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Valuation and Asset Pricing

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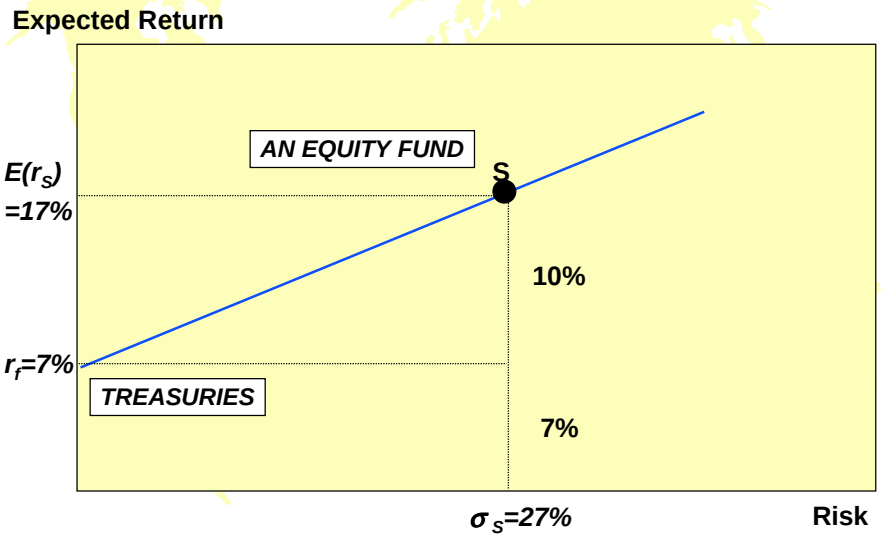
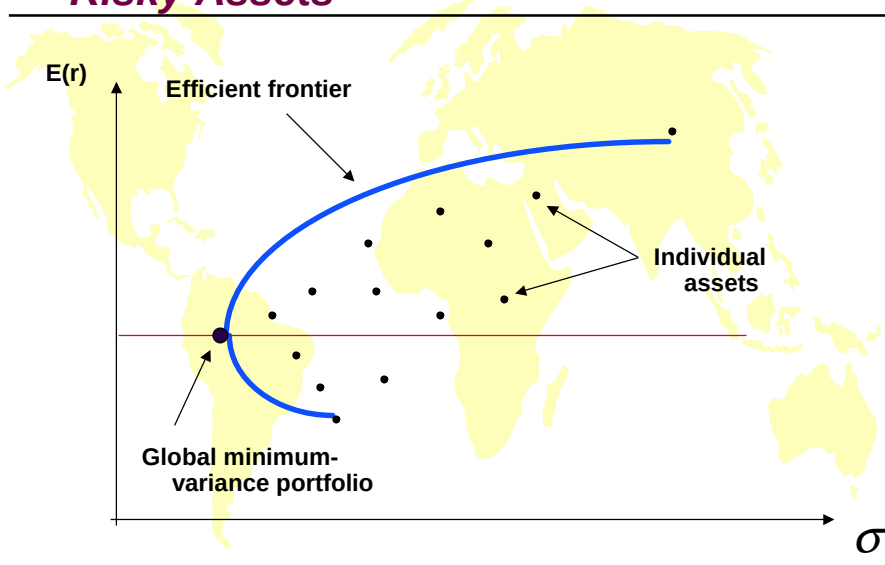
Valuation and Asset Pricing

- Capital Asset Pricing
- Beta and the Security Market Line
- Identifying Undervalued and Overvalued Securities
- Estimating Betas
- Arbitrage Pricing Model
- Applications

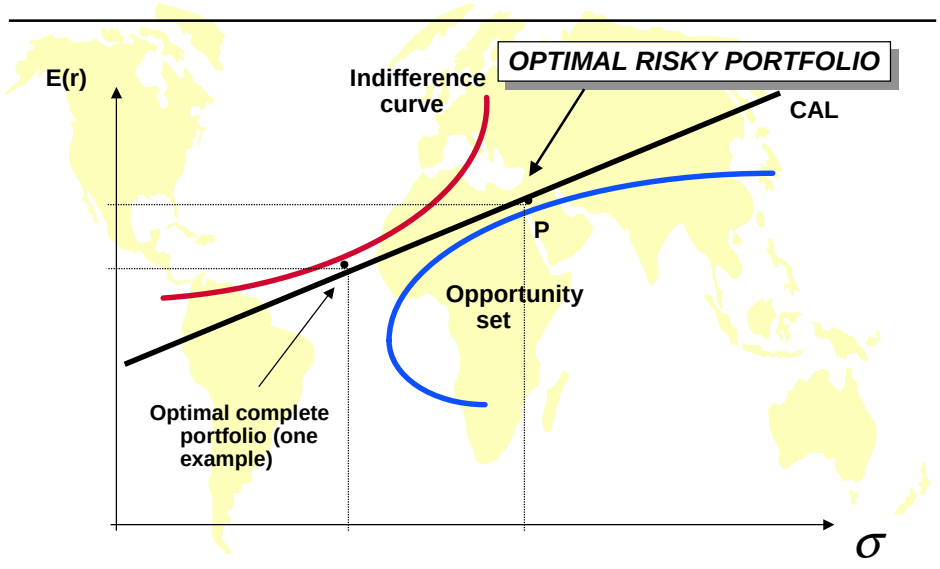
Capital Allocation Line: Risk-Free Plus Risky Asset



