Valuation

Aswath Damodaran
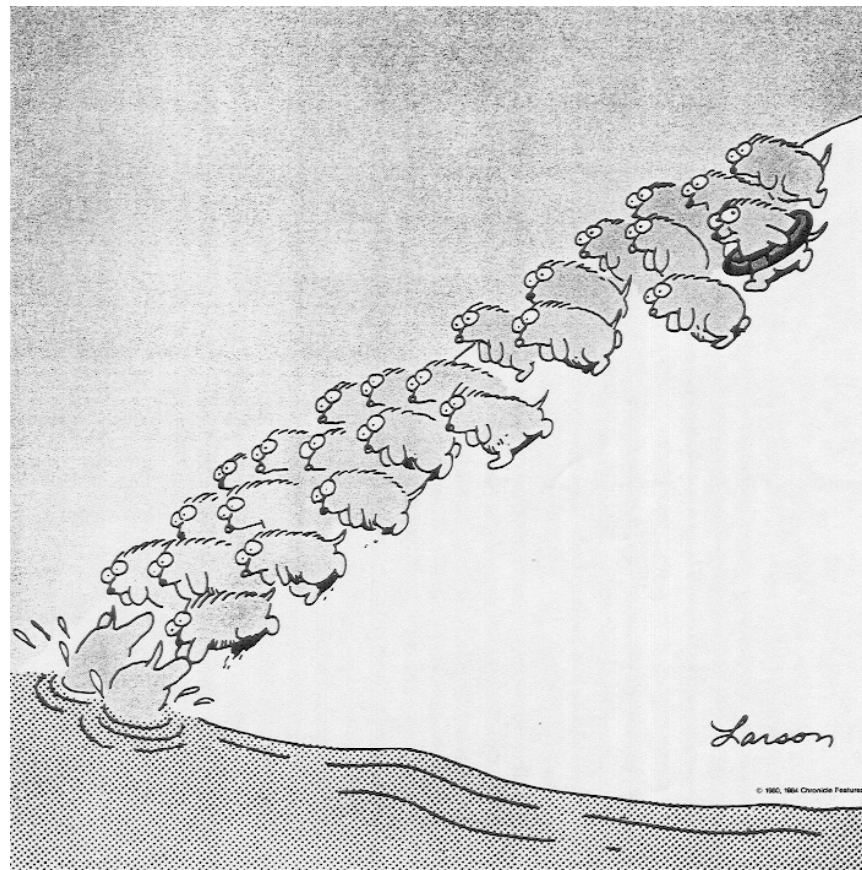
http://www.damodaran.com

Details on valuations in this presentation:
http://pages.stern.nyu.edu/~adamodar/New_Home_Page/country.htm

Some Initial Thoughts

" One hundred thousand lemmings cannot be wrong"

Graffiti

Misconceptions about Valuation

- Myth 1: A valuation is an objective search for "true" value
  - Truth 1.1: All valuations are biased. The only questions are how much and in which direction.
  - Truth 1.2: The direction and magnitude of the bias in your valuation is directly proportional to who pays you and how much you are paid.
- Myth 2.: A good valuation provides a precise estimate of value
  - Truth 2.1: There are no precise valuations
  - Truth 2.2: The payoff to valuation is greatest when valuation is least precise.
- Myth 3: . The more quantitative a model, the better the valuation
  - Truth 3.1: One's understanding of a valuation model is inversely proportional to the number of inputs required for the model.
  - Truth 3.2: Simpler valuation models do much better than complex ones.
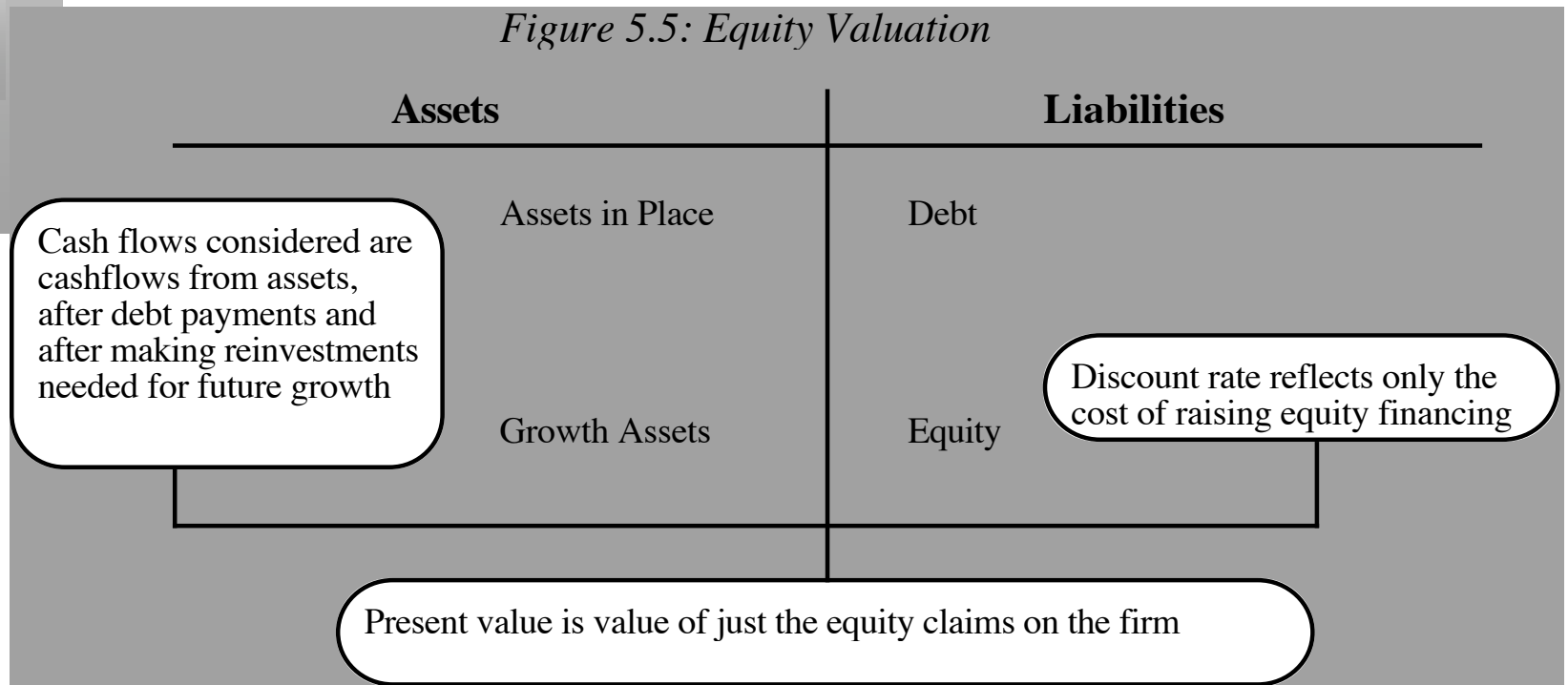
Approaches to Valuation

