CHAPTER 8
Risk and Rates of Return

- Stand-alone risk
- Portfolio risk
- Risk & return: CAPM

The basic goal of the firm is to:

maximize shareholder wealth!

Investment returns

The rate of return on an investment can be calculated as follows:

$$\text{Return} = \frac{\text{(Amount received – Amount invested)}}{\text{Amount invested}}$$

For example, if $1,000 is invested and $1,100 is returned after one year, the rate of return for this investment is:

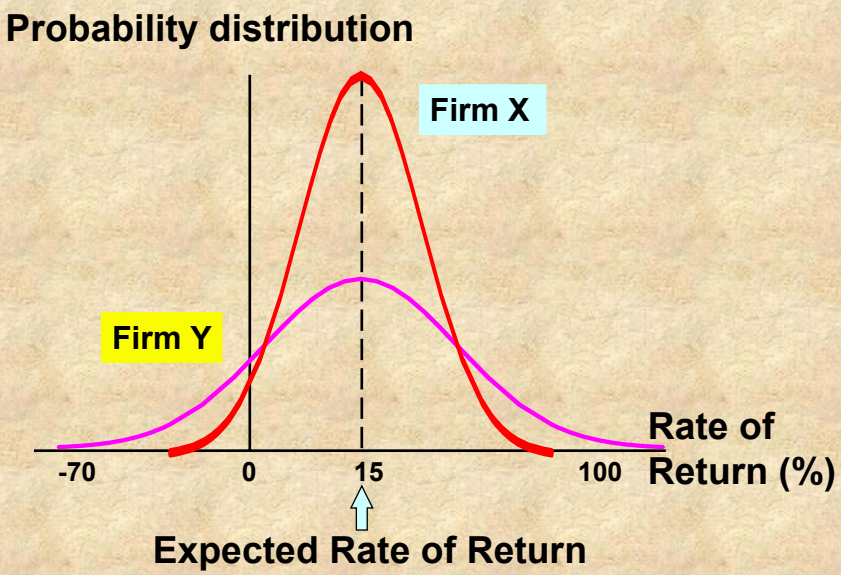
($1,100 - $1,000) / $1,000 = 10%.

What is risk?

Risk is the possibility that more than one outcome may occur.

Risk pertains to the possibility that actual returns will be different from the expected return

The greater the chance (and range) of returns being different from the expected return, the riskier the investment.



Selected Realized Returns, 1926 – 2004

	Average Return	Standard Deviation
Small-company stocks	17.5%	33.1%
Large-company stocks	12.4	20.3
L-T corporate bonds	6.2	8.6
L-T government bonds	5.8	9.3
U.S. Treasury bills	3.8	3.1

Source: Based on *Stocks, Bonds, Bills, and Inflation: (Valuation Edition) 2005 Yearbook* (Chicago: Ibbotson Associates, 2005), 28.

If an asset has no risk, it is called risk-free. The closest approximation we have are government securities.

T-bills return their promised return regardless of the economy.

This is why we use T-bills as a proxy for the risk-free rate.

Do T-bills promise a completely risk-free return?

NO

T-bills are still exposed to the risk of inflation. However, not much unexpected inflation is likely to occur over a relatively short period.

Risk Tolerance of Individuals

- Risk aversion is a dislike for risk.
- Risk averse individuals consider a trade-off between risk and return in making decisions.
- Risk averse investors require higher expected rates of return to compensate them for assuming higher levels of risk.

Required return

- Investors will expect to receive the risk-free rate of return for any investment, since it can be obtained without any risk.
- They also will require additional expected return to compensate them for the risk of the asset.

The return on any asset can be described by the following equation.

Asset's required return = **Risk-free rate of return** + **Asset's risk premium**

NOTE

- It is important to note that investors make their decision based on expected returns and risk.
- Actual returns may differ from expected returns, so actual returns are not always higher for higher risk investments in the short-run.
- In the long-run, higher returns do generally occur for higher risk assets.