The Minimum-Variance Frontier of Risky Assets



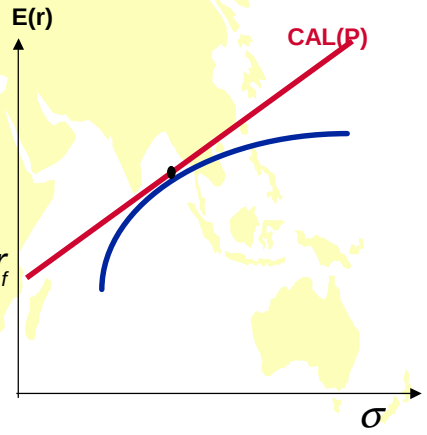
Optimal Overall Portfolio



The Capital Asset Pricing Model

CAPM Says:

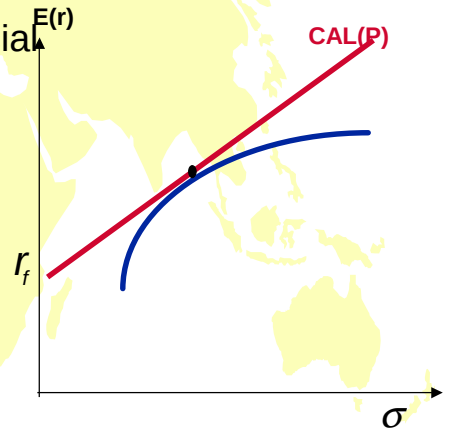
- All investors will choose to hold the market portfolio, ie all assets, in proportion to their market values
- This market portfolio is the optimal risky portfolio
- The part of a stock's risk that is diversifiable does not matter to investors.



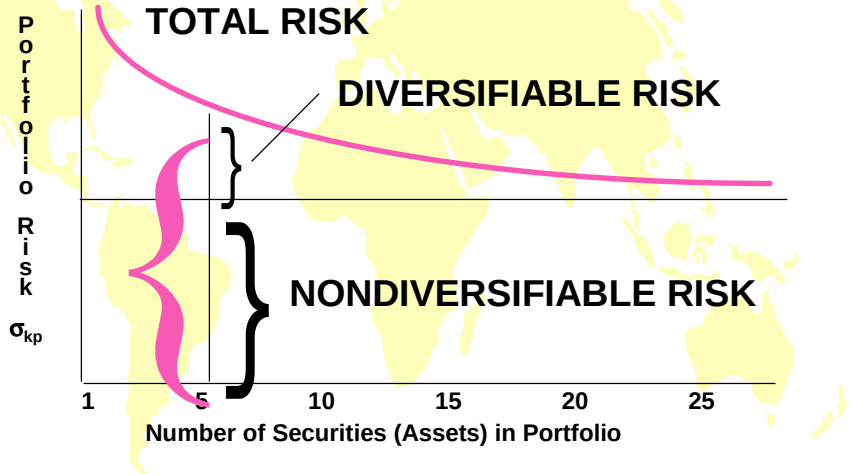
The Capital Asset Pricing Model

CAPM Says:

- The total risk of a financial asset is made up of two components.
  - A. Diversifiable (unsystematic) risk
  - B. Nondiversifiable (systematic) risk
- The only relevant risk is nondiversifiable risk.



Types of Risk



Risk Premium: The Market

M	=	Market portfolio
r_f	=	Risk free rate
$E(r_M) - r_f$	=	Market risk premium
$\frac{E(r_M) - r_f}{\sigma_M}$	=	Market price of risk
	=	Slope of the CAL

Risk Premium: Individual Stock

M	=	Market portfolio
r_f	=	Risk free rate
$E(r_s) - r_f$	=	Stock's risk premium
$\frac{E(r_s) - r_f}{\beta_i \sigma_M}$	=	Stock's reward-to-risk ratio
	=	Market price of risk

Derivation of the CAPM

- Risk Premium for the Market Portfolio:
  $S = E[(R_M) - R_f] / \sigma_M$
- Risk premium for security's risk per unit of contribution to the market portfolio risk:
  $[E(R_s) - R_f] / \beta_S\sigma_M$
- Setting the two values equal to each other:
  $[E(R_M) - R_f] / \sigma_M = [E(R_S) - R_f] / \beta_S\sigma_M$
- From which one derives the CAPM's expected return-beta relationship:
  $E(R_S) = R_f + \beta_S[E(R_M) - R_f]$

The Equation for the CAPM

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

where:

r_j	=	Required return on asset j;
R_F	=	Risk-free rate of return
β_j	=	Beta Coefficient for asset j;
r_m	=	Market return

The term $[\beta_j(r_m - R_F)]$ is called the risk premium and (r_m-R_F) is called the market risk premium

Summary: Capital Asset Pricing Model

- The Capital Asset Pricing Model (CAPM) - an equilibrium model of the relationship between risk and return.