■ **Discounted cashflow valuation**, relates the value of an asset to the present value of expected future cashflows on that asset.

■ **Relative valuation**, estimates the value of an asset by looking at the pricing of 'comparable' assets relative to a common variable like earnings, cashflows, book value or sales.

■ **Contingent claim valuation**, uses option pricing models to measure the value of assets that share option characteristics.

Discounted Cash Flow Valuation

■ **What is it**: In discounted cash flow valuation, the value of an asset is the present value of the expected cash flows on the asset.

■ **Philosophical Basis**: Every asset has an intrinsic value that can be estimated, based upon its characteristics in terms of cash flows, growth and risk.

■ **Information Needed**: To use discounted cash flow valuation, you need

  • to estimate the <u>life of the asset</u>

  • to estimate the <u>cash flows</u> during the life of the asset

  • to estimate the <u>discount rate</u> to apply to these cash flows to get present value

■ **Market Inefficiency**: Markets are assumed to make <u>mistakes</u> in pricing assets <u>across time</u>, and are assumed to correct themselves over time, as new information comes out about assets.

Equity Valuation

Figure 5.5: Equity Valuation

Assets	Liabilities
Assets in Place	Debt
Growth Assets	Equity

Cash flows considered are cashflows from assets, after debt payments and after making reinvestments needed for future growth

Discount rate reflects only the cost of raising equity financing

Present value is value of just the equity claims on the firm

Firm Valuation

Figure 5.6: Firm Valuation

Assets		Liabilities	
Assets in Place		Debt	
Growth Assets		Equity	

Cash flows considered are cashflows from assets, prior to any debt payments but after firm has reinvested to create growth assets

Discount rate reflects the cost of raising both debt and equity financing, in proportion to their use

Present value is value of the entire firm, and reflects the value of all claims on the firm.

Valuation with Infinite Life

DISCOUNTED CASHFLOW VALUATION

Cash flows
Firm: Pre-debt cash flow
Equity: After debt cash flows

Expected Growth
Firm: Growth in Operating Earnings
Equity: Growth in Net Income/EPS

Firm is in stable growth: Grows at constant rate forever

Terminal Value

Value
Firm: Value of Firm

Equity: Value of Equity

CF_1 CF_2 CF_3 CF_4 CF_5 .... CF_n

Forever

Length of Period of High Growth

Discount Rate
Firm:Cost of Capital

Equity: Cost of Equity

Aswath Damodaran

DISCOUNTED CASHFLOW VALUATION

Cashflow to Firm
EBIT (1-t)
- (Cap Ex - Depr)
- Change in WC
= FCFF

Expected Growth
Reinvestment Rate
* Return on Capital

Firm is in stable growth:
Grows at constant rate
forever

Terminal Value= $FCFF_{n+1}/(r-g_n)$

Value of Operating Assets
+ Cash & Non-op Assets
= Value of Firm
- Value of Debt
= Value of Equity

$FCFF_1$ $FCFF_2$ $FCFF_3$ $FCFF_4$ $FCFF_5$ $FCFF_n$ ....

Forever

Discount at   WACC= Cost of Equity (Equity/(Debt + Equity)) + Cost of Debt (Debt/(Debt+ Equity))

Cost of Equity

Cost of Debt
(Riskfree Rate
+ Default Spread) (1-t)

Weights
Based on Market Value

Riskfree Rate :
- No default risk
- No reinvestment risk
- In same currency and
in same terms (real or
nominal as cash flows

+

Beta
- Measures market risk

X

Risk Premium
- Premium for average
risk investment

| Type of Business | Operating Leverage | Financial Leverage | Base Equity Premium | Country Risk Premium |

BMW: Status Quo (Euros)

Return on Capital 9.17%

Current Cashflow to Firm
EBIT(1-t) :   2,227
- Nt CpX   687
- Chg WC   583
= FCFF   € 958
Reinvestment Rate=(687+583)/2227
                    = 57%

Reinvestment Rate 57%

Expected Growth in EBIT (1-t)
.57*.0917=.0523
5.23%

Stable Growth
g = 2%; Beta = 1.00;
Country Premium= 1.5%
Cost of capital = 7.15%
ROC= 7.15%; Tax rate=37%
Reinvestment Rate=g/ROC
              =2/ 7.15= 27.97%

Terminal Value5= 2225/(.0715-.02) = 43,205

Euro Cashflows

Op. Assets€ 34,631
+ Cash: 4,123
- Debt   5,597
- Non-Debt   7,517
=Equity   25,640

