Picking the Right Investments: Investment Analysis

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First Principles

- Invest in projects that yield a return greater than the **minimum acceptable hurdle rate**.
  - **The hurdle rate should be higher for riskier projects and reflect the financing mix used - owners' funds (equity) or borrowed money (debt)**
  - Returns on projects should be measured based on cash flows generated and the timing of these cash flows; they should also consider both positive and negative side effects of these projects.
- Choose a financing mix that minimizes the hurdle rate and matches the assets being financed.
- If there are not enough investments that earn the hurdle rate, return the cash to stockholders.
  - The form of returns - dividends and stock buybacks - will depend upon the stockholders' characteristics.

What is a investment or a project?

- Any decision that requires the use of resources (financial or otherwise) is a project.
- Broad strategic decisions
  - Entering new areas of business
  - Entering new markets
  - Acquiring other companies
- Tactical decisions
- Management decisions
  - The product mix to carry
  - The level of inventory and credit terms
- Decisions on delivering a needed service
  - Lease or buy a distribution system
  - Creating and delivering a management information system

The notion of a benchmark

- Since financial resources are finite, there is a hurdle that projects have to cross before being deemed acceptable.
- This hurdle will be higher for riskier projects than for safer projects.
- A simple representation of the hurdle rate is as follows:

  Hurdle rate = Riskless Rate + Risk Premium

- The two basic questions that every risk and return model in finance tries to answer are:
  - How do you measure risk?
  - How do you translate this risk measure into a risk premium?

What is Risk?

- Risk, in traditional terms, is viewed as a ‘negative’. Webster’s dictionary, for instance, defines risk as “exposing to danger or hazard”. The Chinese symbols for risk, reproduced below, give a much better description of risk

- The first symbol is the symbol for “danger”, while the second is the symbol for “opportunity”, making risk a mix of danger and opportunity.

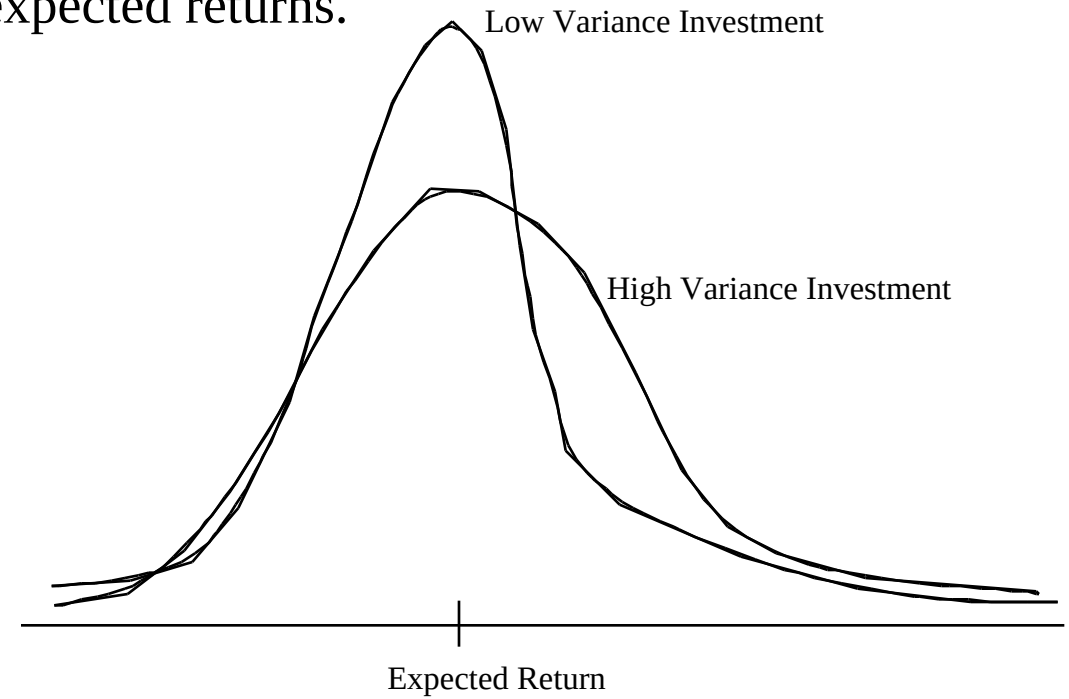
The Capital Asset Pricing Model

- Uses variance as a measure of risk
- Specifies that a portion of variance can be diversified away, and that is only the non-diversifiable portion that is rewarded.
- Measures the non-diversifiable risk with beta, which is standardized around one.
- Translates beta into expected return -

  Expected Return = Riskfree rate + Beta * Risk Premium
- Works as well as the next best alternative in most cases.

The Mean-Variance Framework

- The variance on any investment measures the disparity between actual and expected returns.



The Importance of Diversification: Risk Types

- The risk (variance) on any individual investment can be broken down into two sources. Some of the risk is specific to the firm, and is called firm-specific, whereas the rest of the risk is market wide and affects all investments.
- The risk faced by a firm can be fall into the following categories –
  - (1) Project-specific; an individual project may have higher or lower cash flows than expected.
  - (2) Competitive Risk, which is that the earnings and cash flows on a project can be affected by the actions of competitors.
  - (3) Industry-specific Risk, which covers factors that primarily impact the earnings and cash flows of a specific industry.
  - (4) International Risk, arising from having some cash flows in currencies other than the one in which the earnings are measured and stock is priced
  - (5) Market risk, which reflects the effect on earnings and cash flows of macro economic factors that essentially affect all companies

The Effects of Diversification

- Firm-specific risk can be reduced, if not eliminated, by increasing the number of investments in your portfolio (i.e., by being diversified). Market-wide risk cannot. This can be justified on either economic or statistical grounds.
- On economic grounds, diversifying and holding a larger portfolio eliminates firm-specific risk for two reasons-
  - (a) Each investment is a much smaller percentage of the portfolio, muting the effect (positive or negative) on the overall portfolio.
  - (b) Firm-specific actions can be either positive or negative. In a large portfolio, it is argued, these effects will average out to zero. (For every firm, where something bad happens, there will be some other firm, where something good happens.)

The Role of the Marginal Investor

- The marginal investor in a firm is the investor who is most likely to be the buyer or seller on the next trade.
- Since trading is required, the largest investor may not be the marginal investor, especially if he or she is a founder/manager of the firm (Michael Dell at Dell Computers or Bill Gates at Microsoft)
- In all risk and return models in finance, we assume that the marginal investor is well diversified.

The Market Portfolio

- Assuming diversification costs nothing (in terms of transactions costs), and that all assets can be traded, the limit of diversification is to hold a portfolio of every single asset in the economy (in proportion to market value). This portfolio is called the market portfolio.
- Individual investors will adjust for risk, by adjusting their allocations to this market portfolio and a riskless asset (such as a T-Bill)

Preferred risk level	*Allocation decision*
No risk	100% in T-Bills
Some risk	50% in T-Bills; 50% in Market Portfolio;
A little more risk	25% in T-Bills; 75% in Market Portfolio
Even more risk	100% in Market Portfolio
A risk hog..	Borrow money; Invest in market portfolio;

- Every investor holds some combination of the risk free asset and the market portfolio.

The Risk of an Individual Asset

- The risk of any asset is the risk that it adds to the market portfolio
- Statistically, this risk can be measured by how much an asset moves with the market (called the covariance)
- Beta is a standardized measure of this covariance
- Beta is a measure of the non-diversifiable risk for any asset can be measured by the covariance of its returns with returns on a market index, which is defined to be the asset's beta.
- The cost of equity will be the required return,

$$\text{Cost of Equity} = R_f + \text{Equity Beta} * (E(R_m) - R_f)$$

where,

R_f = Riskfree rate

$E(R_m)$ = Expected Return on the Market Index

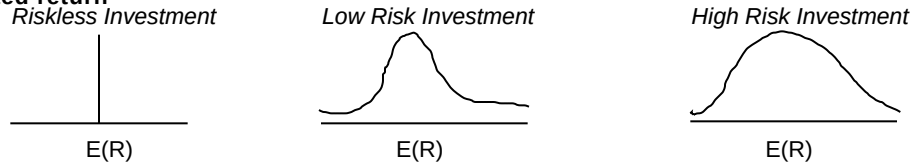
Limitations of the CAPM

- 1. The model makes unrealistic assumptions
- 2. The parameters of the model cannot be estimated precisely
  - - Definition of a market index
  - - Firm may have changed during the 'estimation' period'
- 3. The model does not work well
  - - If the model is right, there should be
    - a linear relationship between returns and betas
    - the only variable that should explain returns is betas
  - - The reality is that
    - the relationship between betas and returns is weak
    - Other variables (size, price/book value) seem to explain differences in returns better.

