Chapter 8 Risk and Return

Risk and Return Fundamentals

In most important business decisions there are two key financial considerations: risk and return.

Each financial decision presents certain risk and return characteristics, and the combination of these characteristics can increase or decrease a firm's share price.

Analysts use different methods to quantify risk depending on whether they are looking at a single asset or a **portfolio—**a collection, or group, of assets.

Risk and Return Fundamentals: Risk Defined

Risk is a measure of the **uncertainty** surrounding the return that an investment will earn or, more formally, the **variability** of returns associated with a given asset.

Return is the total gain or loss experienced on an investment over a given period of time; calculated by dividing the asset's cash distributions during the period, plus change in value, by its beginning-of-period investment value.

Focus on Ethics

If It Sounds Too Good To Be True...

- For many years, investors around the world clamored to invest with Bernard Madoff.
- Madoff generated high returns year after year, seemingly with very little risk.
- On December 11, 2008, the U.S. Securities and Exchange Commission (SEC) charged Madoff with securities fraud. Madoff's hedge fund, Ascot Partners, turned out to be a giant Ponzi scheme.
- What are some hazards of allowing investors to pursue claims based their most recent accounts statements?

Risk and Return Fundamentals: Risk Defined (cont.)

The expression for calculating the total rate of return earned on any asset over period t, r_t, is commonly defined as

$$r_t = \frac{C_t + P_t - P_{t-1}}{P_{t-1}}$$

$$r_t = \left(\frac{P_{end} + CF}{P_{beg}} \right)^{1/n} - 1$$

where

r_t = actual, expected, or required rate of return during period t
C_t = cash (flow) received from the asset investment in the time period $t - 1$ to t
P_t = price (value) of asset at time t
P_{t-} = price (value) of asset at time $t - 1$
n = Time in years

Risk and Return Fundamentals: Risk Defined (cont.)

Robin's Gameroom wishes to determine the returns on two of its video machines, Conqueror and Demolition. Conqueror was purchased 1 year ago for $20,000 and currently has a market value of $21,500. During the year, it generated $800 worth of after-tax receipts. Demolition was purchased 4 years ago; its value in the year just completed declined from $12,000 to $11,800. During the year, it generated $1,700 of after-tax receipts. Which is best? Annualized?

Conqueror (C):

$$r_C = \frac{\$800 + \$21{,}500 - \$20{,}000}{\$20{,}000} = \frac{\$2{,}300}{\$20{,}000} = \underline{\underline{11.5\%}}$$

Demolition (D):

$$r_D = \frac{\$1{,}700 + \$11{,}800 - \$12{,}000}{\$12{,}000} = \frac{\$1{,}500}{\$12{,}000} = \underline{\underline{12.5\%}}$$

Beginning Value	$20,000.00
Ending Value	$21,500.00
Investment Cash Flows	$800.00
Investment Time (Yrs)	1.000
HPR (annualized return)	11.500%

Beginning Value	$12,000.00
Ending Value	$11,800.00
Investment Cash Flows	$1,700.00
Investment Time (Yrs)	4.000
HPR (annualized return)	2.988%

Table 8.1 Historical Returns on Selected Investments (1900–2009)

TABLE 8.1 Historical Returns on Selected Investments (1900–2009)

Investment	Average nominal return	Average real return
Treasury bills	3.9%	0.9%
Treasury bonds	5.0	1.9
Common stocks	9.3	6.2

Source: Elroy Dimson, Paul Marsh, and Mike Staunton, *Triumph of the Optimists: 101 Years of Global Investment Returns* (Princeton, NJ: Princeton University Press, 2002).

Investment	Average annual return
Large-company stocks	12.3%
Small-company stocks	17.4
Long-term corporate bonds	6.2
Long-term government bonds	5.8
U.S. Treasury bills	3.8
Inflation	3.1%

Source: Stocks, Bonds, Bills, and Inflation, 2007 Yearbook (Chicago: Ibbotson Associates, Inc., 2007).

Risk and Return Fundamentals: Risk Preferences

Economists use three categories to describe how investors respond to risk.

- **Risk averse** is the attitude toward risk in which investors would require an increased return as compensation for an increase in risk.
- **Risk-neutral** is the attitude toward risk in which investors choose the investment with the higher return regardless of its risk.
- **Risk-seeking** is the attitude toward risk in which investors prefer investments with greater risk even if they have lower expected returns.

Risk of a Single Asset: Risk Assessment

Scenario analysis is an approach for assessing risk that uses several possible alternative outcomes (scenarios) to obtain a sense of the variability among returns.

- One common method involves considering pessimistic (worst), most likely (expected), and optimistic (best) outcomes and the returns associated with them for a given asset.