Value/Sh   € 38.07

Year	1	2	3	4	5	Term Yr
						3089
EBIT (1-t)	€ 2,344	€ 2,467	€ 2,596	€ 2,731	€ 2,874	- 864
Reinvestment	€ 1,336	€ 1,406	€ 1,479	€ 1,557	€ 1,638	= 2225
FCFF	€ 1,008	€ 1,061	€ 1,116	€ 1,174	€ 1,236	

g=2%
Tax rate changes

Discount at $ Cost of Capital (WACC) = 8.52% (.8015) + 3.26% (0.1985) = 7.47%

On Sept 23, 2004
BMW Common = 33.50 Eu

Cost of Equity
8.52%

Cost of Debt
(3.95%+1.50%)(1-.4021)
= 3.26%

Weights
E = 80.15% D = 19.85%

Riskfree Rate:
Euro Riskfree Rate= 3.95%

+

Beta 1.14

X

Mature market premium 3.83 %

+

Lambda 0.08

X

Emerg Market Equity Risk Premium 2.50%

Unlevered Beta for Sectors: 0.99

Firm's D/E Ratio: 24.77%

Aswath Damodaran

Discounted Cash Flow Valuation: High Growth with Negative Earnings

Current Revenue	Current Operating Margin	Reinvestment		Stable Growth

Reinvestment

Sales Turnover Ratio	Competitive Advantages

Stable Growth

Stable Revenue Growth	Stable Operating Margin	Stable Reinvestment

EBIT

Revenue Growth	Expected Operating Margin

Tax Rate - NOLs

FCFF = Revenue* Op Margin (1-t) - Reinvestment

Terminal Value= FCFF $_{n+1}/(r-g_n)$

Value of Operating Assets
+ Cash & Non-op Assets
= Value of Firm
- Value of Debt
= Value of Equity
- Equity Options
= Value of Equity in Stock

$FCFF_1$ $FCFF_2$ $FCFF_3$ $FCFF_4$ $FCFF_5$ $FCFF_n$ ....

Forever

Discount at WACC= Cost of Equity (Equity/(Debt + Equity)) + Cost of Debt (Debt/(Debt+ Equity))

Cost of Equity

Cost of Debt
(Riskfree Rate
+ Default Spread) (1-t)

Weights
Based on Market Value

Riskfree Rate :
- No default risk
- No reinvestment risk
- In same currency and in same terms (real or nominal as cash flows

+

Beta
- Measures market risk

X

Risk Premium
- Premium for average risk investment

Type of Business	Operating Leverage	Financial Leverage	Base Equity Premium	Country Risk Premium

Reinvestment:
Cap ex includes acquisitions
Working capital is 3% of revenues

Stable Growth

Current Revenue $ 1,117	Current Margin: -36.71%
Sales Turnover Ratio: 3.00	Competitive Advantages
Stable Revenue Growth: 6%	Stable Operating Margin: 10.00%	Stable ROC=20% Reinvest 30% of EBIT(1-t)

EBIT -410m

Revenue Growth: 42%

Expected Margin: -> 10.00%

NOL: 500 m

Terminal Value= 1881/(.0961-.06) =52,148

Term. Year
$41,346
10.00%
35.00%
$2,688
$ 807
$1,881

	1	2	3	4	5	6	7	8	9	10	
Revenues	$2,793	5,585	9,774	14,661	19,059	23,862	28,729	33,211	36,798	39,006	
EBIT	-$373	-$94	$407	$1,038	$1,628	$2,212	$2,768	$3,261	$3,646	$3,883	
EBIT (1-t)	-$373	-$94	$407	$871	$1,058	$1,438	$1,799	$2,119	$2,370	$2,524	
- Reinvestment	$559	$931	$1,396	$1,629	$1,466	$1,601	$1,623	$1,494	$1,196	$736	
FCFF	-$931	-$1,024	-$989	-$758	-$408	-$163	$177	$625	$1,174	$1,788	
Cost of Equity	12.90%	12.90%	12.90%	12.90%	12.90%	12.42%	12.30%	12.10%	11.70%	10.50%	Forever
Cost of Debt	8.00%	8.00%	8.00%	8.00%	8.00%	7.80%	7.75%	7.67%	7.50%	7.00%	
AT cost of debt	8.00%	8.00%	8.00%	6.71%	5.20%	5.07%	5.04%	4.98%	4.88%	4.55%	
Cost of Capital	12.84%	12.84%	12.84%	12.83%	12.81%	12.13%	11.96%	11.69%	11.15%	9.61%	

Value of Op Assets	$ 14,910
+ Cash	$ 26
= Value of Firm	$14,936
- Value of Debt	$ 349
= Value of Equity	$14,587
- Equity Options	$ 2,892
Value per share	$ 34.32

Cost of Equity 12.90%

Cost of Debt
6.5%+1.5%=8.0%
Tax rate = 0% -> 35%

Weights
Debt= 1.2% -> 15%

Riskfree Rate :
T. Bond rate = 6.5%

+ **Beta** 1.60 -> 1.00

X **Risk Premium** 4%

| Internet/ Retail | Operating Leverage | Current D/E: 1.21% | Base Equity Premium | Country Risk Premium |

**Amazon.com
January 2000
Stock Price = $ 84**

I. Discount Rates:Cost of Equity

Preferably, a bottom-up beta, based upon other firms in the business, and firm's own financial leverage

Cost of Equity =   Riskfree Rate   +   Beta   *   (Risk Premium)

Has to be in the same currency as cash flows, and defined in same terms (real or nominal) as the cash flows

Historical Premium
1. Mature Equity Market Premium: Average premium earned by stocks over T.Bonds in U.S.
2. Country risk premium =
Country Default Spread* ($\sigma_{Equity}/\sigma_{Country\ bond}$)

or

Implied Premium
Based on how equity market is priced today and a simple valuation model

A Simple Test

■ You are valuing BMW in <u>Euros</u> for a <u>US institutional investor</u> and are attempting to estimate a risk free rate to use in the analysis. The risk free rate that you should use is

❑ The interest rate on a US $ denominated treasury bond (4.25%)

❑ The interest rate on a Euro-denominated bond issued by the German government (3.95%)

❑ The lowest interest rate on a 10-year Euro-denominated bond issued by any European government (3.95%)

❑ The lowest interest rate on a 10-year bond issued by a European government (Swiss bond: 2.62%)

Everyone uses historical premiums, but..

■ The historical risk premium is easiest to estimate in the United States, because there is unbroken market data going back to 1870.

