### Chapter 13

### • Return, Risk, and the Security Market Line

### Key Concepts and Skills

- Know how to calculate expected returns
- Understand the impact of diversification
- Understand the systematic risk principle
- Understand the security market line
- Be able to use the Capital Asset Pricing Model (CAPM)



Example 13.1: Expected Returns					
<ul> <li>Suppose you returns for si states of nat returns?</li> </ul>	u have pred tocks C and ure. What a	icted the fo I T in three are the expe	llowing possible cted		
<ul> <li>State</li> </ul>	Probability	С	Т		
Boom	0.3	15	25		
<ul> <li>Normal</li> </ul>	0.5	10	20		
<ul> <li>Recession</li> </ul>	???	2	1		
			13-3		

### Variance and Standard Deviation

- Variance and standard deviation still measure the volatility of returns
- Weighted average of squared deviations

$$\sigma^{2} = \sum_{i=1}^{n} p_{i} (R_{i} - E(R))^{2}$$

Example 13.2: Variance and  
Standard Deviation  
• Consider the previous example. What are the  
variance and standard deviation for each stock?  
• Stock C  
• 
$$\sigma^2 = .3(15-9.9)^2 + .5(10-9.9)^2 + .2(2-9.9)^2 = 20.29$$
  
•  $\sigma = 4.5$   
• Stock T  
•  $\sigma^2 = .3(25-17.7)^2 + .5(20-17.7)^2 + .2(1-17.7)^2 =$   
74.41  
•  $\sigma = 8.63$ 

Examp	le 13.3
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•	Consider	the	following	information:	
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<ul> <li>State</li> </ul>	Probability	ABC, Inc. (%)				
<ul> <li>Boom</li> </ul>	.25	15				
<ul> <li>Normal</li> </ul>	.50	8				
<ul> <li>Slowdown</li> </ul>	.15	4				
<ul> <li>Recession</li> </ul>	.10	-3				
What is the expected return?						

- What is the variance?
- What is the standard deviation?



### Portfolios

- A portfolio is a collection of assets
- An asset's risk and return are important in how they affect the risk and return of the portfolio
- The risk-return trade-off for a portfolio is measured by the portfolio expected return and standard deviation, just as with individual assets

# Example 13.4: Portfolio Weights

Suppose you have \$15,000 to invest and you have purchased securities in the following amounts. What are your portfolio weights in each security?
 \$2000 of DCLK
 DCLK: 2/15 = .133

- \$2000 of DOLI
- \$3000 of KO
- \$4000 of INTC
- \$6000 of KEI
- •KO: 3/15 = .2 •INTC: 4/15 = .267
- •KEI: 6/15 = .4

### 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 13.5: 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?

- DCLK: 19.69%
- KO: 5.25%
- INTC: 16.65%
- KEI: 18.24%

### **Portfolio Variance**

- Compute the portfolio return for each state:  $R_P = w_1R_1 + w_2R_2 + ... + w_mR_m$
- 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 13.6: Portfolio Variance Consider the following information Invest 50% of your money in Asset A Portfolio State Probability A В 12.5% • Boom .4 30% -5% 7.5% 25% • Bust .6 -10% A) What are the expected return and standard deviation for each asset? B) What are the expected return and standard deviation for the portfolio?







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Ρ	ortfo	lios	Lis	tec	l for	Ye	ar	19	26	-20(	02)
							-				

securities	Nom. Av. An.Ret.	St. Dev. of Ret.	Real AV. An. Ret.	Risk Premium			
Small Comp. Stock	16,9%	33,2%	13,8%	13,1%			
Large Comp. Stock	12,2	20,5	9,1	8,4			
L-T Corp. Bonds	6,2	8,7	3,1	2,4			
L-T Gov. Bonds	5,8	9,4	2,7	2,0			
US Treasury Bills	3,8	3,2	0,7	0			
Av. Inflatio	on Rate: 3.1						
<ol> <li>The Nominal A</li> </ol>	Average Annual Rat	te of Return					
(2) Standard Devi	ation of Returns (M	leasure the Volatil	ity or Riskiness of th	e Returns)			
(3) The Real Average Annual Rate of Return (The Nominal Return less the Average Inflation Rate)							
(4) Risk Premium: The additional return received beyond the Risk-Free Rate (Treasury Bill). (The Nominal Return less the Average Risk-Free Rate) (Eg. 16,9 - 3,8=13,1)							
<ul> <li>We expect the Treasury Bill to be the least risky of the 5 portfolios</li> </ul>							
<ul> <li>We expe</li> </ul>	ct the c/s of Sma	all Companies 1	o be <u>the most risk</u>	Ω.			
<ul> <li>We expe Bond W</li> </ul>	ct the L-T Gover	nment Bond is	less risky than L-	T Corporate			
There is a chance of default on a corporate bond, which is essentially non-							