Range is a measure of an asset's risk, which is found by subtracting the return associated with the pessimistic (worst) outcome from the return associated with the optimistic (best) outcome.

Risk of a Single Asset: Risk Assessment (cont.)

Norman Company wants to choose the better of two investments, A and B. Each requires an initial outlay of $10,000 and each has a most likely annual rate of return of 15%. Management has estimated the returns associated with each investment. Asset A appears to be less risky than asset B. The risk averse decision maker would prefer asset A over asset B, because A offers the same most likely return with a lower range (risk).

TABLE 8.2 Assets A and B

	Asset A	Asset B
Initial investment	$10,000	$10,000
Annual rate of return		
Pessimistic	13%	7%
Most likely	15%	15%
Optimistic	17%	23%
Range	4%	16%

Risk of a Single Asset: Risk Assessment

Probability is the chance that a given outcome will occur.

A **probability distribution** is a model that relates probabilities to the associated outcomes.

A **bar chart** is the simplest type of probability distribution; shows only a limited number of outcomes and associated probabilities for a given event.

A **continuous probability distribution** is a probability distribution showing all the possible outcomes and associated probabilities for a given event.

Risk of a Single Asset: Risk Assessment (cont.)

Norman Company's past estimates indicate that the probabilities of the pessimistic, most likely, and optimistic outcomes are 25%, 50%, and 25%, respectively. Note that the sum of these probabilities must equal 100%; that is, they must be based on all the alternatives considered.

Risk of a Single Asset: Risk Measurement

Standard deviation (σ_r) is the most common statistical indicator of an asset's risk; it measures the dispersion around the *expected value*.

Expected value of a return (*r*) is the average return that an investment is expected to produce over time.

$$\bar{r} = \sum\left(r_j * Pr_j\right) = E(r) \qquad \bar{r} = \frac{\sum r_j}{n}$$

where

r_j = return for the j^{th} outcome

Pr_t = probability of occurrence of the j^{th} outcome

n = number of outcomes considered

Risk of a Single Asset: Standard Deviation

The expression for the standard deviation of returns, σ_r, is

$$\sigma = \sqrt{\sum (r_j - \bar{r})^2 * Pr_j} \qquad \sigma_r = \sqrt{\frac{\sum (r_j - \bar{r})^2}{n-1}}$$

In general, the higher the standard deviation, the greater the risk.

Coefficient of variation

$$CV = \frac{\sigma}{\bar{r}}$$

- For making risk comparisons

Predicted Returns

Economic Conditions	Probability	Asset A	Asset B	Asset C
Very Good				
Good	0.250	17.00%	23.00%	-4.00%
Average	0.500	15.00%	15.00%	7.00%
Bad	0.250	13.00%	7.00%	12.00%
Very Bad				
Total Probabilities	1.000			

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	Portfolio Weights			1.00	
Statistics		Asset A	Asset B	Asset C	Portfolio
Expected Return		15.000%	15.000%	5.500%	5.500%
Variance		0.020%	0.320%	0.343%	0.343%
Standard Deviation		1.414%	5.657%	5.852%	5.852%
Coefficient of Var		0.094	0.377	1.064	1.064
Range		4.00%	16.00%	16.00%	
95% Confidence Interval	High	17.772%	26.087%	16.971%	16.971%
	Low	12.228%	3.913%	-5.971%	-5.971%

Table 8.5 Historical Returns and Standard Deviations on Selected Investments (1900–2009)

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Investment	Average nominal return	Standard deviation	Coefficient of variation
Treasury bills	3.9%	4.7%	1.21
Treasury bonds	5.0	10.2	2.04
Common stocks	9.3	20.4	2.19

Source: Elroy Dimson, Paul Marsh, and Mike Staunton, *Triumph of the Optimists: 101 Years of Global Investment Returns* (Princeton, NJ: Princeton University Press, 2002).

Investment	Average annual return (1)	Standard deviation (2)	Coefficient of variation[a] (3)
Large-company stocks	12.3%	20.1%	1.63
Small-company stocks	17.4	32.7	1.88
Long-term corporate bonds	6.2	8.5	1.37
Long-term government bonds	5.8	9.2	1.59
U.S. Treasury bills	3.8	3.1	0.82
Inflation	3.1%	4.3%	1.39

[a]Calculated by dividing the standard deviation in column 2 by the average annual return in column 1.

Source: Stocks, Bonds, Bills, and Inflation, 2007 Yearbook (Chicago: Ibbotson Associates, Inc., 2007).