	Arithmetic average		*Geometric Average*	
	Stocks -	Stocks -	Stocks -	Stocks -
Historical Period	T.Bills	T.Bonds	T.Bills	T.Bonds
1928-2003	7.92%	6.54%	5.99%	4.82%
1963-2003	6.09%	4.70%	4.85%	3.82%
1993-2003	8.43%	4.87%	6.68%	3.57%

■ It is difficult to get enough historical data to estimate risk premiums in other countries.

Risk Premium for a Mature Market? Broadening the sample..

Equity Risk Premiums – By Country

Average Risk Premium across all mature equity markets = 4%
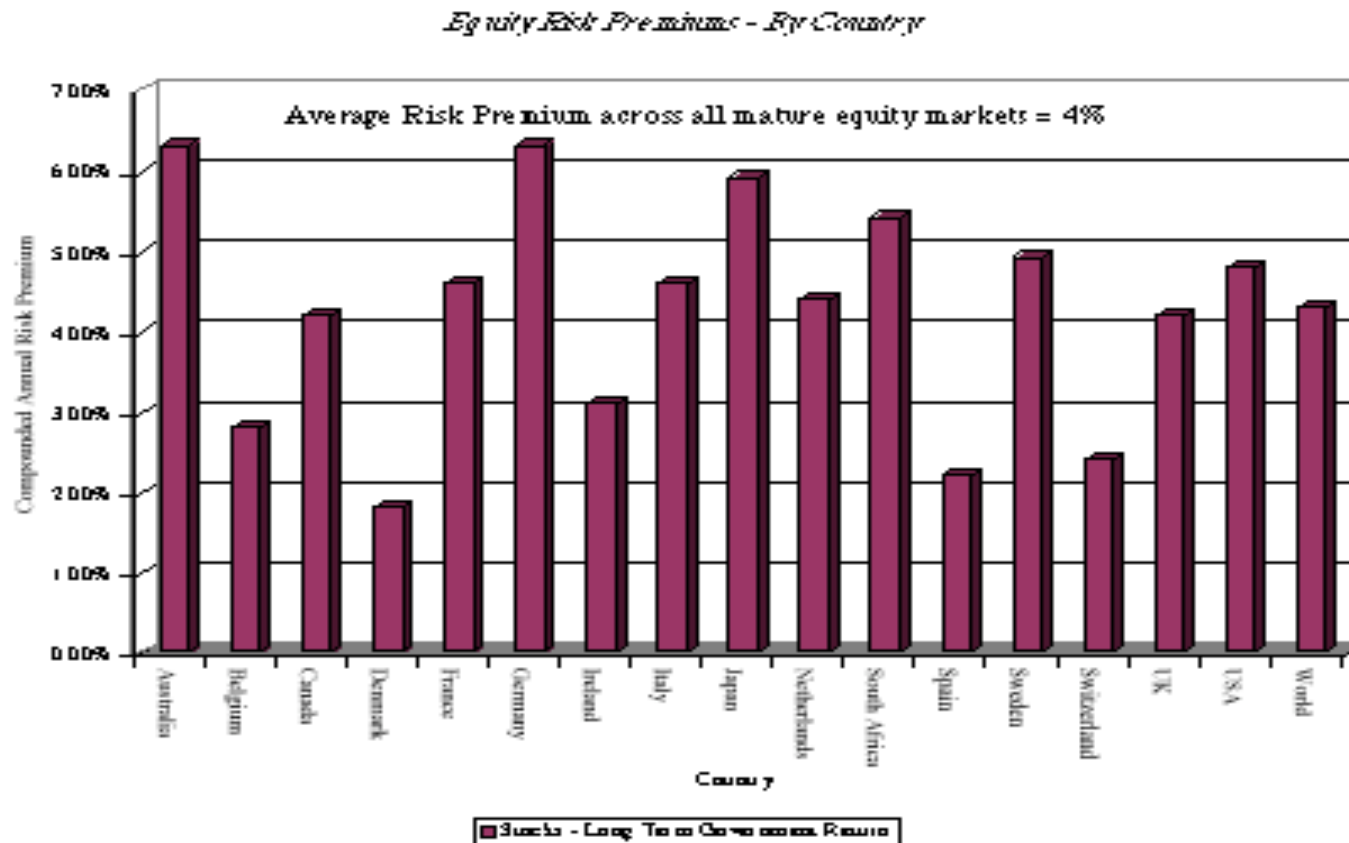
An Alternative to Historical Risk Premiums: Implied Equity Premium for the S&P 500: January 1, 2004

■ We can use the information in stock prices to back out how risk averse the market is and how much of a risk premium it is demanding.

In 2003, dividends & stock buybacks were 2.81% of the index, generating 31.29 in cashflows

Analysts expect earnings to grow 9.5% a year for the next 5 years as the economy comes out of a recession.

After year 5, we will assume that earnings on the index will grow at 4.25%, the same rate as the entire economy

| 34.26 | 37.52 | 41.08 | 44.98 | 49.26 |
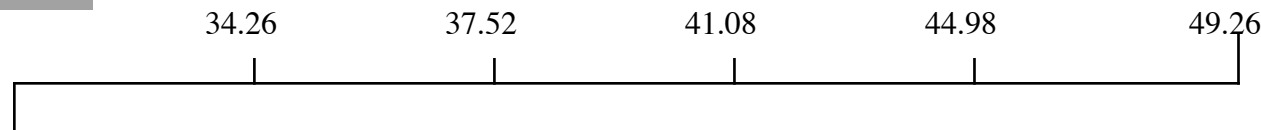
January 1, 2004
S&P 500 is at 1111.91

■ If you pay the current level of the index, you can expect to make a return of 7.94% on stocks (which is obtained by solving for r in the following equation)

$$1111.91 = \frac{34.26}{(1+r)} + \frac{37.52}{(1+r)^2} + \frac{41.08}{(1+r)^3} + \frac{44.98}{(1+r)^4} + \frac{49.26}{(1+r)^5} + \frac{49.26(1.0425)}{(r-.0425)(1+r)^5}$$

■ Implied Equity risk premium = Expected return on stocks - Treasury bond rate = 7.94% - 4.25% = 3.69%

Implied Premiums in the US

Implied Premium for US Equity

Choosing an Equity Risk Premium

- *Historical Risk Premium*: When you use the historical risk premium, you are assuming that premiums will revert back to a historical norm and that the time period that you are using is the right norm. You are also more likely to find stocks to be overvalued than undervalued (Why?)