### Risk

- We can divide the total risk (total variability) of our portfolios into 2 types of risk.
  - (1) Systematic Risk (Market Related Risk)
  - (2) Unsystematic Risk (Firm Specific)

### 1. Systematic Risk

- Also known as non-diversifiable risk or market risk
- Risk factors that affect a large number of assets
- Market Risk is non-diversifiable risk, it can not be eliminated, no matter how much we diversify.
- Includes such things as changes in GDP, inflation, interest rates, recessions, wars etc.

### 2. Unsystematic Risk

- Also known as company unique risk and assetspecific risk
- Risk factors that affect a limited number of assets
- Diversifiable risk, because it can be diversify away.
- Includes such things as labor strikes, part shortage, etc.

### 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.	
(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







### 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

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 (non-diversifiable 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

# Beta is a relative measure of non-diverifiable risk. An index of the degree of movement of asset's return in response to a change in the market return. An asset's historical return are used in finding the asset's beta coefficients. If beta is positive: moves in the same direction as market. If beta is negative: moves in the opposite direction to market If beta is 0: Unaffacted by market movement

	Table	13.8	
		Beta Coefficient (Br)	
	Coca-Cola Bottling	0.45	_
	General Mills	0.55	
	ExxonMobil	0.80	
	3M	0.90	
	American Electric Power	1.05	
	General Motors	1.25	
	eBay	1.55	
	Yahoo!	1.85	
Source:	Value Line Investment Survey, 2004.		
			5
			13-32

Total ve	rsus Systemat	ic Risk
Consider the	e following informat	ion:
	Standard Deviation	Beta
<ul> <li>Security C</li> </ul>	20%	1.25
<ul> <li>Security K</li> </ul>	30%	0.95
<ul> <li>Which secu</li> <li>Which secu</li> </ul>	rity has more total r rity has more syster	isk? natic risk?
		13-33

# Beta: A measure of the volatility (or systematic risk) of a security or a portfolio in comparison to the market as a whole. A beta 1: indicates that security's price will move with the market.

- A beta 0,25 :indicates that security will be less volatile than the market
- A beta 1,25 :indicates that theoretically 25% more volatile than the market.

### Example 13.8: Portfolio Betas Measures the portfolios non-diversifiable risk. Consider the previous example with the following four securities Security Weight Beta DCLK .133 2.685 • KO .2 0.195 .167 INTC 2.161 KEI .4 2.434 What is the portfolio beta?

### The Capital Asset Pricing Model (CAPM)

 CAPM is a model that describes the relationship between risk and expected return in the pricing of risky securities.

$$\mathsf{E}(\mathsf{R}_{\mathsf{A}}) = \mathsf{R}_{\mathsf{f}} + \beta_{\mathsf{A}}(\mathsf{E}(\mathsf{R}_{\mathsf{M}}) - \mathsf{R}_{\mathsf{f}})$$

- Rf : Risk free rate
- E(R<sub>M</sub>): Expected market return (return on the market portfolio of all traded securities Eg. S&P's 500 stock composite is used as market return)
- $\beta_A$ : Beta of the security
- $E(R_A)$ . Expected return of a security or a portfolio.
- $(E(R_M) R_f)$ : Market risk premium

### Beta and the Risk Premium

- <u>Risk Premium :</u> The additional return received beyond the *risk free rate.* (Eg. Treasury Bills being the least risky)
- Remember that the risk premium = the expected return less the risk-free rate
- The higher the beta, the greater the risk premium should be
- The market risk premium is determined from the slope of the SML.

### SML

- SML graphs the results from the CAPM formula. It plots the result of the CAPM for all different risks (betas).
- X- axis represents risk (beta), and Y-axis represents expected return.
- A line that graphs the systematic, or market risk versus return of the whole market at a certain time and show all risky marketable securities.





Example 13.9 - CAPM				
• Consider the betas for each of the assets given earlier. If the risk-free rate is 2.13% and the market risk premium is 8.6%, what is the expected return for each?				
Security	Beta	Expected Return		
DCLK	2.685			
ко	0.195			
INTC	2.161			
KEI	2.434			
		12.41		

## Sugested Problems

• 1-11, 13-15,16, 23, 26.