Alternatives to the CAPM

Step 1: Defining Risk

The risk in an investment can be measured by the variance in actual returns around an expected return



Step 2: Differentiating between Rewarded and Unrewarded Risk

Risk that is specific to investment (Firm Specific)
Can be diversified away in a diversified portfolio
1. each investment is a small proportion of portfolio
2. risk averages out across investments in portfolio

Risk that affects all investments (Market Risk)
Cannot be diversified away since most assets are affected by it.

The marginal investor is assumed to hold a "diversified" portfolio. Thus, only market risk will be rewarded and priced.

Step 3: Measuring Market Risk

The CAPM	**The APM**	**Multi-Factor Models**	**Proxy Models**
If there is 1. no private information 2. no transactions cost the optimal diversified portfolio includes every traded asset. Everyone will hold this market portfolio **Market Risk = Risk added by any investment to the market portfolio:**	If there are no arbitrage opportunities then the market risk of any asset must be captured by betas relative to factors that affect all investments. **Market Risk = Risk exposures of any asset to market factors**	Since market risk affects most or all investments, it must come from macro economic factors. **Market Risk = Risk exposures of any asset to macro economic factors.**	In an efficient market, differences in returns across long periods mus be due to market risk differences. Looking for variables correlated with returns should then give us proxies for this risk. **Market Risk = Captured by the Proxy Variable(s)**
Beta of asset relative to Market portfolio (from a regression)	Betas of asset relative to unspecified market factors (from a factor analysis)	Betas of assets relative to specified macro economic factors (from a regression)	Equation relating returns to proxy variables (from a regression)

⌛Application Test: Who is the marginal investor in your firm?

- Looking at the top 15 stockholders in your firm again, consider whether the marginal investor is
  - An institutional investor
  - An individual investor
  - The manager(s) of the firm

Inputs required to use the CAPM -

(a) the current risk-free rate

(b) the expected market risk premium (the premium expected for investing in risky assets over the riskless asset)

(c) the beta of the asset being analyzed.

The Riskfree Rate and Time Horizon

- On a riskfree asset, the actual return is equal to the expected return.
- Therefore, there is no variance around the expected return.
- For an investment to be riskfree, i.e., to have an actual return be equal to the expected return, two conditions have to be met –
  - There has to be no default risk, which generally implies that the security has to be issued by the government. Note, however, that not all governments can be viewed as default free.
  - There can be no uncertainty about reinvestment rates, which implies that it is a zero coupon security with the same maturity as the cash flow being analyzed.

Riskfree Rate in Practice

- The riskfree rate is the rate on a zero coupon government bond matching the time horizon of the cash flow being analyzed.
- Theoretically, this translates into using different riskfree rates for each cash flow - the 1 year zero coupon rate for the cash flow in year 2, the 2-year zero coupon rate for the cash flow in year 2 ...
- Practically speaking, if there is substantial uncertainty about expected cash flows, the present value effect of using time varying riskfree rates is small enough that it may not be worth it.

The Bottom Line on Riskfree Rates

- Using a long term government rate (even on a coupon bond) as the riskfree rate on all of the cash flows in a long term analysis will yield a close approximation of the true value.
- For short term analysis, it is entirely appropriate to use a short term government security rate as the riskfree rate.
- If the analysis is being done in real terms (rather than nominal terms) use a real riskfree rate, which can be obtained in one of two ways –
  - from an inflation-indexed government bond, if one exists
  - set equal, approximately, to the long term real growth rate of the economy in which the valuation is being done.

Measurement of the risk premium

- The risk premium is the premium that investors demand for investing in an average risk investment, relative to the riskfree rate.
- As a general proposition, this premium should be
  - greater than zero
  - increase with the risk aversion of the investors in that market
  - increase with the riskiness of the “average” risk investment

What is your risk premium?

- Assume that stocks are the only risky assets and that you are offered two investment options:
  - a riskless investment (say a Government Security), on which you can make 6.7%
  - a mutual fund of all stocks, on which the returns are uncertain

How much of an expected return would you demand to shift your money from the riskless asset to the mutual fund?

- Less than 6.7%
- Between 6.7 - 7.8%
- Between 8.7 - 10.7%
- Between 10.7 - 12.7%
- Between 12.7 - 14.7%
- More than 14.7%

Risk Aversion and Risk Premiums

- If this were the capital market line, the risk premium would be a weighted average of the risk premiums demanded by each and every investor.
- The weights will be determined by the magnitude of wealth that each investor has. Thus, Warren Bufffet's risk aversion counts more towards determining the "equilibrium" premium than yours' and mine.
- As investors become more risk averse, you would expect the "equilibrium" premium to increase.

Risk Premiums do change..

Go back to the previous example. Assume now that you are making the same choice but that you are making it in the aftermath of a stock market crash (it has dropped 25% in the last month). Would you change your answer?

- I would demand a larger premium
- I would demand a smaller premium
- I would demand the same premium

Estimating Risk Premiums in Practice

- Survey investors on their desired risk premiums and use the average premium from these surveys.
- Assume that the actual premium delivered over long time periods is equal to the expected premium - i.e., use historical data
- Estimate the implied premium in today's asset prices.

The Survey Approach

- Surveying all investors in a market place is impractical.
- However, you can survey a few investors (especially the larger investors) and use these results. In practice, this translates into surveys of money managers' expectations of expected returns on stocks over the next year.
- The limitations of this approach are:
  - there are no constraints on reasonability (the survey could produce negative risk premiums or risk premiums of 50%)
  - they are extremely volatile
  - they tend to be short term; even the longest surveys do not go beyond one year

The Historical Premium Approach

- This is the default approach used by most to arrive at the premium to use in the model
- In most cases, this approach does the following
  - it defines a time period for the estimation (1926-Present, 1962-Present....)
  - it calculates average returns on a stock index during the period
    - it calculates average returns on a riskless security over the period
      - it calculates the difference between the two
      - and uses it as a premium looking forward
- The limitations of this approach are:
  - it assumes that the risk aversion of investors has not changed in a systematic way across time. (The risk aversion may change from year to year, but it reverts back to historical averages)
  - it assumes that the riskiness of the "risky" portfolio (stock index) has not changed in a systematic way across time.

Historical Average Premiums for the United States

Historical period	Stocks - T.Bills		Stocks - T.Bonds	
	Arith	Geom	Arith	Geom
1926-1999	9.41%	8.14%	7.64%	6.60%
1962-1999	7.07%	6.46%	5.96%	5.74%
1981-1999	13.24%	11.62%	16.08%	14.17%

What is the right historical premium?

- Go back as far as you can. Otherwise, the standard error in the estimate will be large. The standard error in the risk premium estimate is roughly equal to
  - Standard Error in Risk premium = Annual Standard deviation in Stock prices / Square root of the number of years of historical data
  - With an annual standard deviation in stock prices of 24% and 25 years of data, for instance, the standard error would be

    Standard Error of Estimate = 24%/ √25 = 4.8%
- Be consistent in your use of a riskfree rate. If you use the T.Bill(T.Bond) rate, use the spread over the T.Bill (T.Bond) rate.
- Use arithmetic premiums for one-year estimates of costs of equity and geometric premiums for estimates of long term costs of equity.

What about historical premiums for other markets?