- *Current Implied Equity Risk premium*: You are assuming that the market is correct in the aggregate but makes mistakes on individual stocks. If you are required to be market neutral, this is the premium you should use. (What types of valuations require market neutrality?)

- *Average Implied Equity Risk premium*: The average implied equity risk premium between 1960-2003 in the United States is about 4%. You are assuming that the market is correct on average but not necessarily at a point in time.

Implied Equity Risk Premium for Germany: September 23, 2004

■ We can use the information in stock prices to back out how risk averse the market is and how much of a risk premium it is demanding.

Dividends and stock buybacks were 2.67% of the index last year
Source: Bloomberg

Analysts are estimating an expected growth rate of 11.36% in earnings over the next 5 years for stocks in the DAX (Source: IBES)

Expected dividends and stock buybacks over next 5 years

| 116.13 | 129.32 | 144.01 | 160.37 | 178.59 |

Assumed to grow at 3.95% a year forever after year 5
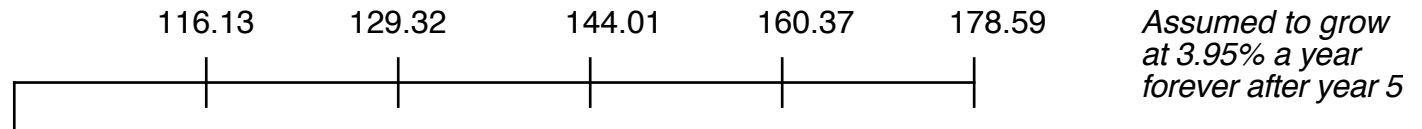
Buy the index for 3905.65

■ If you pay the current level of the index, you can expect to make a return of 7.94% on stocks (which is obtained by solving for r in the following equation)

$$3905.65 = \frac{116.13}{(1+r)} + \frac{129.32}{(1+r)^2} + \frac{144.01}{(1+r)^3} + \frac{160.37}{(1+r)^4} + \frac{178.59}{(1+r)^5} + \frac{178.59(1.0395)}{(r-.0425)(1+r)^5}$$

■ Implied Equity risk premium = Expected return on stocks - Treasury bond rate = 7.78% - 3.95% = 3.83%

Opportunities and Threats: The Allure of Asia and the Risk…

Country	Rating	Typical Default Spread
China	A2	90
Hong Kong	A1	80
India	Baa2	130
Indonesia	B2	550
Malaysia	A3	95
Pakistan	B2	550
Singapore	Aaa	0
Taiwan	Aa3	70
Thailand	Baa1	120
Vietnam	B1	450
Vietnam	B1	450

Using Country Ratings to Estimate Equity Spreads

■ 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 adjust the country spread upwards is to use information from the US market. In the US, the equity risk premium has been roughly twice the default spread on junk bonds.

- Another is to multiply the bond spread by the relative volatility of stock and bond prices in that market. For example,
  - Standard Deviation in BSE = 32%
  - Standard Deviation in Indian Government Bond = 16%
  - Adjusted Equity Spread = 1.30% (32/16) = 2.60%

Equity Risk Premiums in Asia

Country	Rating	Typical Default Spread	Relative Equity Market volatility	Equity Risk Premium
China	A2	90	2.25	2.03%
Hong Kong	A1	80	1.8	1.44%
India	Baa2	130	2	2.60%
Indonesia	B2	550	1.8	9.90%
Malaysia	A3	95	2.5	2.38%
Pakistan	B2	550	1.75	9.63%
Singapore	Aaa	0	2.2	0.00%
Taiwan	Aa3	70	2.5	1.75%
Thailand	Baa1	120	2.2	2.64%
Vietnam	B1	450	1.6	7.20%
Weighted average risk premium =				2.50%

Country Risk and Company Risk: Three points of view

■ Approach 1: Assume that every company in the country is equally exposed to country risk. In this case,

E(Return) = Riskfree Rate + Country premium + Beta (Mature market premium)

■ Approach 2: Assume that a company's exposure to country risk is similar to its exposure to other market risk.

E(Return) = Riskfree Rate + Beta (Mature market premium + Country premium)

■ Approach 3: Treat country risk as a separate risk factor and allow firms to have different exposures to country risk (perhaps based upon the proportion of their revenues come from non-domestic sales)

E(Return)=Riskfree Rate+ β (Mature market premium) + λ (Country premium)

Estimating Company Exposure to Country Risk: Determinants

- <u>Source of revenues</u>: Other things remaining equal, a company should be more exposed to risk in a country if it generates more of its revenues from that country. A firm that generates the bulk of its revenues in an emerging market should be more exposed to country risk in that market than one that generates a smaller percent of its business within that market.

- <u>Manufacturing facilities</u>: Other things remaining equal, a firm that has all of its production facilities in an emerging market should be more exposed to country risk than one which has production facilities spread over multiple countries. The problem will be accented for companies that cannot move their production facilities (mining and petroleum companies, for instance).

- <u>Use of risk management products</u>: Companies can use both options/futures markets and insurance to hedge some or a significant portion of country risk.