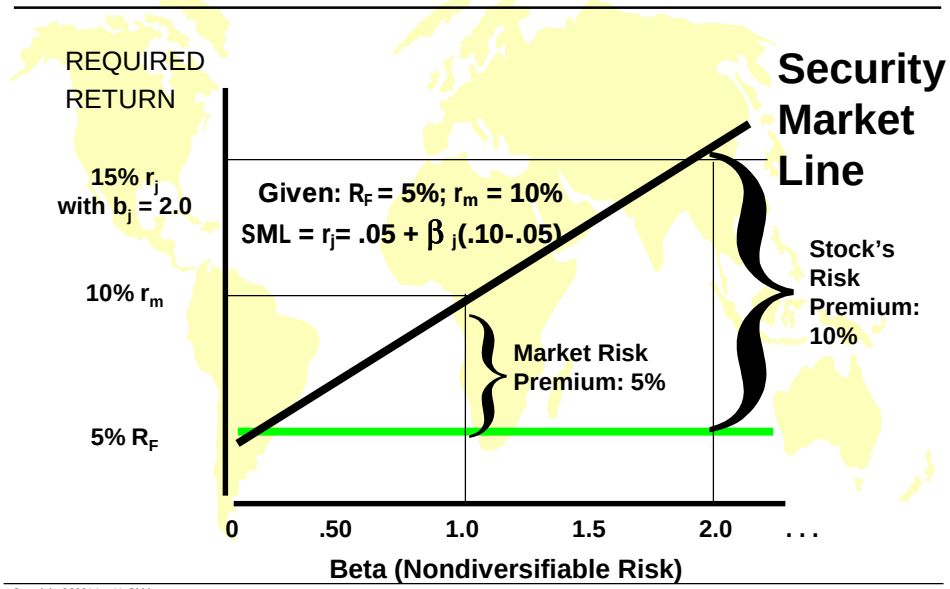
  What determines an asset's expected return?

  - The risk-free rate - the pure time value of money
  - The market risk premium - the reward for bearing systematic risk
  - The beta coefficient - a measure of the amount of systematic risk present in a particular asset
  - The CAPM: $E(R_i) = R_f + \beta_i [E(R_M) - R_f]$

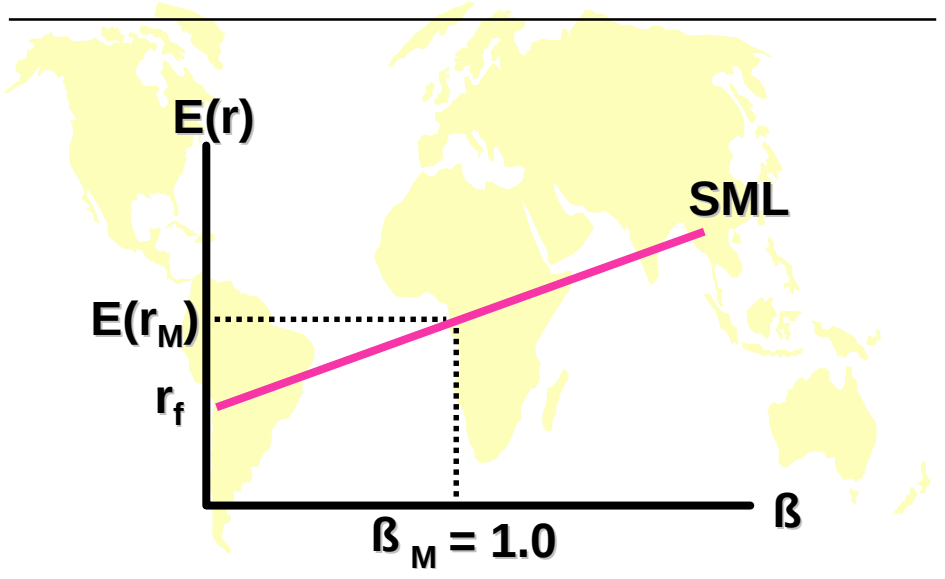
Expected Return and Risk on Individual Securities

- The risk premium on individual securities is a function of the individual security's contribution to the risk of the market portfolio
- Individual security's risk premium is a function of the covariance of returns with the assets that make up the market portfolio