Matter of Fact

All Stocks Are Not Created Equal

- Stocks are riskier than bonds, but are some stocks riskier than others?
- A recent study examined the historical returns of large stocks and small stocks and found that the average annual return on large stocks from 1926-2009 was 11.8%, while small stocks earned 16.7% per year on average.
- The higher returns on small stocks came with a cost, however.
- The standard deviation of small stock returns was a whopping 32.8%, whereas the standard deviation on large stocks was just 20.5%.

Portfolio Risk and Return

- An investment **portfolio** is any collection or combination of financial assets.
- If we assume all investors are rational and therefore **risk averse**, that investor will ALWAYS choose to invest in portfolios rather than in single assets.
  - Investors will hold portfolios because he or she will **diversify** away a portion of the risk that is inherent in “putting all your eggs in one basket.”

Risk of a Portfolio

In real-world situations, the risk of any single investment would not be viewed independently of other assets.

New investments must be considered in light of their impact on the risk and return of an investor's portfolio of assets.

The financial manager's goal is to create an **efficient portfolio,** a portfolio that maximum return for a given level of risk.

Risk of a Portfolio: Portfolio Return and Standard Deviation

The return on a portfolio is a weighted average of the returns on the individual assets from which it is formed.

$$\bar{r}_p = \sum\left(w_j * \bar{r}_j\right)$$

where

w_j = proportion of the portfolio's total dollar value represented by asset j

r_j = return on asset j

Risk of a Portfolio: Correlation

Correlation is a statistical measure of the relationship between any two series of numbers.

- **Positively correlated** describes two series that move in the same direction.
- **Negatively correlated** describes two series that move in opposite directions.

The **correlation coefficient** is a measure of the degree of correlation between two series.

- **Perfectly positively correlated** describes two positively correlated series that have a correlation coefficient of +1.
- **Perfectly negatively correlated** describes two negatively correlated series that have a correlation coefficient of –1.

Risk of a Portfolio: Diversification

To reduce overall risk, it is best to diversify by combining, or adding to the portfolio, assets that have the lowest possible correlation.

Combining assets that have a low correlation with each other can reduce the overall variability of a portfolio's returns.

Uncorrelated describes two series that lack any interaction and therefore have a correlation coefficient close to zero.

Invest 70% in Asset A and 30% in Asset B

Probability	Asset A	Asset B	Asset C
0.250	17.00%	23.00%	-4.00%
0.500	15.00%	15.00%	7.00%
0.250	13.00%	7.00%	12.00%
1.000			

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Portfolio Weights	0.70	0.30	0.00	
	Asset A	Asset B	Asset C	Portfolio
	15.000%	15.000%	5.500%	15.000%
	0.020%	0.320%	0.343%	0.072%
	1.414%	5.657%	5.852%	2.687%
	0.094	0.377	1.064	0.179
	4.00%	16.00%	16.00%	
High	17.772%	26.087%	16.971%	20.267%
Low	12.228%	3.913%	-5.971%	9.733%

NOTE: What happened to CV?

Invest 70% in Asset B and 30% in Asset C

Economic Conditions	Probability	Asset A	Asset B	Asset C
Very Good				
Good	0.250	17%	23.00%	-4.00%
Average	0.500	15%	15.00%	7.00%
Bad	0.250	13%	7.00%	12.00%
Very Bad				
Total Probabilities	1.000			

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	Portfolio Weights		0.70	0.30	
Statistics		Asset A	Asset B	Asset C	Portfolio
Expected Return		15.00%	15.00%	5.50%	12.15%
Variance		0.02%	0.32%	0.34%	0.05%
Standard Deviation		1.41%	5.66%	5.85%	2.31%
Coefficient of Var		9.43%	37.71%	106.41%	18.99%
Range		4.00%	16.00%	16.00%	
95% Confidence Interval	High	17.77%	26.09%	16.97%	16.67%
	Low	12.23%	3.91%	-5.97%	7.63%

Correlation	
AB	1.00000
AC	-0.96660
BC	-0.96660

NOTE: What happened to CV?

Invest 30% in Asset A, 50% in Asset B, and .2 in Asset C

Portfolio Weights	0.30	0.50	0.20	
	Asset A	Asset B	Asset C	Portfolio
	15.000%	15.000%	5.500%	13.100%
	0.020%	0.320%	0.343%	0.046%
	1.414%	5.657%	5.852%	2.142%
	0.094	0.377	1.064	0.164
	4.00%	16.00%	16.00%	
High	17.772%	26.087%	16.971%	17.299%
Low	12.228%	3.913%	-5.971%	8.901%

NOTE: What happened to CV?

