAPM).

The Capital Asset Pricing Model (CAPM)

- The capital asset pricing model defines the relationship between risk and return
- $E(R_A) = R_f + \beta_A(E(R_M) - R_f)$
- If we know an asset's systematic risk, we can use the CAPM to determine its expected return
- This is true whether we are talking about financial assets or physical assets

Factors Affecting Expected Return

- Pure time value of money – measured by the risk-free rate
- Reward for bearing systematic risk – measured by the market risk premium
- Amount of systematic risk – measured by beta

Example - CAPM

- Consider the betas for each of the assets given earlier. If the risk-free rate is 4.5% and the market risk premium is 8.5%, what is the expected return for each?

Security	Beta	Expected Return
ABC	3.69	4.5 + 3.69(8.5) = 35.865%
DEF	.64	4.5 + .64(8.5) = 9.940%
GHI	1.64	4.5 + 1.64(8.5) = 18.440%
JKL	1.79	4.5 + 1.79(8.5) = 19.715%

Arbitrage Pricing Theory (APT)

- Similar to the CAPM, the APT can handle multiple factors that the CAPM ignores
- Unexpected return is related to several market factors

$$E(R) = R_F + E(R_1 - R_F) \times \beta_1 + E(R_2 - R_F) \times \beta_2 + \ldots + E(R_K - R_F) \times \beta_K$$