Risk depends on what could happen versus what is expected to happen.

So, we need to be able to determine what return is expected for a particular asset.

Expected rate of return on an individual asset

$\hat{k}$ = expected rate of return.

$$\hat{k} = \sum_{i=1}^{n} k_i P_i .$$

P_i = probability the i^{th} outcome will occur

k_i = return for i^{th} possible outcome

Expected Rate of Return

Outcomes	Return		Probability		
Better	22%	X	0.3	=	6.6%
Same	12%	X	0.5	=	6.0%
Worse	-8%	X	0.2	=	-1.6%
		Exp. Return		=	11.0%

Risk and Return

- Risk can be measured in many different ways. There are two main ways of looking at risk.

- Stand-alone risk
- Portfolio risk

What is stand-alone risk?

Stand-alone risk considers all risk.

It is measured by the dispersion of returns about the mean and is relevant only for assets held in isolation.

Risk Measures

- Stand-alone risk measures:
  - standard deviation
  - coefficient of variation
- Market risk measure:
  - beta

How do we calculate standard deviation?

Standard deviation measures "total risk."

$$\sigma = \sqrt{\text{Variance}} = \sqrt{\sum_{i=1}^{n} (k_i - \hat{k})^2 P_i}$$

- **measure of "stand-alone" risk**
- **the larger the σ the lower the probability that actual returns will be close to expected returns.**

Coefficient of Variation (CV)

Standardized measure of dispersion about the expected value:

$$CV = \frac{\text{Std dev}}{\text{Mean}} = \frac{\sigma}{\hat{k}}.$$

Shows risk per unit of return.
(still a stand-alone risk measure)

Diversification

- Generally, we do not hold assets in isolation. We own many assets at any one time.
- This is what is meant by the term diversification (simply, holding more than one asset).
- Diversification has several benefits for investors.

- Diversification's main benefit is easily seen.
  - Since not all investments go up or down at the same time, combining several assets together means that it will be likely that when some are doing "poorly" others will be doing "well."
  - This results in returns being closer to the average or expected return over time, which means that there is less risk.

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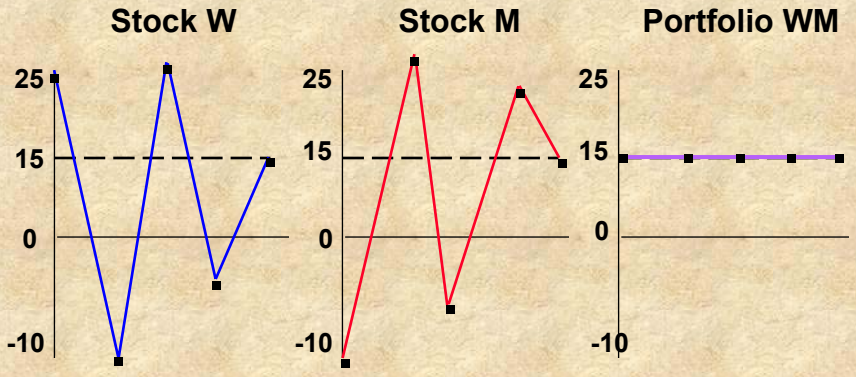
Returns Distributions for Two Perfectly Negatively Correlated Stocks (r = -1.0) and for Portfolio WM