- Historical data for markets outside the United States tends to be sketch and unreliable.
- Ibbotson, for instance, estimates the following premiums for major markets from 1970-1996

Country	*Annual Return on*	*Annual Return on*	*Equity Risk Premium*
Australia	8.47%	6.99%	1.48%
France	11.51%	9.17%	2.34%
Germany	11.30%	12.10%	-0.80%
Italy	5.49%	7.84%	-2.35%
Japan	15.73%	12.69%	3.04%
Mexico	11.88%	10.71%	1.17%
Singapore	15.48%	6.45%	9.03%
Spain	8.22%	7.91%	0.31%
Switzerland	13.49%	10.11%	3.38%
UK	12.42%	7.81%	4.61%

Assessing Country Risk Using Currency Ratings: Latin America - June 1999

Country	*Rating*	*Default Spread over US T.Bond*
Argentina	Ba3	525
Bolivia	B1	600
Brazil	B2	750
Chile	Baa1	150
Colombia	Baa3	200
Ecuador	B3	850
Paraguay	B2	750
Peru	Ba3	525
Uruguay	Baa3	200
Venezuela	B2	750

Using Country Ratings to Estimate Equity Spreads

- The simplest way of estimating a country risk premium for another country is to add the default spread for that country to the US risk premium (treating the US premium as the premium for a mature equity market). Thus, the risk premium for Argentina would be:

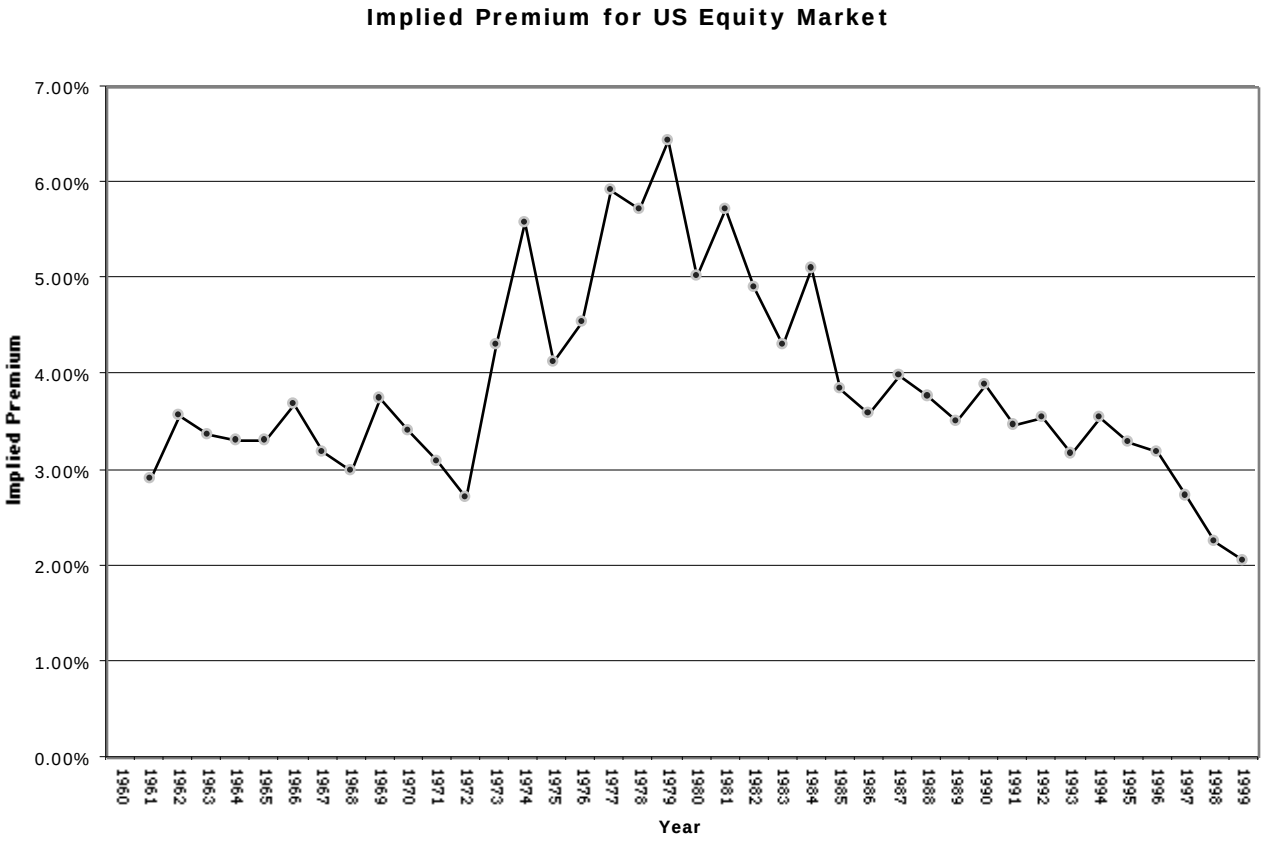
  Risk Premium = U.S. premium + 5.25%

- Country ratings measure default risk. While default risk premiums and equity risk premiums are highly correlated, one would expect equity spreads to be higher than debt spreads.
  - One way to estimate it is to multiply the bond spread by the relative volatility of stock and bond prices in that market. For example,
    - Standard Deviation in Merval (Equity) = 42.87%
    - Standard Deviation in Argentine Long Bond = 21.37%
    - Adjusted Equity Spread = 5.25% (42.87/21.37) = 10.53%

Implied Equity Premiums

- If we use a basic discounted cash flow model, we can estimate the implied risk premium from the current level of stock prices.
- For instance, if stock prices are determined by the simple Gordon Growth Model:
  - Value = Expected Dividends next year/ (Required Returns on Stocks - Expected Growth Rate)
  - Plugging in the current level of the index, the dividends on the index and expected growth rate will yield a “implied” expected return on stocks. Subtracting out the riskfree rate will yield the implied premium.
- The problems with this approach are:
  - the discounted cash flow model used to value the stock index has to be the right one.
  - the inputs on dividends and expected growth have to be correct
  - it implicitly assumes that the market is currently correctly valued

Implied Premiums in the US



Application Test: A Market Risk Premium

- Based upon our discussion of historical risk premiums so far, the risk premium looking forward should be:
- About 10%, which is what the arithmetic average premium has been since 1981, for stocks over T.Bills
- About 6%, which is the geometric average premum since 1926, for stocks over T.Bonds
- About 2%, which is the implied premium in the stock market today

In Summary...

- The historical risk premium is 6.6%, if we use a geometric risk premium, and much higher, if we use arithmetic averages.
- The implied risk premium is much lower. Even if we use liberal estimates of cashflows (dividends +stock buybacks) and high expected growth rates, the implied premium is about 4% and probably lower.
- We will use a risk premium of 5.5%, because
  - The historical risk premium is much too high to use in a market, where equities are priced with with premiums of 4% or lower.
  - The implied premium might be too low, especially if we believe that markets can become overvalued.

Estimating Beta

- The standard procedure for estimating betas is to regress stock returns (R_j) against market returns (R_m) -

$$R_j = a + b\ R_m$$

  - where a is the intercept and b is the slope of the regression.
- The slope of the regression corresponds to the beta of the stock, and measures the riskiness of the stock.

Estimating Performance

- The intercept of the regression provides a simple measure of performance during the period of the regression, relative to the capital asset pricing model.

$R_j = R_f + b (R_m - R_f)$

$= R_f (1-b) + b R_m$ ..... Capital Asset Pricing Model

$R_j = a + b R_m$ ..... Regression Equation

- If

$a > R_f (1-b)$ .... Stock did better than expected during regression period

$a = R_f (1-b)$ .... Stock did as well as expected during regression period

$a < R_f (1-b)$ .... Stock did worse than expected during regression period

- This is Jensen's alpha.

Firm Specific and Market Risk

- The R squared (R^2) of the regression provides an estimate of the proportion of the risk (variance) of a firm that can be attributed to market risk;
- The balance ($1 - R^2$) can be attributed to firm specific risk.