Graphic Depiction of CAPM



Security Market Line



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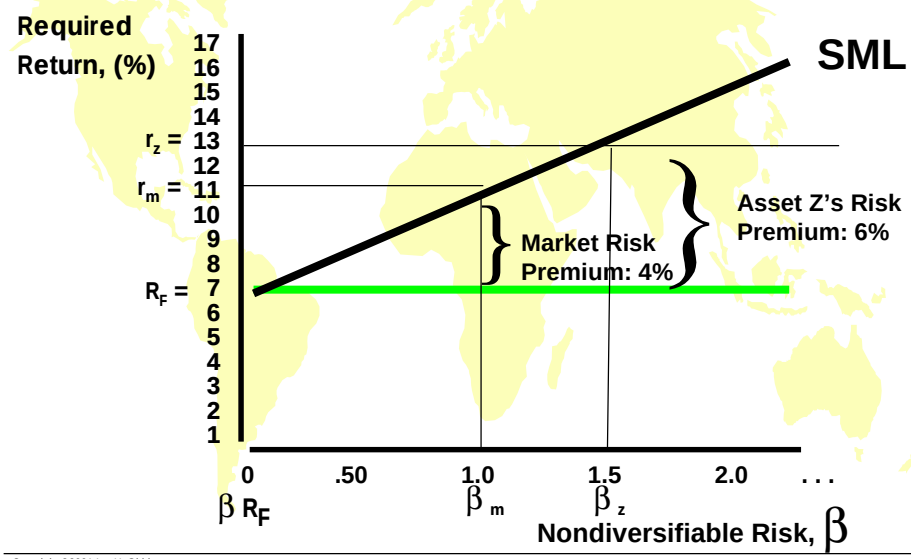


SML Relationships

Slope of SML

$= E(r_m) - r_f$

$=$ market risk premium

$$E(r_i) = r_f + \beta[E(r_m) - r_f]$$

$$\beta = [COV(r_i, r_m)] / \sigma_m^2$$

Sample Calculations for SML

$E(r_m) - r_f = .08$ $r_f = .03$

Xeptional Inc.

$\beta_x = 1.25$

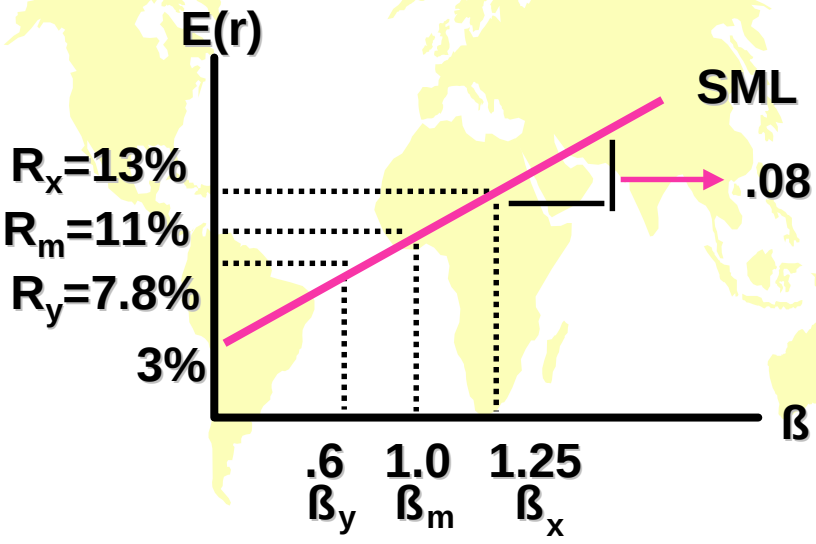
$E(r_x) = .03 + 1.25(.08) = .13$ or 13%

Yknot Inc.

$\beta_y = .6$

$E(r_y) = .03 + .6(.08) = .078$ or 7.8%

Graph of Sample Calculations



Interpreting Beta

- Beta Coefficients are estimated from historical data by regression analysis.
- *Stock Betas* are easily obtained from published sources, such as *Value Line Investment Survey*, on the Web, or through brokerage firms.
- *Portfolio Betas* are determined by calculating the weighted average of the Betas of all assets included in the portfolio, using each asset's proportion of the total dollar value of the portfolio as its weight.

Beta Coefficients for Selected Companies

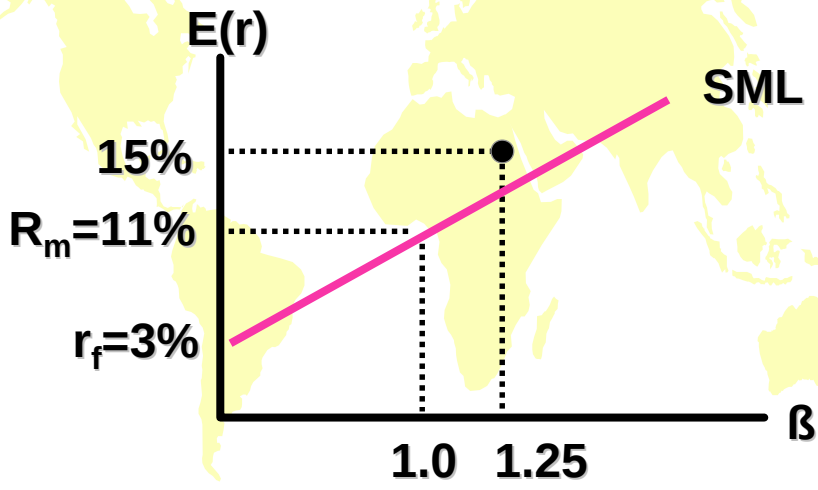
Exxon	0.65
AT&T	0.90
IBM	0.95
Wal-Mart	1.10
General Motors	1.15
Microsoft	1.30
Harley-Davidson	1.65
America Online	2.40

Source: From Value Line *Investment Survey*, April 19, 1996.