	Investment ($ or we	Weights	Returns
A	$0.30	0.300	15.000%
B	$0.50	0.500	15.000%
C	$0.20	0.200	5.500%
D		0.000	
E		0.000	
F		0.000	
G		0.000	
H		0.000	
Portfolio Investment	$1.00		
		Portfolio Return	13.100%

Risk of a Portfolio: International Diversification

The inclusion of assets from countries with business cycles that are not highly correlated with the U.S. business cycle reduces the portfolio's responsiveness to market movements.

Over long periods, internationally diversified portfolios tend to perform better (meaning that they earn higher returns relative to the risks taken) than purely domestic portfolios.

However, over shorter periods such as a year or two, internationally diversified portfolios may perform better or worse than domestic portfolios.

Currency risk and political risk are unique to international investing.

Risk and Return: The Capital Asset Pricing Model (CAPM)

The **capital asset pricing model (CAPM)** is the basic theory that links risk and return for all assets.

The CAPM quantifies the relationship between risk and return.

In other words, it measures how much additional return an investor should expect from taking a little extra risk.

Risk and Return: The CAPM: Types of Risk

Total risk is the combination of a security's nondiversifiable risk and diversifiable risk.

Diversifiable risk is the portion of an asset's risk that is attributable to firm-specific, random causes; can be eliminated through diversification. Also called unsystematic risk.

Nondiversifiable risk is the relevant portion of an asset's risk attributable to market factors that affect all firms; cannot be eliminated through diversification. Also called systematic risk.

Because any investor can create a portfolio of assets that will eliminate virtually all diversifiable risk, *the only relevant risk is nondiversifiable risk.*

Total Risk

Total risk	**= systematic**	**+ unsystematic**
	= market risk	**+ company specific**
	= non-diversifiable	**+ diversifiable**
Causes	**interest rates**	**strikes**
	inflation	**lawsuits**

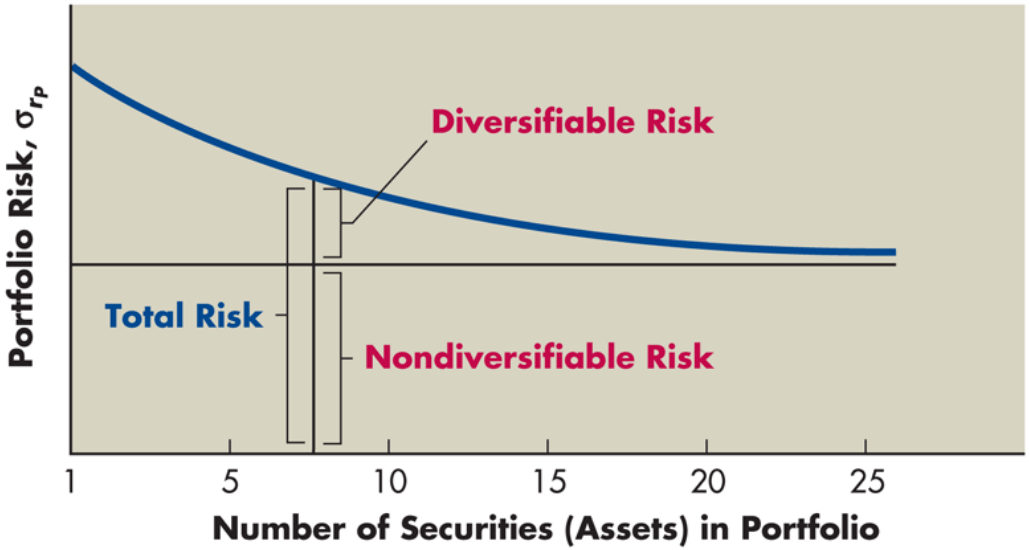
$$\sigma_p^2 = w_A^2\sigma_A^2 + w_B^2\sigma_B^2 + 2 * w_A * w_B * \rho_{AB} * \sigma_A * \sigma_B$$

Impact on risk from interaction of assets A and B

Figure 8.7
Risk Reduction

FIGURE 8.7

Risk Reduction
Portfolio risk and diversification



In this problem, you are given returns, variance and / or standard deviation, beta and the correlation matrix.

Asset	Weights	Returns	Variance	Standard Deviation
A	0.300	15.000%	0.020%	1.414%
B	0.500	15.000%	0.320%	5.657%
C	0.200	5.500%	0.343%	5.857%

Correlation Matrix	A	B	C
A	1.000		
B	1.000	1.000	
C	-0.966	-0.966	1.000

Portfolio Return	13.100%
Portfolio Variance	0.046%
Portfolio Standard Dev.	2.143%
Portfolio Coefficent of Var.	0.164
Portfolio Beta	0.000

Risk and Return: The CAPM

The **beta coefficient (*b*)** is a relative measure of nondiversifiable risk. An index of the degree of movement of an asset's return in response to a change in the market return.