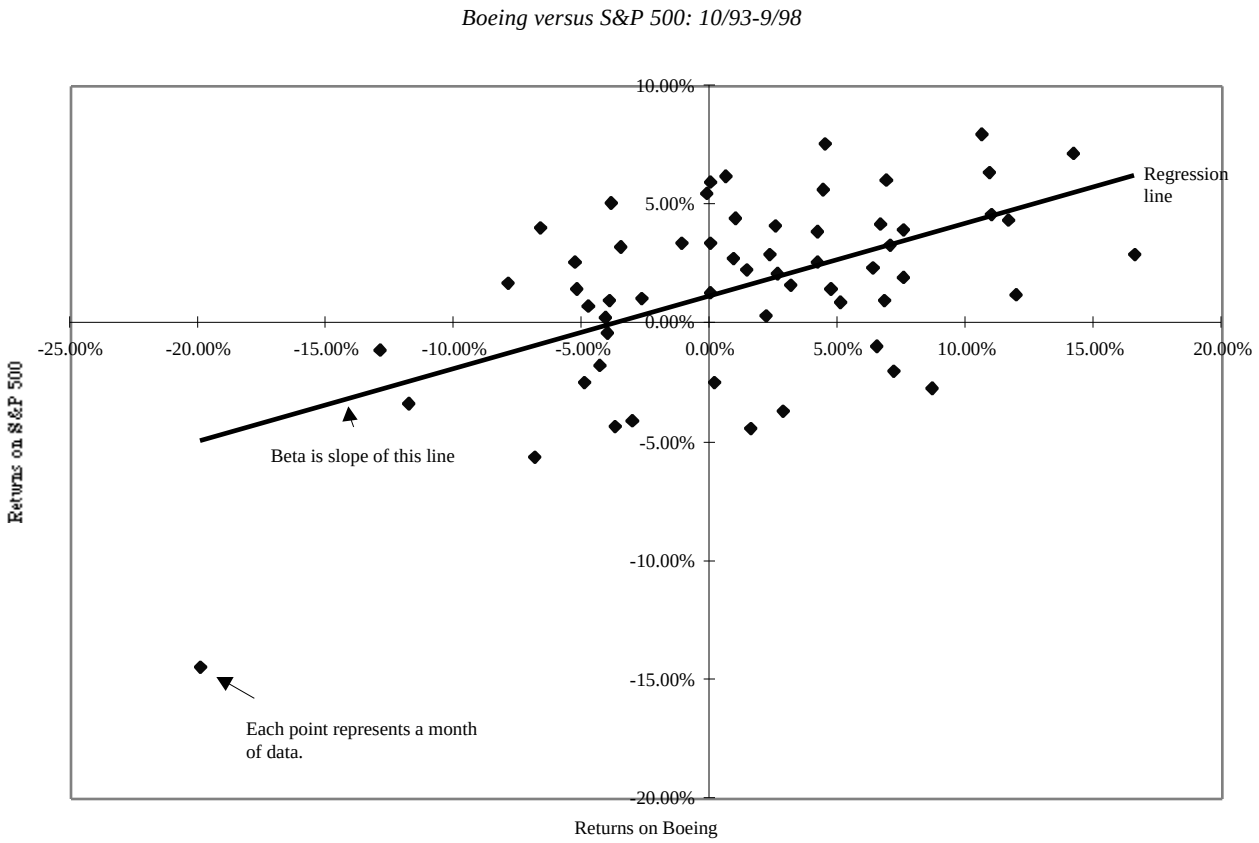
Setting up for the Estimation

- Decide on an estimation period
  - Services use periods ranging from 2 to 5 years for the regression
  - Longer estimation period provides more data, but firms change.
  - Shorter periods can be affected more easily by significant firm-specific event that occurred during the period (Example: ITT for 1995-1997)
- Decide on a return interval - daily, weekly, monthly
  - Shorter intervals yield more observations, but suffer from more noise.
  - Noise is created by stocks not trading and biases all betas towards one.
- Estimate returns (including dividends) on stock
  - Return = $(\text{Price}_{\text{End}} - \text{Price}_{\text{Beginning}} + \text{Dividends}_{\text{Period}})/ \text{Price}_{\text{Beginning}}$
  - Included dividends only in ex-dividend month
- Choose a market index, and estimate returns (inclusive of dividends) on the index for each interval for the period.

Choosing the Parameters: Boeing

- Period used: 5 years
- Return Interval = Monthly
- Market Index: S&P 500 Index.
- For instance, to calculate returns on Boeing in May 1995,
  - Price for Boeing at end of April= $ 27.50
  - Price for Boeing at end of May = $ 29.44
  - Dividends during month = $0.125 (It was an ex-dividend month)
  - Return =($29.44 - $ 27.50 + $ 0.125)/$ 27.50= 7.50%
- To estimate returns on the index in the same month
  - Index level (including dividends) at end of April = 514.7
  - Index level (including dividends) at end of May = 533.4
  - Dividends on the Index in May = 1.84
  - Return =(533.4-514.7+1.84)/ 514.7 = 3.99%

Boeing's Historical Beta



The Regression Output

- $\text{Returns}_{\text{Boeing}} = -0.09\% + 0.96\ \text{Returns}_{\text{S \& P 500}}$ (R squared=29.57%)
  (0.20)
- Intercept = -0.09%
- Slope = 0.96

Analyzing Boeing's Performance

- Intercept = -0.09%
- This is an intercept based on monthly returns. Thus, it has to be compared to a monthly riskfree rate.
- Between 1993 and 1998,
  - Monthly Riskfree Rate = 0.4% (Annual T.Bill rate divided by 12)
  - Riskfree Rate (1-Beta) = 0.4% (1-0.96) = .01%
- The Comparison is then between

Intercept	versus	Riskfree Rate (1 - Beta)
-0.09%	versus	0.4%(1-0.96)= 0.01%

- Jensen's Alpha = -0.09% -(0.01%) = -0.10%
- Boeing did 0.1% worse than expected, per month, between 1993 and 1998.
- Annualized, Boeing's annual excess return = (1-.0001)^12-1= -1.22%

More on Jensen's Alpha

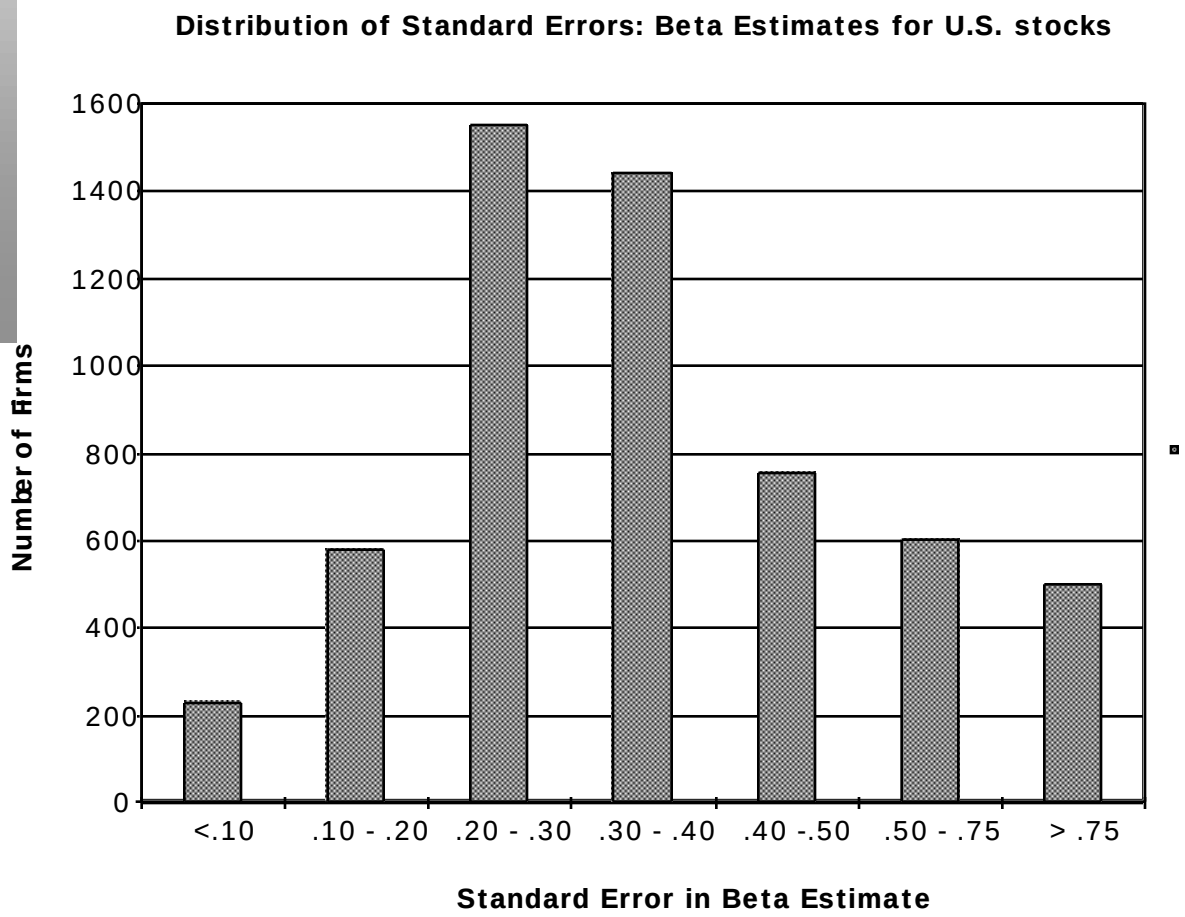
If you did this analysis on every stock listed on an exchange, what would the average Jensen's alpha be across all stocks?

- Depend upon whether the market went up or down during the period
- Should be zero
- Should be greater than zero, because stocks tend to go up more often than down

Estimating Boeing's Beta

- Slope of the Regression of 0.96 is the beta
- Regression parameters are always estimated with noise. The noise is captured in the standard error of the beta estimate, which in the case of Boeing is 0.20.
- Assume that I asked you what Boeing's true beta is, after this regression.
  - What is your best point estimate?
  - What range would you give me, with 67% confidence?
  - What range would you give me, with 95% confidence?