Disequilibrium Example

- Suppose a security with a β of 1.25 is offering expected return of 15%
- According to SML, it should be 13%
- Underpriced: offering too high of a rate of return for its level of risk

Disequilibrium Example



Risk: Systematic and Unsystematic

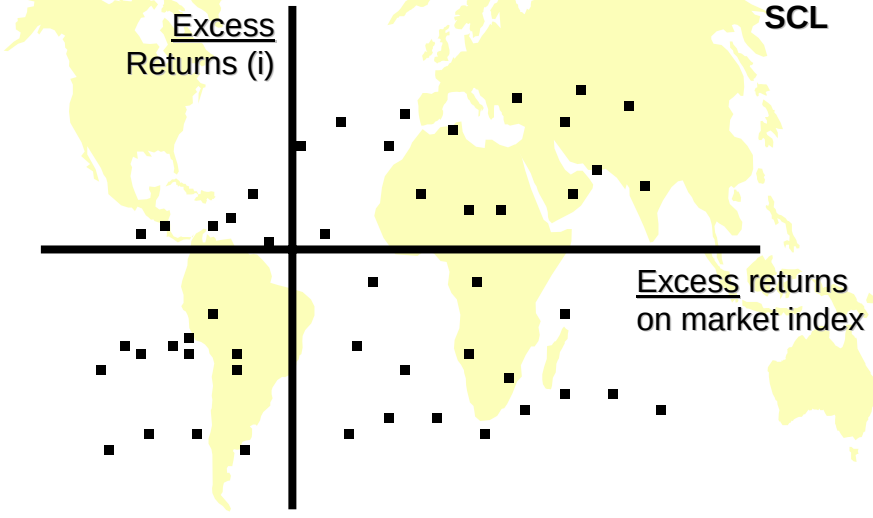
- Systematic and Unsystematic Risk
  - Types of surprises
    1. Systematic or "market" risks
    2. Unsystematic/unique/asset-specific risks
  - Systematic and unsystematic components of return

    Total return = Expected return + Unexpected return

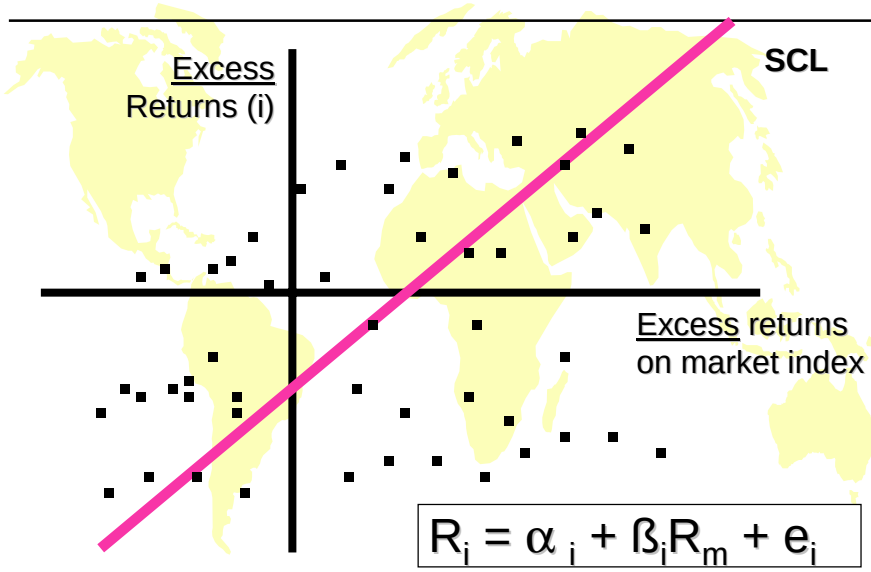
    R = E(R) + U

    = E(R) + systematic portion + unsystematic portion

Security Characteristic Line



Security Characteristic Line



$$R_i = \alpha_i + \beta_i R_m + e_i$$

Using the Text Example

	Excess GM Ret.	Excess Mkt. Ret.
Jan.	5.41	7.24
Feb.	-3.44	.93
.	.	.
.	.	.
Dec	2.43	3.90
Mean	-.60	1.75
Std Dev	4.97	3.32