- An asset's historical returns are used in finding the asset's beta coefficient.
- The beta coefficient for the entire market equals 1.0. All other betas are viewed in relation to this value.

The **market return** is the return on the market portfolio of all traded securities.

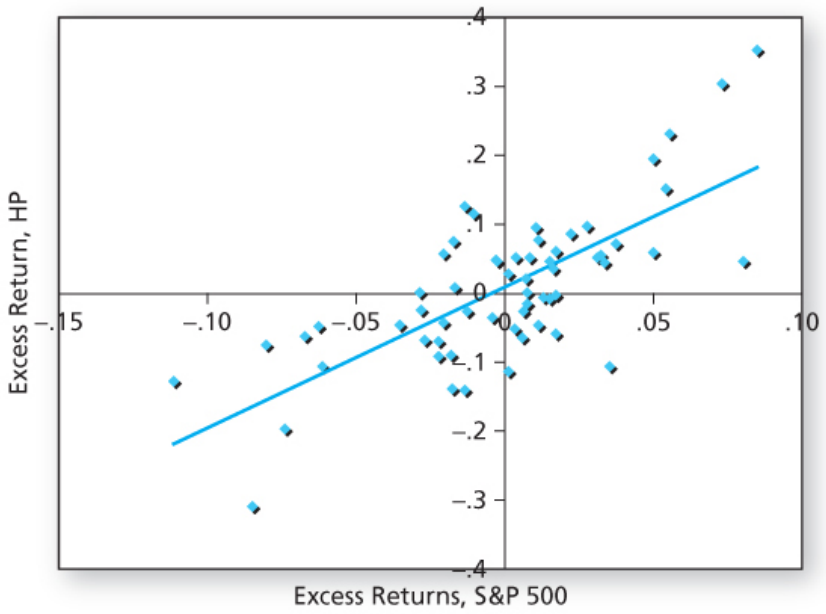


Figure 8.3 Scatter diagram of HP, the S&P 500, and the security characteristic line (SCL) for HP

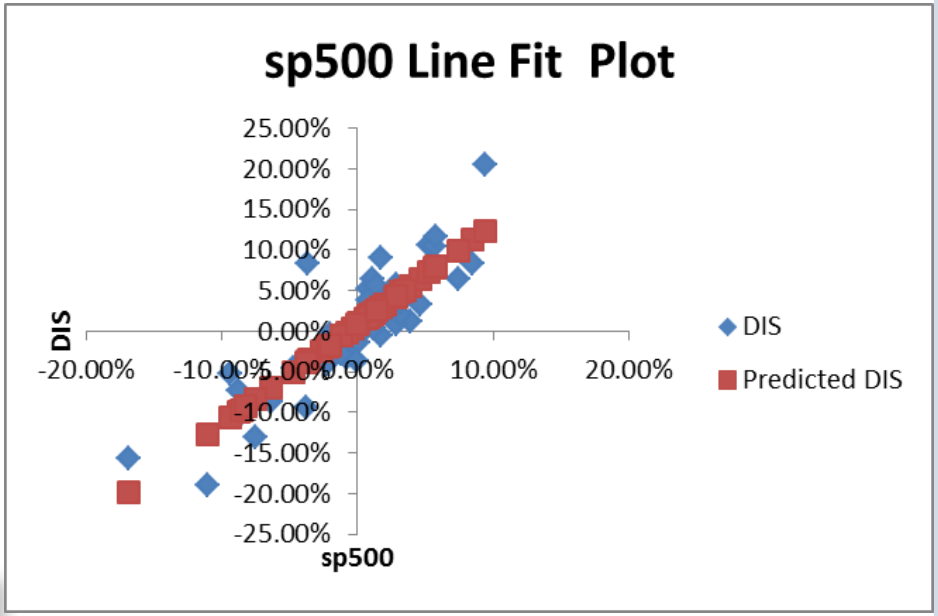


Table 8.8 Selected Beta Coefficients and Their Interpretations

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Beta	Comment	Interpretation
2.0	Move in same direction as market	Twice as responsive as the market
1.0		Same response as the market
0.5		Only half as responsive as the market
0		Unaffected by market movement
−0.5	Move in opposite direction to market	Only half as responsive as the market
−1.0		Same response as the market
−2.0		Twice as responsive as the market

Table 8.9 Beta Coefficients for Selected Stocks (June 7, 2010)

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Stock	Beta	Stock	Beta
Amazon.com	0.99	JP Morgan Chase & Co.	1.16
Anheuser-Busch	1.00	Bank of America	2.58
Ford Motor	2.72	Microsoft	0.99
Disney	1.25	Nike, Inc.	0.92
eBay	1.75	PepsiCo, Inc.	0.57
ExxonMobil Corp.	0.37	Qualcomm	0.89
Gap (The), Inc.	1.31	Sempra Energy	0.60
General Electric	1.68	Wal-Mart Stores	0.29
Intel	1.12	Xerox	1.50
Int'l Business Machines	0.68	Yahoo! Inc.	0.92

Source: www.finance.yahoo.com

Risk and Return: The CAPM (cont.)