The Dirty Secret of "Standard Error"



Breaking down Boeing's Risk

- R Squared = 29.57%
- This implies that
  - 29.57% of the risk at Boeing comes from market sources
  - 70.43%, therefore, comes from firm-specific sources
- The firm-specific risk is diversifiable and will not be rewarded

The Relevance of R Squared

You are a diversified investor trying to decide whether you should invest in Boeing or Amgen. They both have betas of 0.96, but Boeing has an R Squared of 30% while Amgen's R squared of only 15%. Which one would you invest in?

- Amgen, because it has the lower R squared
- Boeing, because it has the higher R squared
- You would be indifferent

Would your answer be different if you were an undiversified investor?

Beta Estimation in Practice: Bloomberg

HISTORICAL BETA

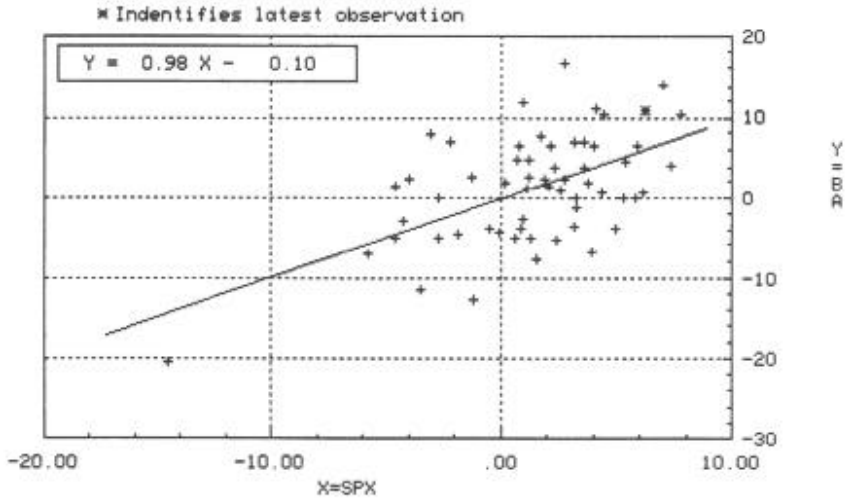
Number of points may be insufficient for an accurate beta.

BA **US** BOEING CO

Relative Index SPX S&P 500 INDEX

Period M
Range 10/29/93 To 9/30/98
Market U Trade

ADJ BETA	.98
RAW BETA	.98
Alpha (Intercept)	-.10
R2 (Correlation)	.31
Std Dev of Error	5.75
Std Error of Beta	.19
Number of Points	59



Adj beta = (0.67) * Raw Beta
+ (0.33) * 1.0

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Estimating Expected Returns: December 31, 1998

- Boeing's Beta = 0.96
- Riskfree Rate = 5.00% (Long term Government Bond rate)
- Risk Premium = 5.50% (Approximate historical premium)
- Expected Return = 5.00% + 0.96 (5.50%) = 10.31%

Use to a Potential Investor in Boeing

As a potential investor in Boeing, what does this expected return of 10.31% tell you?

- This is the return that I can expect to make in the long term on Boeing, 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 Boeing 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 Boeing will yield 25% a year for the next 5 years. Based upon the expected return of 10.31%, you would

- Buy the stock
- Sell the stock

How managers use this expected return

- Managers at Boeing
  - need to make at least 10.31% 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, Boeing's cost of equity is 10.31%.
- What is the cost of not delivering this cost of equity?

Application Test: Analyzing the Risk Regression

- Using your Bloomberg risk and return print out, answer the following questions:
  - How well or badly did your stock do, relative to the market, during the period of the regression? (You can assume an annualized riskfree rate of 4.8% during the regression period)
  - What proportion of the risk in your stock is attributable to the market? What proportion is firm-specific?
  - What is the historical estimate of beta for your stock? What is the range on this estimate with 67% probability? With 95% probability?
  - Based upon this beta, what is your estimate of the required return on this stock?

A Quick Test

You are advising a very risky software firm on the right cost of equity to use in project analysis. You estimate a beta of 2.0 for the firm and come up with a cost of equity of 18%. The CFO of the firm is concerned about the high cost of equity and wants to know whether there is anything he can do to lower his beta.

How do you bring your beta down?

Should you focus your attention on bringing your beta down?

- Yes
- No

Beta Estimation and Index Choice

HISTORICAL BETA

Number of points may be insufficient for an accurate beta.

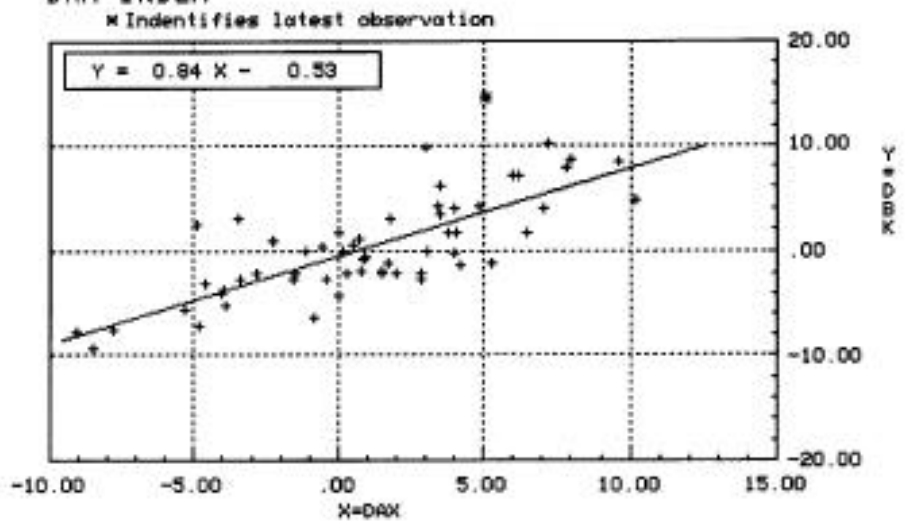
DBK **GR** DEUTSCHE BANK AG

Market DAX

DAX INDEX

Period M (D-W-M-Q-Y)
Range 1/31/92 To 1/31/97
1 (T=Trade,F=Fixing)

ADJ BETA	.90
RAW BETA	.84
Alpha (Intercept)	-.53
R2 (Correlation)	.57
Std Dev of Error	3.22
Std Error of Beta	.10
Number of Points	60



Adj beta = (0.67) * Raw Beta
+ (0.33) * 1.0

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A Few Questions

- The R squared for Deutsche Bank is very high (57%), at least relative to U.S. firms. Why is that?
- The beta for Deutsche Bank is 0.84.
  - Is this an appropriate measure of risk?
  - If not, why not?
- If you were an investor in primarily U.S. stocks, would this be an appropriate measure of risk?

Deutsche Bank: To a U.S. Investor?

HISTORICAL BETA

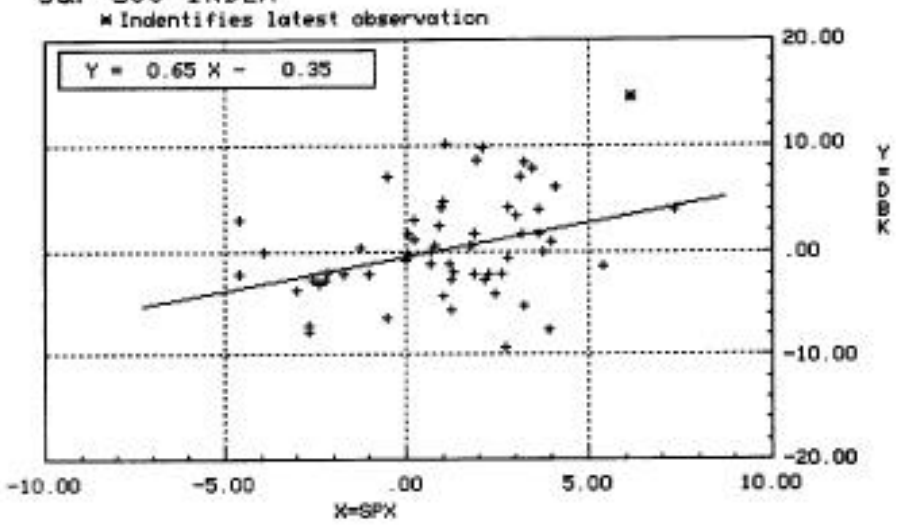
Number of points may be insufficient for an accurate beta.