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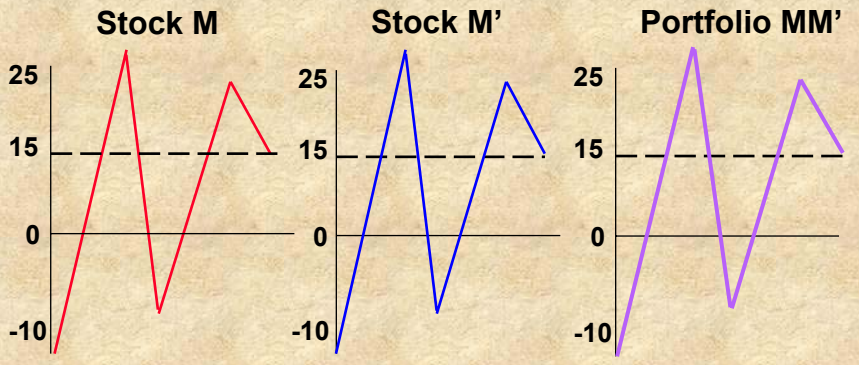
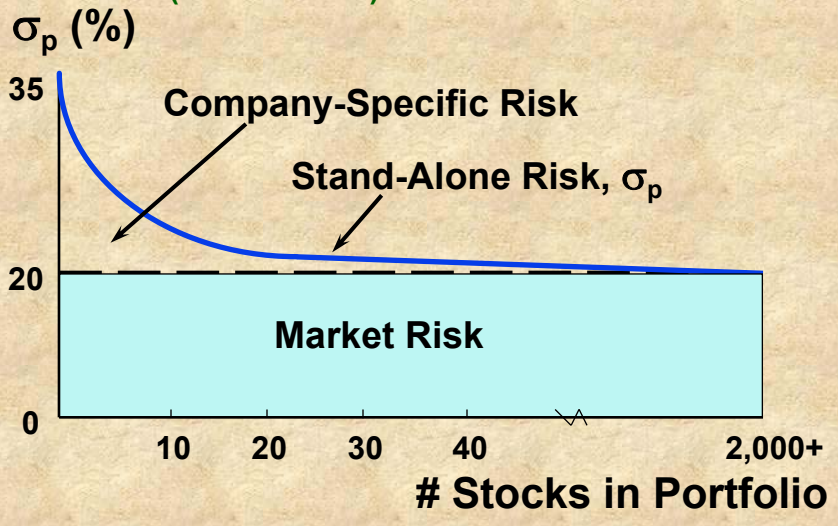
Returns Distributions for Two Perfectly Positively Correlated Stocks (r = +1.0) and for Portfolio MM'



- Risk that only affects an individual asset (company specific risk) is "removed" when many assets are held together.
- If you could own a portfolio of all assets, all company specific risk could be eliminated. Only the risk that affects all assets would remain.

By forming portfolios, we can eliminate about half the riskiness of individual stocks (35% vs. 20%).



$$\underset{\text{risk}}{\text{Stand-alone}} = \underset{\text{risk}}{\text{Market}} + \underset{\text{risk}}{\text{Firm-specific}}$$

Market risk is that part of a security's stand-alone risk that *cannot* be eliminated by diversification, and it is measured by beta.

Firm-specific risk is that part of a security's stand-alone risk that can be eliminated by proper diversification.

What is company specific risk?

- Caused by company specific events (e.g., lawsuits, strikes, winning or losing major contracts, etc.)
- Effects of such events on a portfolio can be eliminated by diversification.

What is market risk?

- **Stems from such external events as war, inflation, recession, and interest rates.**
- **Because all firms are affected simultaneously by these factors, market risk cannot be eliminated by diversification.**
- **Market risk is also known as systematic risk since it shows the degree to which a stock moves systematically with other stocks.**

If you chose to hold a one-stock portfolio and thus are exposed to more risk than diversified investors, would you be compensated for all the risk you bear?

- NO!
- Stand-alone risk as measured by a stock's σ or CV is not important to a well-diversified investor.
- Rational, risk-averse investors are concerned with σ_p , which is based on market risk.

- There can only be one price, hence market return, for a given security. Therefore, no compensation can be earned for the additional risk of a one-stock portfolio.

Portfolio Return and Standard Deviation

- The expected return for a portfolio will be the weighted average return for all assets in the portfolio.

- Portfolio standard deviation is generally less than the weighted average of the standard deviations of the individual assets in the portfolio.