Estimating Lambdas: The Revenue Approach

■ The easiest and most accessible data is on revenues. Most companies break their revenues down by region. One simplistic solution would be to do the following:

λ = % of revenues domestically$_{firm}$/ % of revenues domestically$_{avg\ firm}$

■ Consider, for instance, the fact that BMW got about 12% of its revenues from Asia, Africa and Oceania (?). Assuming that 6% of the revenues are from Japan and Australia, we would estimate that the remaining 6% are in "Emerging Asia", we can estimate a lambda for BMW for Asia (using the assumption that the typical Asian firm gets about 75% of its revenues in Asia)

- Lambda$_{BMW,\ Asia}$ = 6%/ 75% = .08

■ There are two implications

- A company's risk exposure is determined by where it does business and not by where it is located
- Firms might be able to actively manage their country risk exposures

BMW's Cost of Equity

■ BMW is a German company with substantial multinational corporation and is exposed to emerging market risk.

■ The beta measures exposure to mature market risk and should have the mature market equity risk premium attached to it.

■ The lambda measures exposure to emerging market risk.

■ Cost of equity = Riskfree Rate + Beta * Mature Market Equity Risk Premium + Lambda * Emerging Market Risk Premioum

   BMW's Cost of Equity = 3.95% + 1.14 (3.83%) + 0.08 (2.50%) = 8.52%

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.

■ This beta has three problems:

- It has high standard error
- It reflects the firm's business mix over the period of the regression, not the current mix
- It reflects the firm's average financial leverage over the period rather than the current leverage.

Beta Estimation: Amazon

<HELP> for explanation, <MENU> for similar functions.   DG26 Equity **BETA**

HISTORICAL BETA

AMZN	US	AMAZON.COM INC

Relative Index **SPX**   S&P 500 INDEX
                                   *Indentifies latest observation

Period [ ] Weekly
Range **2/27/98** To **2/18/00**
Market [ ] Trade

Y = 2.23 X + 2.60

ADJ BETA	1.82
RAW BETA	2.23
Alpha (Intercept)	2.60
R2 (Correlation)	.17
Std Dev of Error	13.20
Std Error of Beta	.50
Number of Points	103

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

Copyright 2000 BLOOMBERG L.P.   Frankfurt:69-920410   Hong Kong:2-977-6000   London:171-330-7500   New York:212-318-2000
Princeton:609-279-3000   Singapore:226-3000   Sydney:2-9777-8686   Tokyo:3-3201-8900   Sao Paulo:11-3048-4500
I257-602-0 22-Feb-00 16:21:23

Bloomberg PROFESSIONAL

Beta Estimation for BMW: The Index Effect

Who is the marginal investor in BMW?
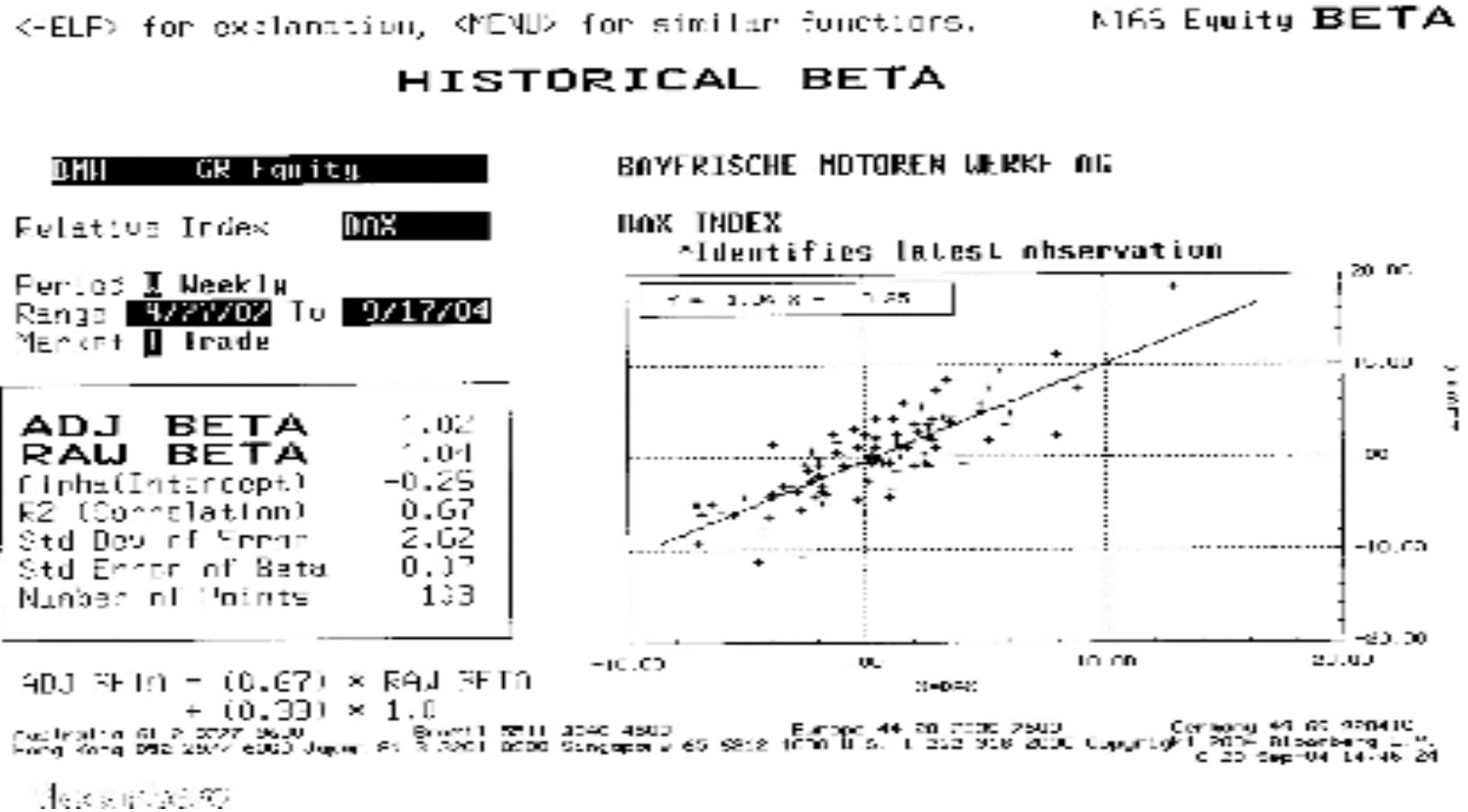
A more reasonable assessment of market risk?