DBK **GR** DEUTSCHE BANK AG

Market SPX S&P 500 INDEX

Period M (D-W-M-Q-Y)
Range 1/31/92 To 1/31/97
T (T=Trade, F=Fixing)

ADJ BETA	.77
RAW BETA	.65
Alpha (Intercept)	-.35
R2 (Correlation)	.12
Std Dev of Error	4.62
Std Error of Beta	.23
Number of Points	60



Adj beta = (0.67) * Raw Beta
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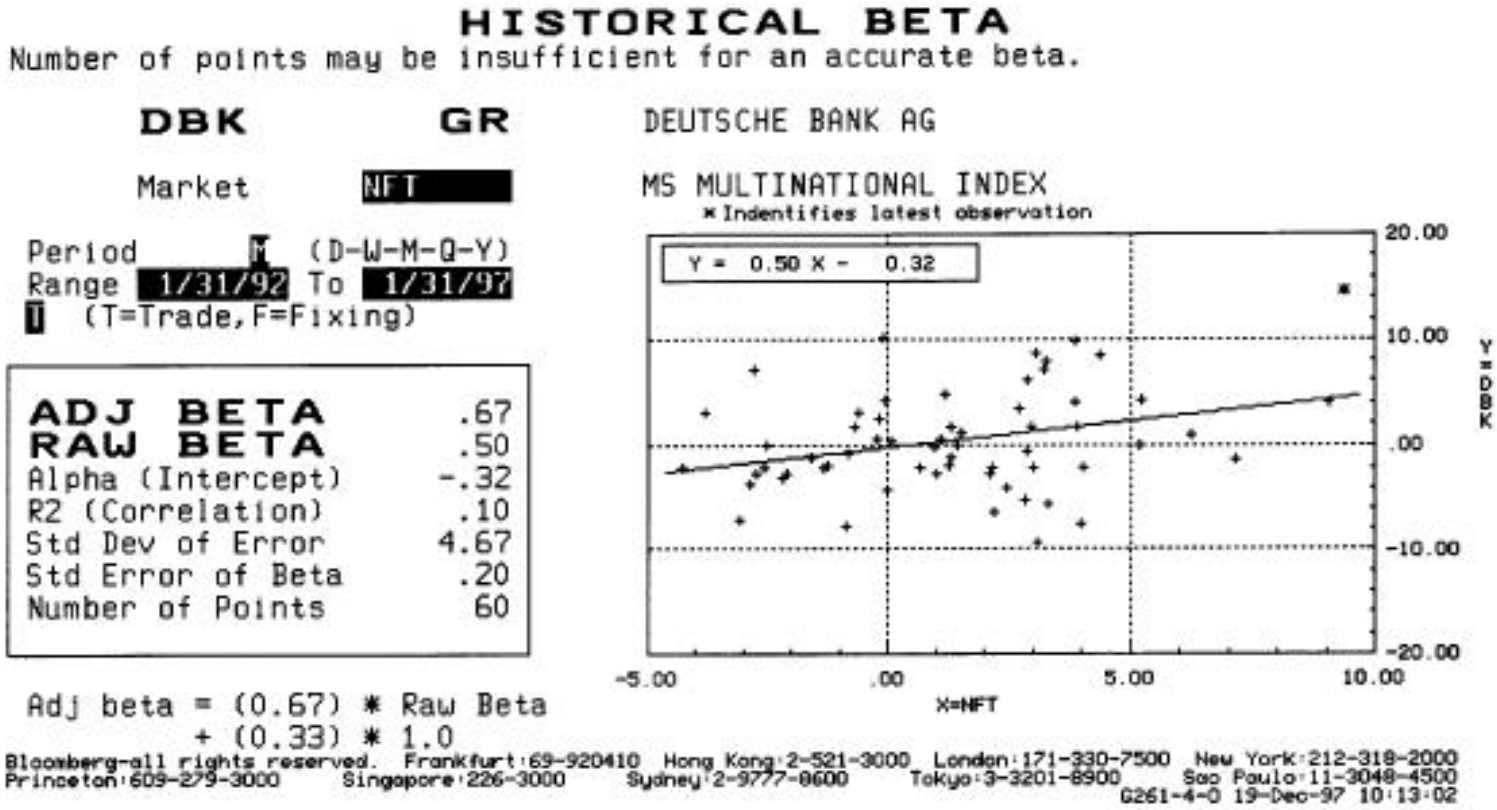
Deutsche Bank: To a Global Investor



Beta Estimation With an Index Problem

- **The Local Solution**: Estimate the beta relative to a local index, that is equally weighted or more diverse than the one in use.
- **The U.S. Solution**: If the stock has an ADR listed on the U.S. exchanges, estimate the beta relative to the S&P 500.
- **The Global Solution**: Use a global index to estimate the beta
- An Alternative Solution: Do not use a regression to estimate the firm's beta.

Fundamental Determinants of Betas

- **Type of Business**: Firms in more cyclical businesses or that sell products that are more discretionary to their customers will have higher betas than firms that are in non-cyclical businesses or sell products that are necessities or staples.
- **Operating Leverage**: Firms with greater fixed costs (as a proportion of total costs) will have higher betas than firms will lower fixed costs (as a proportion of total costs)
- **Financial Leverage**: Firms that borrow more (higher debt, relative to equity) will have higher equity betas than firms that borrow less.

Determinant 1: Product Type

- **Industry Effects**: The beta value for a firm depends upon the sensitivity of the demand for its products and services and of its costs to macroeconomic factors that affect the overall market.
  - Cyclical companies have higher betas than non-cyclical firms
  - Firms which sell more discretionary products will have higher betas than firms that sell less discretionary products

A Simple Test

Consider an investment in Tiffany's. What kind of beta do you think this investment will have?

- Much higher than one
- Close to one
- Much lower than one

Determinant 2: Operating Leverage Effects

- Operating leverage refers to the proportion of the total costs of the firm that are fixed.
- Other things remaining equal, higher operating leverage results in greater earnings variability which in turn results in higher betas.

Measures of Operating Leverage

Fixed Costs Measure = Fixed Costs / Variable Costs

- This measures the relationship between fixed and variable costs. The higher the proportion, the higher the operating leverage.

EBIT Variability Measure = % Change in EBIT / % Change in Revenues

- This measures how quickly the earnings before interest and taxes changes as revenue changes. The higher this number, the greater the operating leverage.

A Look at The Home Depot's Operating Leverage

Year	Net Sales	% Change in Sales	EBIT	% Change in EBIT
1988	$ 1,454		$ 98	
1989	$ 2,000	37.55%	$ 127	29.59%
1990	$ 2,759	37.95%	$ 185	45.67%
1991	$ 3,815	38.27%	$ 265	43.24%
1992	$ 5,137	34.65%	$ 382	44.15%
1993	$ 7,148	39.15%	$ 549	43.72%
1994	$ 9,239	29.25%	$ 744	35.52%
1995	$ 12,477	35.05%	$ 1,039	39.65%
1996	$ 15,470	23.99%	$ 1,232	18.58%
1997	$ 19,536	26.28%	$ 1,534	24.51%
1998	$ 24,156	23.65%	$ 1,914	24.77%
Average (87-96)		32.58%		34.94%

Reading The Home Depot's Operating Leverage

- Operating Leverage = % Change in EBIT/ % Change in Sales
  = 34.94%/ 32.58% = 1.07
- This is similar to the operating leverage for other retail firms, which we computed to be 1.05. This would suggest that The Home Depot has a similar cost structure to its competitors.

A Test

Assume that you are comparing a European automobile manufacturing firm with a U.S. automobile firm. European firms are generally much more constrained in terms of laying off employees, if they get into financial trouble. What implications does this have for betas, if they are estimated relative to a common index?

- ❒ European firms will have much higher betas than U.S. firms
- ❒ European firms will have similar betas to U.S. firms
- ❒ European firms will have much lower betas than U.S. firms

Determinant 3: Financial Leverage

- As firms borrow, they create fixed costs (interest payments) that make their earnings to equity investors more volatile.
- This increased earnings volatility which increases the equity beta

Equity Betas and Leverage

- The beta of equity alone 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

- The unlevered beta measures the riskiness of the business that a firm is in and is often called an **asset beta**.

Effects of leverage on betas: Boeing

- The regression beta for Boeing is 0.96. This beta is a levered beta (because it is based on stock prices, which reflect leverage) and the leverage implicit in the beta estimate is the average market debt equity ratio during the period of the regression (1993 to 1998)
- The average debt equity ratio during this period was 17.88%.
- The unlevered beta for Boeing can then be estimated:(using a marginal tax rate of 35%)

  = Current Beta / (1 + (1 - tax rate) (Average Debt/Equity))

  = 0.96 / (1 + (1 - 0.35) (0.1788)) = 0.86

Boeing : Beta and Leverage

Debt to Capital	Debt/Equity Ratio	Beta	Effect of Leverage
0.00%	0.00%	0.86	0.00
10.00%	11.11%	0.92	0.06
20.00%	25.00%	1.00	0.14
30.00%	42.86%	1.10	0.24
40.00%	66.67%	1.23	0.37
50.00%	100.00%	1.42	0.56
60.00%	150.00%	1.70	0.84
70.00%	233.33%	2.16	1.30
80.00%	400.00%	3.10	2.24
90.00%	900.00%	5.89	5.03

Betas are weighted Averages

- The beta of a portfolio is always the market-value weighted average of the betas of the individual investments in that portfolio.
- Thus,
  - the beta of a mutual fund is the weighted average of the betas of the stocks and other investment in that portfolio
  - the beta of a firm after a merger is the market-value weighted average of the betas of the companies involved in the merger.