The beta of a portfolio can be estimated by using the betas of the individual assets it includes.

Letting w_j represent the proportion of the portfolio's total dollar value represented by asset j, and letting b_j equal the beta of asset j, we can use the following equation to find the portfolio beta, b_p:

$$\beta_p = \sum(W_i * \beta_i)$$

Table 8.10 Mario Austino's Portfolios V and W

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	Portfolio V		Portfolio W	
Asset	Proportion	Beta	Proportion	Beta
1	0.10	1.65	0.10	0.80
2	0.30	1.00	0.10	1.00
3	0.20	1.30	0.20	0.65
4	0.20	1.10	0.10	0.75
5	0.20	1.25	0.50	1.05
Totals	1.00		1.00	

	Investment	Weights	Retu	Betas
A	$0.10	0.100		1.650
B	$0.30	0.300		1.000
C	$0.20	0.200		1.300
D	$0.20	0.200		1.100
E	$0.20	0.200		1.250
F		0.000		
G		0.000		
H		0.000		
Portfolio Investment	$1.00			
		Portfolio	####	
			Portf	1.195

	Investment	Weights	Retu	Betas
A	$0.10	0.100		0.800
B	$0.10	0.100		1.000
C	$0.20	0.200		0.650
D	$0.10	0.100		0.750
E	$0.50	0.500		1.050
F		0.000		
G		0.000		
H		0.000		
Portfolio Investment	$1.00			
		Portfolio	####	
			Portf	0.910

Risk and Return: The Capital Asset Pricing Model (CAPM) (cont.)

- The **required return** for all assets is composed of two parts: the **risk-free rate** and a **risk premium**.

The risk-free rate (R_F) is usually estimated from the return on US T-bills or T-bonds

The risk premium is a function of both market conditions and the asset itself.

Risk and Return: The CAPM (cont.)

Using the beta coefficient to measure nondiversifiable risk, the capital asset pricing model (CAPM) is given in the following equation:

$$r_j = RF + \beta_j (r_m - RF)$$

where

r_t = required return on asset j

R_F = risk-free rate of return, commonly measured by the return on a U.S. Treasury bill

b_j = beta coefficient or index of nondiversifiable risk for asset j

r_m = market return; return on the market portfolio of assets

Risk and Return: The CAPM (cont.)

Benjamin Corporation, a growing computer software developer, wishes to determine the required return on asset Z, which has a beta of 1.5. The risk-free rate of return is 7%; the return on the market portfolio of assets is 11%. Substituting $b_Z = 1.5$, $R_F = 7\%$, and $r_m = 11\%$ into the CAPM yields a return of:

$$r_Z = 7\% + [1.5 \times (11\% - 7\%)] = 7\% + 6\% = \underline{13\%}$$

CAPM (SML)	
Risk Free Rate	7.000%
Avg Return of Market	11.000%
Portfolio Beta	1.500
Ks (Expected Return)	13.000%
Market Risk Premium	

Figure 8.9
Security Market Line

FIGURE 8.9

Security Market Line
Security market line (SML) with Benjamin Corporation's asset Z data shown