Portfolio return

$$\hat{k}_p = \sum_{i=1}^{n} w_i k_i$$

w_i = fraction of funds invested in asset i

k_i = exp. return for i^{th} asset

Expected Return for a Portfolio

Asset	Invested	Return
AAA	$2,000	25%
BBB	$4,000	20%
CCC	$6,000	16%
DDD	$8,000	10%

Expected Return for a Portfolio

Determine the fraction of total funds in each asset, multiply times the return, and sum the resulting values.

Asset	Invested			Return		
AAA	$2,000	/20000	**X**	25%	=	2.50%
BBB	$4,000	/20000	**X**	20%	=	4.00%
CCC	$6,000	/20000	**X**	16%	=	4.80%
DDD	$8,000	/20000	**X**	10%	=	4.00%
total	$20,000			Exp return		15.30%

What is the CAPM?

- An equilibrium model specifying the relationship between risk and required return on assets held in *diversified* portfolios.

It says that the return on any asset is equal to the risk-free return plus a risk-premium. The risk-premium equals the asset's beta times the risk-premium for the market portfolio.

What is the market risk premium?

- Additional return over the risk-free rate needed to compensate investors for assuming an average amount of risk.
- Its size depends on the perceived risk of the stock market and investors' degree of risk aversion.
- Varies from year to year, but most estimates suggest that it ranges between 4% and 8% per year.

- Since by forming well-diversified portfolios we can eliminate company specific risk, we need a risk measure that only considers market risk.
- Beta is that risk measure. Beta measures the risk of an asset relative to the "market."
- Beta shows how risky a stock is if the stock is held in a well-diversified portfolio.

How are betas calculated?

- Run a regression of past returns on Stock *i* versus returns on the market.
- The slope of the regression line is defined as the beta coefficient.

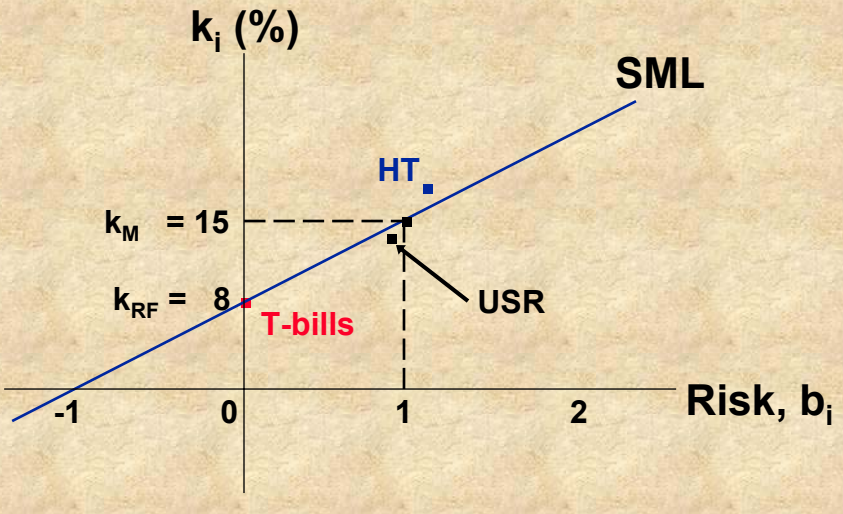
- If beta = 1.0, average stock.
- If beta > 1.0, stock riskier than average.
- If beta < 1.0, stock less risky than average.
- Most stocks have betas in the range of 0.5 to 1.5.