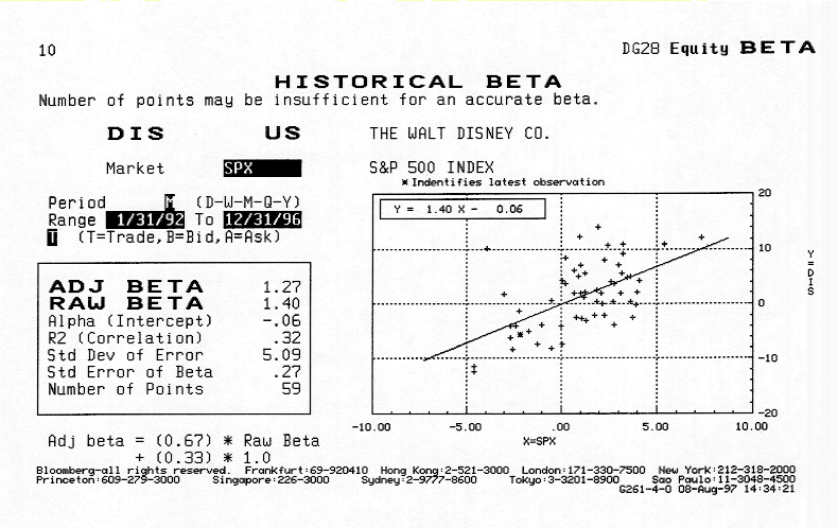
Regression Results:

$$r_{GM} - r_f = \alpha + ß(r_m - r_f)$$

	α	ß
Estimated coefficient	-2.590	1.1357
Std error of estimate	(1.547)	(0.309)

Variance of residuals = 12.601
Std dev of residuals = 3.550
R-SQR = 0.575

Beta Estimation in Practice: Bloomberg



Industry Betas

Industry Name	Number of Firms	Average Beta	Market D/E Ratio	Tax Rate	Unlevered Beta	Cash/Firm Value	Unlevered Beta corrected for cash
Advertising	24	1.63	16.26%	20.66%	1.44	6.79%	1.55
Aerospace/Defense	37	0.82	36.89%	27.36%	0.65	3.27%	0.67
Air Transport	35	0.99	91.60%	27.28%	0.59	13.84%	0.69
Apparel	38	0.81	32.03%	30.24%	0.66	4.06%	0.69
Auto & Truck	19	0.89	170.35%	28.14%	0.40	9.69%	0.44
Auto Parts	52	0.74	77.31%	27.37%	0.47	3.78%	0.49
Bank	159	0.76	27.72%	31.32%	0.64	9.43%	0.70
Bank (Canadian)	8	0.94	10.30%	24.29%	0.87	2.51%	0.89
Bank (Foreign)	3	1.10	12.69%	17.66%	1.00	9.15%	1.10
Bank (Midwest)	31	0.81	23.33%	30.26%	0.70	8.14%	0.76
Beverage (Alcoholic)	16	0.53	15.19%	28.54%	0.48	1.16%	0.48
Beverage (Soft Drink)	14	0.68	12.35%	28.18%	0.62	1.88%	0.64
Biotechnology	15	1.16	1.35%	12.99%	1.15	7.70%	1.24
Building Materials	33	0.82	31.62%	31.02%	0.67	4.27%	0.70
Cable TV	20	1.31	75.60%	4.74%	0.76	5.10%	0.80
Canadian Energy	14	0.72	32.45%	34.94%	0.59	3.00%	0.61
Cement & Aggregates	13	0.72	36.19%	22.95%	0.56	1.99%	0.57
Chemical (Basic)	13	0.90	31.82%	23.80%	0.72	2.42%	0.74
Chemical (Diversified)	30	0.77	26.45%	32.63%	0.65	3.69%	0.68
Chemical (Specialty)	71	0.77	44.35%	25.18%	0.58	2.90%	0.60

Leverage Affects Beta

- **The beta of a firm's equity can be written as a function of the unlevered beta and the debt-equity ratio**