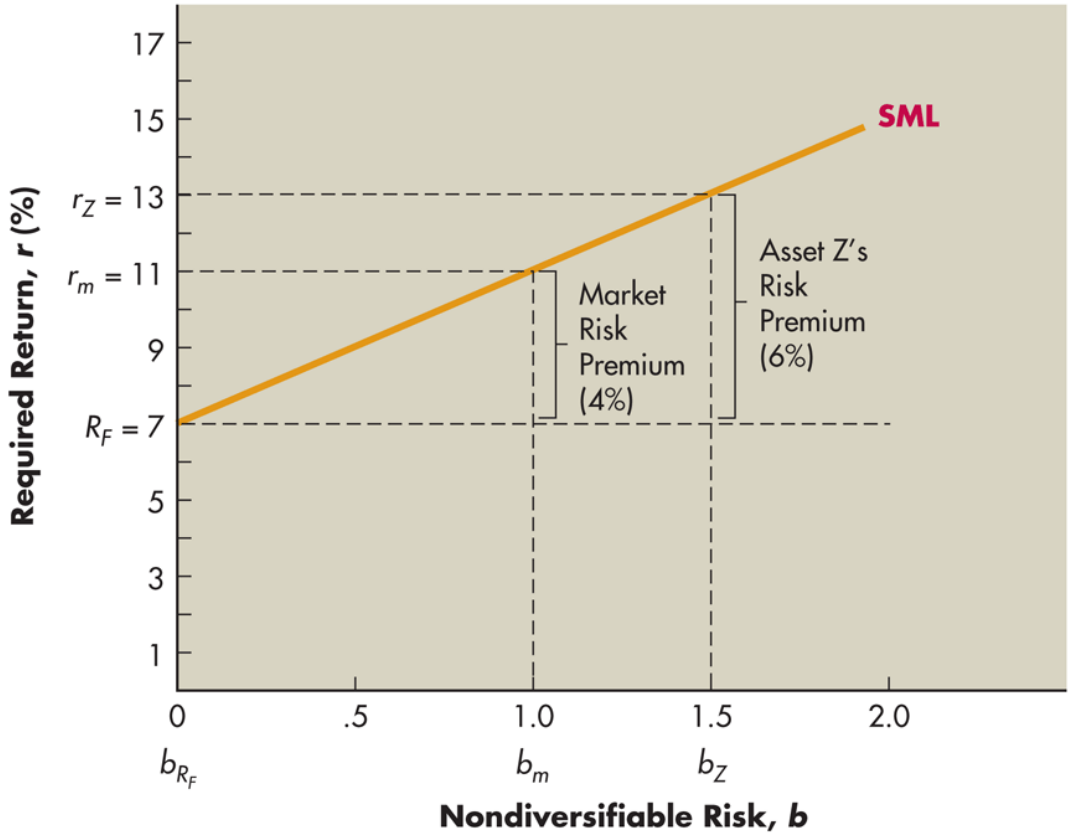


Figure 8.10
Inflation Shifts SML

FIGURE 8.10

Inflation Shifts SML
Impact of increased inflationary expectations on the SML

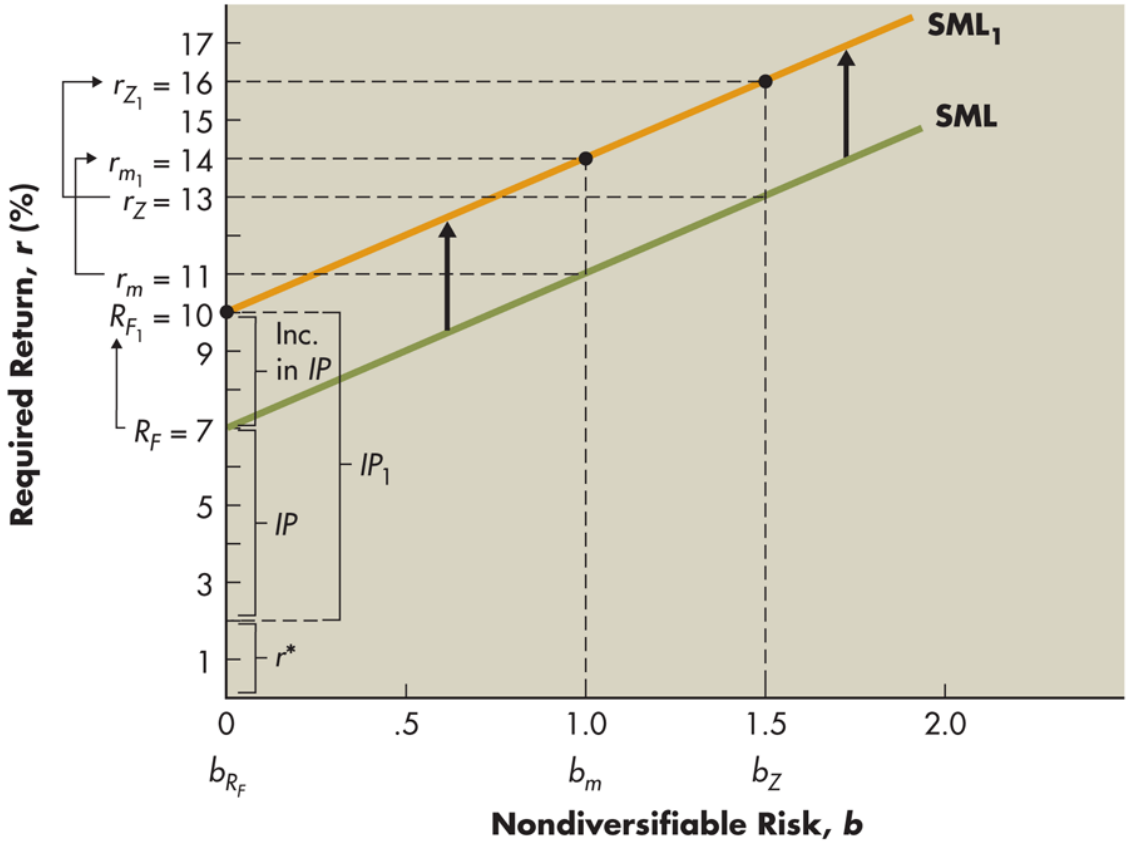
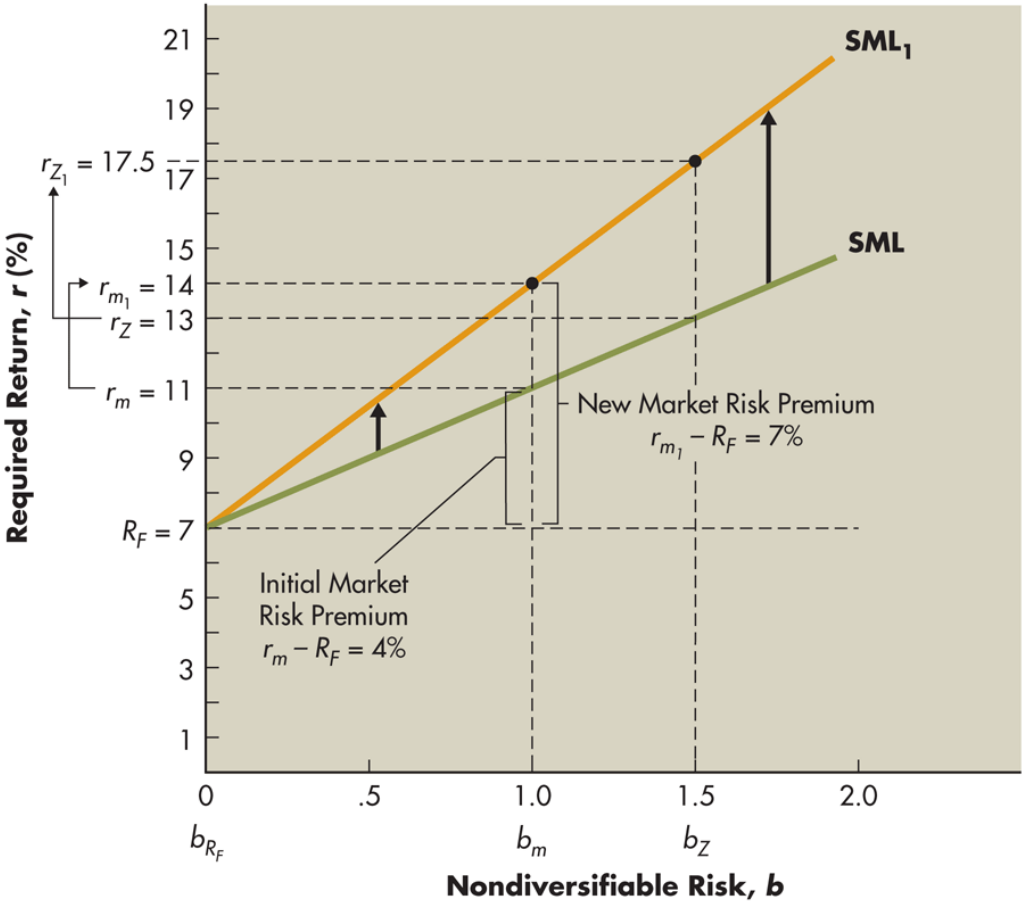


Figure 8.11
Risk Aversion Shifts SML

FIGURE 8.11

Risk Aversion Shifts SML
Impact of increased risk aversion on the SML



Risk and Return: The CAPM (cont.)

The CAPM relies on historical data which means the betas may or may not actually reflect the future variability of returns.

Therefore, the required returns specified by the model should be used only as rough approximations.

The CAPM assumes markets are efficient.

Although the perfect world of efficient markets appears to be unrealistic, studies have provided support for the existence of the expectational relationship described by the CAPM in active markets such as the NYSE.

Change in Returns?

- If the stock market increases by 15%, what should happen to a stock with a beta of 1.5? .25???

What if the stock Market Changes?	
Beta	1.500
% Change in Market	15.000%
Change in Expected Ret.	22.500%

What if the stock Market Changes?	
Beta	0.250
% Change in Market	15.000%
Change in Expected Ret.	3.750%

Numbers Investors should know?

http://youtu.be/SXLkP4_gX1Y