Determinants of Betas

Beta of Equity

Beta of Firm

Nature of product or service offered by company:
Other things remaining equal, the more discretionary the product or service, the higher the beta.

Operating Leverage (Fixed Costs as percent of total costs):
Other things remaining equal the greater the proportion of the costs that are fixed, the higher the beta of the company.

Financial Leverage:
Other things remaining equal, the greater the proportion of capital that a firm raises from debt,the higher its equity beta will be

Implications
1. Cyclical companies should have higher betas than non-cyclical companies.
2. Luxury goods firms should have higher betas than basic goods.
3. High priced goods/service firms should have higher betas than low prices goods/services firms.
4. Growth firms should have higher betas.

Implications
1. Firms with high infrastructure needs and rigid cost structures shoudl have higher betas than firms with flexible cost structures.
2. Smaller firms should have higher betas than larger firms.
3. Young firms should have

Implciations
Highly levered firms should have highe betas than firms with less debt.

In a perfect world… we would estimate the beta of a firm by doing the following

Start with the beta of the business that the firm is in

Adjust the business beta for the operating leverage of the firm to arrive at the unlevered beta for the firm.

Use the financial leverage of the firm to estimate the equity beta for the firm
Levered Beta = Unlevered Beta (1 + (1- tax rate) (Debt/Equity))

Bottom-up Betas

Step 1: Find the business or businesses that your firm operates in.

Possible Refinements

Step 2: Find publicly traded firms in each of these businesses and obtain their regression betas. Compute the simple average across these regression betas to arrive at an average beta for these publicly traded firms. Unlever this average beta using the average debt to equity ratio across the publicly traded firms in the sample.
Unlevered beta for business = Average beta across publicly traded firms/ (1 + (1- t) (Average D/E ratio across firms))

If you can, adjust this beta for differences between your firm and the comparable firms on operating leverage and product characteristics.

Step 3: Estimate how much value your firm derives from each of the different businesses it is in.

While revenues or operating income are often used as weights, it is better to try to estimate the value of each business.

Step 4: Compute a weighted average of the unlevered betas of the different businesses (from step 2) using the weights from step 3.
Bottom-up Unlevered beta for your firm = Weighted average of the unlevered betas of the individual business

If you expect the business mix of your firm to change over time, you can change the weights on a year-to-year basis.

Step 5: Compute a levered beta (equity beta) for your firm, using the market debt to equity ratio for your firm.
Levered bottom-up beta = Unlevered beta (1+ (1-t) (Debt/Equity))

If you expect your debt to equity ratio to change over time, the levered beta will change over time.

BMW's Bottom-up Beta

Business	EBIT	Value/EBIT	Unlevered beta	Value	Weight
Automobiles	3052	7.15	1.02	21,822	88%
Financing	569	5.25	0.81	2,987	12%
Firm			**0.99**		

Levered Beta = Unlevered Beta (1 + (1- tax rate) (D/E Ratio)

= 0.99 (1 + (1-.4021) (.2531)) = 1.14

Amazon's Bottom-up Beta

Unlevered beta for firms in internet retailing =   1.60

Unlevered beta for firms in specialty retailing =   1.00

- ■ Amazon is a specialty retailer, but its risk currently seems to be determined by the fact that it is an online retailer. Hence we will use the beta of internet companies to begin the valuation

- ■ By the fifth year, we are estimating substantial revenues for Amazon and we move the beta towards to beta of the retailing business.

From Cost of Equity to Cost of Capital

Cost of borrowing should be based upon
(1) synthetic or actual bond rating
(2) default spread
Cost of Borrowing = Riskfree rate + Default spread

Marginal tax rate, reflecting tax benefits of debt

Cost of Capital =   Cost of Equity (Equity/(Debt + Equity))   +   Cost of Borrowing   (1-t)   (Debt/(Debt + Equity))

Cost of equity based upon bottom-up beta

Weights should be market value weights
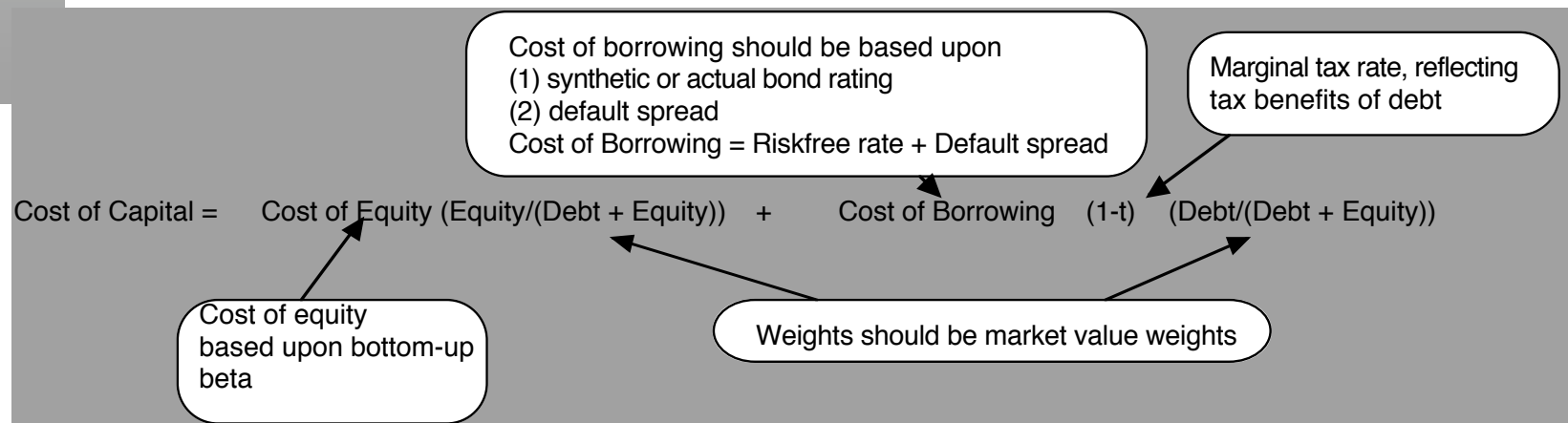
Bond Rating: Synthetic versus Actual

- If a firm is rated, its bond rating represents the ratings agency's judgment of the default risk of a firm. BMW is rated A+ by S&P.