Security Market Line (SML)

$$k_i = k_{RF} + (k_M - k_{RF})b_i \ .$$

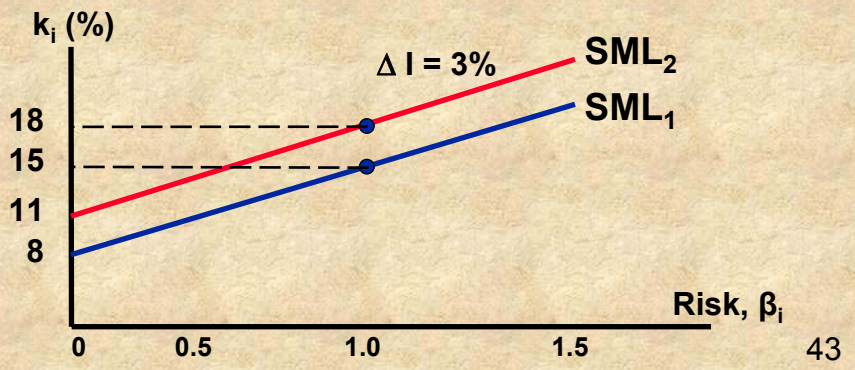
- k_{RF} = risk-free return
- k_M = return on market portfolio
- b_i = beta for asset i
- k_i = return on asset i

SML: $k_i = 8\% + (15\% - 8\%)\, b_i$.



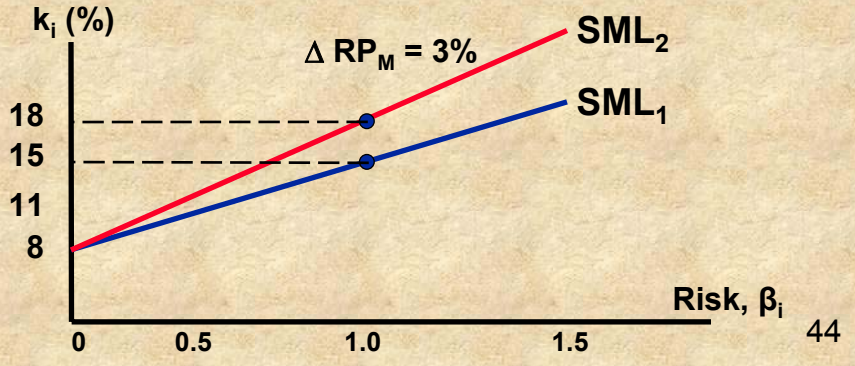
Factors that change the SML

- What if investors raise inflation expectations by 3%, what would happen to the SML?



Factors that change the SML

- What if investors' risk aversion increased, causing the market risk premium to increase by 3%, what would happen to the SML?



Portfolio beta

The beta for a portfolio is the weighted average of the betas for all stocks in the portfolio.

$$\hat{b}_p = \sum_{i=1}^{n} w_i b_i$$

= portfolio beta

w_i = fraction of funds invested in asset i

b_i = beta for i^{th} asset

Beta for a Portfolio

Risk-free rate		5%				
Market return		13%				
Asset	**Invested**			**Beta**		
AAA	$2,000	/20000	**X**	3.0	**=**	0.30
BBB	$4,000	/20000	**X**	2.5	**=**	0.50
CCC	$6,000	/20000	**X**	1.6	**=**	0.48
DDD	$8,000	/20000	**X**	1.2	**=**	0.48
total	$20,000			Beta (port)		1.76

Expected Return for a Portfolio

- Now use the calculated Beta for the portfolio to calculate the expected return for the portfolio.

- $k_i = 5\% + 1.76(13\% - 5\%) = 19.08\%$

Has the CAPM been verified through empirical tests?

- Not completely. Those statistical tests have problems that make verification almost impossible.

- Investors seem to be concerned with both market risk and total risk. Therefore, the SML may not produce a correct estimate of k_i:

$$k_i = k_{RF} + (k_M - k_{RF})b_i + ?$$

- Also, CAPM/SML concepts are based on expectations, yet betas are calculated using historical data. A company's historical data may not reflect investors' expectations about future riskiness.

More thoughts on the CAPM

- Investors seem to be concerned with both market risk and total risk. Therefore, the SML may not produce a correct estimate of k_i.

$$k_i = k_{RF} + (k_M - k_{RF})\,\beta_i + ???$$

- CAPM/SML concepts are based upon expectations, but betas are calculated using historical data. A company's historical data may not reflect investors' expectations about future riskiness.