The Boeing/McDonnell Douglas Merger

Company	*Beta*	*Debt*	*Equity*	*Firm Value*
Boeing	0.95	$ 3,980	$ 32,438	$ 36,418
McDonnell Douglas	0.90	$ 2,143	$ 12,555	$ 14,698

Beta Estimation: Step 1

- Calculate the unlevered betas for both firms

  Boeing = 0.95/(1+0.65*(3980/32438)) = 0.88

  McDonnell Douglas = 0.90/(1+0.65*(2143/12555)) = 0.81

- Calculate the unlevered beta for the combined firm

  Unlevered Beta for combined firm

  = 0.88 (36,418/51,116) + 0.81 (14,698/51,116)

  = 0.86

Beta Estimation: Step 2

- Boeing's acquisition of McDonnell Douglas was accomplished by issuing new stock in Boeing to cover the value of McDonnell Douglas's equity of $12,555 million.

Debt = McDonnell Douglas Old Debt + Boeing's Old Debt

= $3,980 + $2,143 = $6,123 million

Equity = Boeing's Old Equity + New Equity used for Acquisition

= $ 32,438 + $ 12,555 = $44,993 million

D/E Ratio = $ 6,123/44,993 = 13.61%

New Beta = 0.86 (1 + 0.65 (.1361)) = 0.94

Firm Betas versus divisional Betas

- Firm Betas as weighted averages: The beta of a firm is the weighted average of the betas of its individual projects.
- At a broader level of aggregation, the beta of a firm is the weighted average of the betas of its individual division.

Bottom-up versus Top-down Beta

- The top-down beta for a firm comes from a regression
- The bottom up beta can be estimated by doing the following:
  - Find out the businesses that a firm operates in
  - Find the unlevered betas of other firms in these businesses
  - Take a weighted (by sales or operating income) average of these unlevered betas
  - Lever up using the firm's debt/equity ratio
- The bottom up beta will give you a better estimate of the true beta when
  - the standard error of the beta from the regression is high (and) the beta for a firm is very different from the average for the business
  - the firm has reorganized or restructured itself substantially during the period of the regression
  - when a firm is not traded

The Home Depot's Comparable Firms

Company Name	*Beta*	*Market Cap $ (Mil)*	*Debt Due 1-Yr Out*	*Long-Term Debt*
Building Materials	1.05	$136	$1	$113
Catalina Lighting	1	$16	$7	$19
Cont'l Materials Corp	0.55	$32	$2	$7
Eagle Hardware	0.95	$612	$6	$146
Emco Limited	0.65	$187	$39	$119
Fastenal Co.	1.25	$1,157	$16	$ -
HomeBase Inc.	1.1	$227		$116
Hughes Supply	1	$610	$1	$335
Lowe's Cos.	1.2	$12,554	$111	$1,046
Waxman Industries	1.25	$18	$6	$121
Westburne Inc.	0.65	$607	$9	$34
Wolohan Lumber	0.55	$76	$2	$20
Sum		$16,232	$200	$2,076
Average	0.93			

Estimating The Home Depot's Bottom-up Beta

- Average Beta of comparable firms = 0.93
- D/E ratio of comparable firms = (200+2076)/16,232 = 14.01%
- Unlevered Beta for comparable firms = 0.93/(1+(1-.35)(.1401))
  = 0.86

Decomposing Boeing's Beta

Segment	*Revenues*	*Estimated Value*	$\beta_{unlevered}$	*Weight*	*Weighted* β
Commercial Aircraft	$ 26,929	$ 30,160	0.91	70.39%	0.6405
ISDS	$ 18,125	$ 12,688	0.80	29.61%	0.2369
Firm		$ 42,848		100.00%	0.88

- The values were estimated based upon the revenues in each business and the typical multiple of revenues that other firms in that business trade for.
- The unlevered betas for each business were estimated by looking at other publicly traded firms in each business, averaging across the betas estimated for these firms, and then unlevering the beta using the average debt to equity ratio for firms in that business.

  Unlevered Beta = Average Beta / (1 + (1-tax rate) (Average D/E))
- Using Boeing's current market debt to equity ratio of 25%

  Boeing's Beta = = 0.88 (1+(1-.35)(.25)) = 1.014

Discussion Issue

- If you were the chief financial officer of Boeing, what cost of equity would you use in capital budgeting in the different divisions?
  - The cost of equity for Boeing as a company
  - The cost of equity for each of Boeing's divisions?

Estimating Betas for Non-Traded Assets

- The conventional approaches of estimating betas from regressions do not work for assets that are not traded.
- There are two ways in which betas can be estimated for non-traded assets
  - using comparable firms
  - using accounting earnings

Beta for InfoSoft, a Private Software Firm

The following table summarizes the unlevered betas for publicly traded software firms.

Grouping	*Number of Firms*	*Beta*	*D/E Ratio*	*Unlevered Beta*
All Software	264	1.45	3.70%	1.42
Small-cap Software	125	1.54	10.12%	1.45
Entertainment Software	31	1.50	7.09%	1.43

- We will use the beta of entertainment software firms as the unlevered beta for InfoSoft.
- We will also assume that InfoSoft's D/E ratio will be similar to that of these publicly traded firms (D/E = 7.09%)
- Beta for InfoSoft = 1.43 (1 + (1-.42) (.0709)) = 1.49

(We used a tax rate of 42% for the private firm)

Using Accounting Earnings to Estimate Beta for InfoSoft

Period	InfoSoft	S&P 500	Period	InfoSoft	S&P 500
1992: Q1	7.50%	-1.30%	1995: Q2	24.10%	8.50%
1992: Q2	8.30%	2.20%	1995: Q3	17.50%	6.00%
1992: Q3	8.80%	2.50%	1995: Q4	16.00%	5.00%
1992: Q4	7.90%	3.00%	1996: Q1	27.00%	8.10%
1993: Q1	14.30%	3.60%	1996: Q2	21.30%	7.00%
1993: Q2	16.50%	5.10%	1996: Q3	22.50%	7.20%
1993: Q3	17.10%	5.50%	1996: Q4	20.00%	6.00%
1993: Q4	13.50%	6.20%	1997: Q1	17.10%	5.80%
1994: Q1	11.50%	4.30%	1997: Q2	22.20%	8.00%
1994: Q2	12.30%	4.70%	1997: Q3	17.80%	6.10%
1994: Q3	13.00%	4.50%	1997: Q4	14.50%	4.50%
1994: Q4	11.10%	4.20%	1998: Q1	8.50%	1.30%
1995: Q1	18.60%	7.10%	1998: Q2	3.50%	-0.50%

The Accounting Beta for InfoSoft

- Regressing the changes in profits at InfoSoft against changes in profits for the S&P 500 yields the following:

  InfoSoft Earnings Change = 0.05 + 2.15 (S & P 500 Earnings Change)
- Based upon this regression, the beta for InfoSoft's equity is 2.15.
- Using operating earnings for both the firm and the S&P 500 should yield the equivalent of an unlevered beta.

Is Beta an Adequate Measure of Risk for a Private Firm?

- The owners of most private firms are not diversified. Beta measures the risk added on to a diversified portfolio. Therefore, using beta to arrive at a cost of equity for a private firm will
  - Under estimate the cost of equity for the private firm
  - Over estimate the cost of equity for the private firm
  - Could under or over estimate the cost of equity for the private firm

Total Risk versus Market Risk

- Adjust the beta to reflect total risk rather than market risk. This adjustment is a relatively simple one, since the R squared of the regression measures the proportion of the risk that is market risk.

  Total Beta = Market Beta / √R squared

- In the InfoSoft example, where the market beta is 1.10 and the average R-squared of the comparable publicly traded firms is 16%,
  - Total Beta = 1.49/√0.16 = 3.725
  - Total Cost of Equity = 5% + 3.725 (5.5%)= 25.49%
- This cost of equity is much higher than the cost of equity based upon the market beta because the owners of the firm are not diversified.