$$\beta_L = \beta_u (1+ ((1-t)D/E)$$

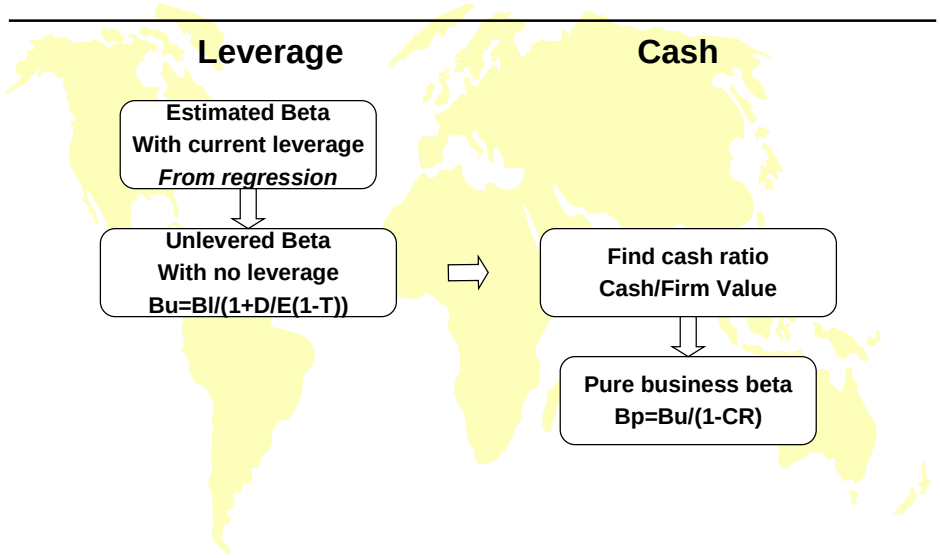
where

β_L = Levered or Equity Beta
β_u = Unlevered Beta
t = Corporate marginal tax rate
D = Market Value of Debt
E = Market Value of Equity

- Hence:

$$\beta_u = \beta_L /(1+ ((1-t)D/E)$$

Betas: Leverage and Cash



Estimating Expected Returns: September 30, 1997

- Disney's Beta = 1.40
- Riskfree Rate = 7.00% (Long term Government Bond rate)
- Risk Premium = 5.50% (Approximate historical premium)
- Expected Return = 7.00% + 1.40 (5.50%) = 14.70%

Use to a Potential Investor in Disney

As a potential investor in Disney, what does this expected return of 14.70% tell you?

- This is the return that I can expect to make in the long term on Disney, if the stock is correctly priced and the CAPM is the right model for risk,
- This is the return that I need to make on Disney in the long term to break even on my investment in the stock
- Both

Assume now that you are an active investor and that your research suggests that an investment in Disney will yield 25% a year for the next 5 years. Based upon the expected return of 14.70%, you would

Buy the stock

- Sell the stock

How managers use this expected return

Managers at Disney

- need to make at least 14.70% as a return for their equity investors to break even.
- this is the hurdle rate for projects, when the investment is analyzed from an equity standpoint

- In other words, Disney's cost of equity is 14.70%.
- What is the cost of not delivering this cost of equity?

Beta Differences: A Look Behind Betas

BETA AS A MEASURE OF RISK

High Risk

Beta > 1
Above-average Risk

America Online: Beta = 2.10: Operates in Risky Business

Time Warner: Beta = 1.45: High leverage is the reason

General Electric: Beta = 1.15: Multiple Business Lines

Beta = 1
Average Stock

Philip Morris: Beta = 1.05: Risk from Lawsuits ????

Microsoft: Beta = 0.95: Size has its advantages

Exxon: Beta=0.65: Oil price Risk may not be market risk

Beta < 1
Below-average Risk

Oracle: Beta = 0.45: Betas are just estimates

Government Bonds: Beta = 0

Low Risk

What's the Beta of a Portfolio?

Example: Portfolio Beta Calculations

Stock	Amount Invested	Portfolio Weights	Beta	
(1)	(2)	(3)	(4)	(3) x (4)
Haskell Mfg.	$ 6,000	50%	0.90	0.450
Cleaver, Inc.	4,000	33%	1.10	0.367
Rutherford Co.	2,000	17%	1.30	0.217
Portfolio	$12,000	100%		1.034

Example: Portfolio Expected Returns and Betas

- Assume you wish to hold a portfolio consisting of asset A and a riskless asset. Given the following information, calculate *portfolio expected returns* and *portfolio betas*, letting the proportion of funds invested in asset A range from 0 to 125%.

  Asset A has a beta of 1.2 and an expected return of 18%. The risk-free rate is 7%.

  Asset A weights: 0%, 25%, 50%, 75%, 100%, and 125%.

Example: Portfolio Expected Returns and Betas (concluded)

Proportion Invested in Asset A (%)	Proportion Invested in Risk-free Asset (%)	Portfolio Expected Return (%)	Portfolio Beta
0	100	7.00	0.00
25	75	9.75	0.30
50	50	12.50	0.60
75	25	15.25	0.90
100	0	18.00	1.20
125	-25	20.75	1.50

Summary: CAPM Equilibrium

- Investors, in the aggregate, hold the market portfolio.
- The market porfolio will be on the efficient frontier and will be the optimal risky portfolio. All investors hold the same risky portfolio (M), adding T-bills to their portfolios to obtain desired risk levels
- The risk premium on the market portfolio is proportional to the variance of the market portfolio and the degree of risk aversion of investors.

Resulting Equilibrium Conditions

- All investors will hold the same portfolio for risky assets – market portfolio
- Market portfolio contains all securities and the proportion of each security is its market value as a percentage of total market value

Resulting Equilibrium Conditions (cont.)

- Risk premium on the market depends on the average risk aversion of all market participants
- Risk premium on an individual security is a function of its covariance with the market

Some Comments on CAPM

- Since Beta coefficients are derived from historical data, they are best viewed as approximations of future expectations of actual risk-return behavior.
- CAPM is based upon an assumed efficient market which, although seemingly unrealistic, is supported empirically in active markets such as the New York Stock Exchange.
- While CAPM is not applicable to all assets, it does provide a conceptual framework that is useful in linking risk and return in financial decisions.

Arbitrage Pricing Theory

Arbitrage - arises if an investor can construct a zero investment portfolio with a sure profit

- Since no investment is required, an investor can create large positions to secure large levels of profit
- In efficient markets, profitable arbitrage opportunities will quickly disappear

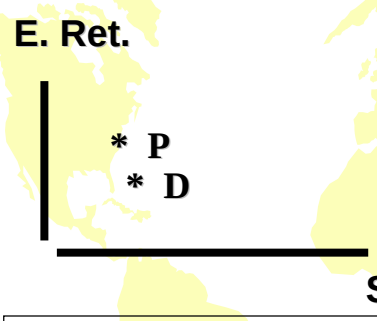
Arbitrage Example from Text

Stock	Current Price$	Expected Return%	Standard Dev.%
A	10	25.0	29.58
B	10	20.0	33.91
C	10	32.5	48.15
D	10	22.5	8.58

Arbitrage Portfolio

	Mean	S.D.	Correlation
Portfolio A,B,C	25.83	6.40	
			0.94
Dreck	22.25	8.58	

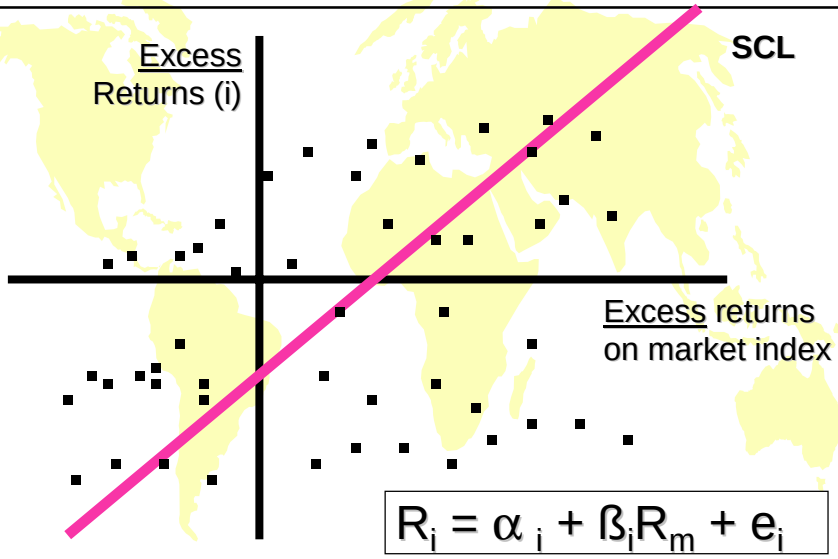
Arbitrage Action and Returns



Short 3 shares of D and buy 1 of A, B & C to form P

You earn a higher rate on the investment than you pay on the short sale

Security Characteristic Line



$$R_i = \alpha_i + \beta_i R_m + e_i$$

The APT

Diversification can get rid of the unsystematic errors

A regression

$$r_j - r_F = \alpha_j + \beta_j (r_m - r_F) + e_j$$

Arbitrage ensures Alpha's are zero

The APT

A regression

$$r_j - r_F = \beta_j (r_m - r_F)$$

The APT

A regression

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

The APT

CAPM

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

APT

$$r_p = R_F + \beta_p (r_m - R_F)$$

Multifactor APT

$$r_p = R_F + \beta_{p1} (r_{p1} - R_F) + \beta_{p2} (r_{p2} - R_F)$$

APT and CAPM Compared

- APT applies to well diversified portfolios and not necessarily to individual stocks
- With APT it is possible for some individual stocks to be mispriced - not lie on the SML
- APT is more general in that it gets to an expected return and beta relationship without the assumption of the market portfolio
- APT can be extended to multifactor models

Diversification and Asset Pricing: Summary

- Investors diversify, because you get a better return for a given risk.
- There is a fully-diversified "market portfolio" that we should all choose
- The risk of an individual asset can be measured by how much risk it adds to the "market portfolio"
- The CAPM tells us how the required return relates to the relevant risk.

Summary of Risk and Return

I. Total risk - the variance (or the standard deviation) of an asset's return.

II. Total return - the expected return + the unexpected return.

III. Systematic and unsystematic risks

Systematic risks are unanticipated events that affect almost all assets to some degree.

Unsystematic risks are unanticipated events that affect single assets or small groups of assets.

IV. The effect of diversification - the elimination of unsystematic risk via the combination of assets into a portfolio.

V. The systematic risk principle and beta - the reward for bearing risk depends *only* on its level of systematic risk.

VI. The reward-to-risk ratio - the ratio of an asset's risk premium to its beta.

VII. The capital asset pricing model: $E(R_i) = R_f + Beta_i [E(R_M) - R_f]$.

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