Application Test: Estimating a Bottom-up Beta

- Based upon the business or businesses that your firm is in right now, and its current financial leverage, estimate the bottom-up unlevered beta for your firm.

From Cost of Equity to Cost of Capital

- The cost of capital is a composite cost to the firm of raising financing to fund its projects.
- In addition to equity, firms can raise capital from debt

What is debt?

- General Rule: Debt generally has the following characteristics:
  - Commitment to make fixed payments in the future
  - The fixed payments are tax deductible
  - Failure to make the payments can lead to either default or loss of control of the firm to the party to whom payments are due.
- As a consequence, debt should include
  - Any interest-bearing liability, whether short term or long term.
  - Any lease obligation, whether operating or capital.

Estimating the Cost of Debt

- If the firm has bonds outstanding, and the bonds are traded, the yield to maturity on a long-term, straight (no special features) bond can be used as the interest rate.
- If the firm is rated, use the rating and a typical default spread on bonds with that rating to estimate the cost of debt.
- If the firm is not rated,
  - and it has recently borrowed long term from a bank, use the interest rate on the borrowing or
  - estimate a synthetic rating for the company, and use the synthetic rating to arrive at a default spread and a cost of debt
- The cost of debt has to be estimated in the same currency as the cost of equity and the cash flows in the valuation.

Estimating Synthetic Ratings

- The rating for a firm can be estimated using the financial characteristics of the firm. In its simplest form, the rating can be estimated from the interest coverage ratio

  Interest Coverage Ratio = EBIT / Interest Expenses

- Consider InfoSoft, a firm with EBIT of $2000 million and interest expenses of $ 315 million

  Interest Coverage Ratio = 2,000/315= 6.15

  - Based upon the relationship between interest coverage ratios and ratings, we would estimate a rating of A for the firm.

Interest Coverage Ratios, Ratings and Default Spreads

Interest Coverage Ratio	*Rating*	*Default Spread*
> 12.5	AAA	0.20%
9.50 - 12.50	AA	0.50%
7.50 – 9.50	A+	0.80%
6.00 – 7.50	A	1.00%
4.50 – 6.00	A-	1.25%
3.50 – 4.50	BBB	1.50%
3.00 – 3.50	BB	2.00%
2.50 – 3.00	B+	2.50%
2.00 - 2.50	B	3.25%
1.50 – 2.00	B-	4.25%
1.25 – 1.50	CCC	5.00%
0.80 – 1.25	CC	6.00%
0.50 – 0.80	C	7.50%
< 0.65	D	10.00%

Costs of Debt for Boeing, the Home Depot and InfoSoft

	Boeing	*Home Depot*	*InfoSoft*
Bond Rating	AA	A+	A
Rating is	Actual	Actual	Synthetic
Default Spread over treasury	0.50%	0.80%	1.00%
Market Interest Rate	5.50%	5.80%	6.00%
Marginal tax rate	35%	35%	42%
Cost of Debt	3.58%	3.77%	3.48%

The treasury bond rate is 5%.

Application Test: Estimating a Cost of Debt

- Based upon your firm's current earnings before interest and taxes, its interest expenses, estimate
  - An interest coverage ratio for your firm
  - A synthetic rating for your firm (use the table from previous page)
  - A pre-tax cost of debt for your firm
  - An after-tax cost of debt for your firm

Estimating Market Value Weights

- Market Value of Equity should include the following
  - Market Value of Shares outstanding
  - Market Value of Warrants outstanding
  - Market Value of Conversion Option in Convertible Bonds
- Market Value of Debt is more difficult to estimate because few firms have only publicly traded debt. There are two solutions:
  - Assume book value of debt is equal to market value
  - Estimate the market value of debt from the book value
  - For Boeing, the book value of debt is $6,972 million, the interest expense on the debt is $ 453 million, the average maturity of the debt is 13.76 years and the pre-tax cost of debt is 5.50%.

$$\text{Estimated MV of Boeing Debt} = 453\left[\frac{\left(1-\frac{1}{(1.055)^{13.76}}\right)}{.055}\right] + \frac{6,972}{(1.055)^{13.76}} = \$7,631$$

Converting Operating Leases to Debt

- The “debt value” of operating leases is the present value of the lease payments, at a rate that reflects their risk.
- In general, this rate will be close to or equal to the rate at which the company can borrow.

Operating Leases at Boeing

- The pre-tax cost of debt at Boeing is 5.80%

Year	*Commitment*	*Present Value at 5.5%*
1	$ 205.00	$ 194.31
2	$ 167.00	$ 150.04
3	$ 120.00	$ 102.19
4	$ 86.00	$ 69.42
5	$ 61.00	$ 46.67
PV of Operating Leases =		$ 562.64

- Debt outstanding at Boeing = $ 7,631 + $ 563 = $ 8,194 mil

Application Test: Estimating Market Value

- Estimate the
  - Market value of equity at your firm and Book Value of equity
  - Market value of debt and book value of debt (If you cannot find the average maturity of your debt, use 3 years): Remember to capitalize the value of operating leases and add them on to both the book value and the market value of debt.
- Estimate the
  - Weights for equity and debt based upon market value
  - Weights for equity and debt based upon book value

Estimating Cost of Capital: Boeing

- Equity
  - Cost of Equity = 5% + 1.01 (5.5%) = 10.58%
  - Market Value of Equity = $32.60 Billion
  - Equity/(Debt+Equity) = 82%
- Debt
  - After-tax Cost of debt = 5.50% (1-.35) = 3.58%
  - Market Value of Debt = $ 8.2 Billion
  - Debt/(Debt +Equity) = 18%
- Cost of Capital = 10.58%(.80)+3.58%(.20) = 9.17%

Boeing's Divisional Costs of Capital

	Boeing	Aerospace	Defense
Cost of Equity	10.58%	10.77%	10.07%
Equity/(Debt + Equity)	79.91%	79.91%	79.91%
Cost of Debt	3.58%	3.58%	3.58%
Debt/(Debt + Equity)	20.09%	20.09%	20.09%
Cost of Capital	9.17%	9.32%	8.76%

Cost of Capital: InfoSoft and The Home Depot

	The Home Depot	*InfoSoft*
Cost of Equity	9.78%	13.19%
Equity/(Debt + Equity)	95.45%	93.38%
Cost of Debt	3.77%	3.48%
Debt/(Debt + Equity)	4.55%	6.62%
Cost of Capital	9.51%	12.55%

Application Test: Estimating Cost of Capital

- Using the bottom-up unlevered beta that you computed for your firm, and the values of debt and equity you have estimated for your firm, estimate a bottom-up levered beta and cost of equity for your firm.

- Based upon the costs of equity and debt that you have estimated, and the weights for each, estimate the cost of capital for your firm.

- How different would your cost of capital have been, if you used book value weights?

Current Practices: Costs of Capital

Cost of capital item	*Current Practices*
Cost of Equity	· 81% of firms used the capital asset pricing model to estimate the cost of equity, 4% used a modified capital asset pricing model and 15% were uncertain about how they estimated the cost of equtiy. · 70% of firms used 10-year treasuries or longer as the riskless rate, 7% used 3 to 5-year treasuries and 4% used the treasury bill rate. · 52% used a published source for a beta estimate, while 30% estimated it themselves. · There was wide variation in the market risk premium used, with 37% using a premium between 5 and 6%.
Cost of Debt	· 52% of firms used a marginal borrowing rate and a marginal tax rate, while 37% used the current average borrowing rate and the effective tax rate.
Weights for Debt and Equity	· 59% used market value weights for debt and equity in the cost of capital, 15% used book value weights and 19% were uncertain about what weights they used.

Choosing a Hurdle Rate

- Either the cost of equity or the cost of capital can be used as a hurdle rate, depending upon whether the returns measured are to equity investors or to all claimholders on the firm (capital)
- If returns are measured to equity investors, the appropriate hurdle rate is the cost of equity.
- If returns are measured to capital (or the firm), the appropriate hurdle rate is the cost of capital.

Back to First Principles

- Invest in projects that yield a return greater than the **minimum acceptable hurdle rate.**
  - **The hurdle rate should be higher for riskier projects and reflect the financing mix used - owners' funds (equity) or borrowed money (debt)**
  - Returns on projects should be measured based on cash flows generated and the timing of these cash flows; they should also consider both positive and negative side effects of these projects.
- Choose a financing mix that minimizes the hurdle rate and matches the assets being financed.
- If there are not enough investments that earn the hurdle rate, return the cash to stockholders.
  - The form of returns - dividends and stock buybacks - will depend upon the stockholders' characteristics.