- 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

$$\text{Interest Coverage Ratio} = \text{EBIT} / \text{Interest Expenses}$$

- For BMW's interest coverage ratio, we used the interest expenses and EBIT from 2003.

$$\text{Interest Coverage Ratio} = 3353/ 811 = 2.64$$

- Amazon.com has negative operating income; this yields a negative interest coverage ratio, which should suggest a low rating. We computed an average interest coverage ratio of 2.82 over the next 5 years.

Interest Coverage Ratios, Ratings and Default Spreads

If Interest Coverage Ratio is	Estimated Bond Rating	Default Spread(1/00)	Default Spread(1/04)	
> 8.50	AAA	0.20%	0.35%	
6.50 - 8.50	AA	0.50%	0.50%	
5.50 - 6.50	A+	0.80%	0.70%	
4.25 - 5.50	A	1.00%	0.85%	
3.00 - 4.25	A−	1.25%	1.00%	
2.50 - 3.00	BBB	1.50%	1.50%	← BMW Interest coverage ratio of 2.64
2.25 - 2.50	BB+	1.75%	2.00%	
2.00 - 2.25	BB	2.00%	2.50%	
1.75 - 2.00	B+	2.50%	3.25%	
1.50 - 1.75	B	3.25%	4.00%	
1.25 - 1.50	B −	4.25%	6.00%	
0.80 - 1.25	CCC	5.00%	8.00%	
0.65 - 0.80	CC	6.00%	10.00%	
0.20 - 0.65	C	7.50%	12.00%	
< 0.20	D	10.00%	20.00%	

Estimating the cost of debt for a firm

■ The synthetic rating for BMW is BBB, lower than the actual rating of the firm of A+. We will use the synethetic rating to estimate the cost of debt. Using the 2004 default spread of 1.50%, we estimate a cost of debt of 5.45% (using a riskfree rate of 3.95%):

Cost of debt = Riskfree rate + Company default spread

= 3.95% + 1.50% = 5.45%

■ The synthetic rating for Amazon.com in 2000 was BBB. The default spread for BBB rated bond was 1.50% in 2000 and the treasury bond rate was 6.5%.

Pre-tax cost of debt = Riskfree Rate + Default spread

= 6.50% + 1.50% = 8.00%

■ The firm is paying no taxes currently. As the firm's tax rate changes and its cost of debt changes, the after tax cost of debt will change as well.

	1	2	3	4	5	6	7	8	9	10
Pre-tax	8.00%	8.00%	8.00%	8.00%	8.00%	7.80%	7.75%	7.67%	7.50%	7.00%
Tax rate	0%	0%	0%	16.13%	35%	35%	35%	35%	35%	35%
After-tax	8.00%	8.00%	8.00%	6.71%	5.20%	5.07%	5.04%	4.98%	4.88%	4.55%

Weights for the Cost of Capital Computation

■ The weights used to compute the cost of capital should be the market value weights for debt and equity.

■ There is an element of circularity that is introduced into every valuation by doing this, since the values that we attach to the firm and equity at the end of the analysis are different from the values we gave them at the beginning.

■ As a general rule, the debt that you should subtract from firm value to arrive at the value of equity should be the same debt that you used to compute the cost of capital.

Estimating Cost of Capital: Amazon.com

- **Equity**
  - Cost of Equity = 6.50% + 1.60 (4.00%) = 12.90%
  - Market Value of Equity = $ 84/share* 340.79 mil shs = $ 28,626 mil (98.8%)
- **Debt**
  - Cost of debt = 6.50% + 1.50% (default spread) = 8.00%
  - Market Value of Debt = $ 349 mil (1.2%)
- **Cost of Capital**

  Cost of Capital = 12.9 % (.988) + 8.00% (1- 0) (.012)) = 12.84%

Estimating Cost of Capital: BMW

- Equity
  - Cost of Equity = 3.95% + 1.14 (3.83%) + 0.08 (2.50%) = 8.52%
  - Market Value of Equity =22,596 million Euros (80.15%)
- Debt
  - Cost of debt = 3.95%+1.50%= 5.45%
  - Market Value of Debt = 5,597 million Euros (19.85%)
- Cost of Capital

Cost of Capital = 8.52 % (.8015) + 5.45% (1- .4021) (0.1985)) = 7.47%

The book value of equity at BMW is 16,150 million Euros

The book value of debt at BMW is 5,499 million; Interest expense is 336 mil; Average maturity of debt = 3 years

Estimated market value of debt = 336 million (PV of annuity, 3 years, 5.45%) + 5,499 million/1.0545^3 = 5,597 million Euros

II. Estimating Cash Flows to Firm

Operating leases
- Convert into debt
- Adjust operating income

R&D Expenses
- Convert into asset
- Adjust operating income

Update
- Trailing Earnings
- Unofficial numbers

Normalize
- History
- Industry

Cleanse operating items of
- Financial Expenses
- Capital Expenses
- Non-recurring expenses

Earnings before interest and taxes

Tax rate
- can be effective for near future, but move to marginal
- reflect net operating losses

- Tax rate * EBIT

= EBIT (1- tax rate)

- (Capital Expenditures - Depreciation)

- Change in non-cash working capital

= Free Cash flow to the firm (FCFF)

Include
- R&D
- Acquisitions

Defined as
Non-cash CA
- Non-debt CL

The Importance of Updating

■ The operating income and revenue that we use in valuation should be updated numbers. One of the problems with using financial statements is that they are dated.

■ As a general rule, it is better to use 12-month trailing estimates for earnings and revenues than numbers for the most recent financial year. This rule becomes even more critical when valuing companies that are evolving and growing rapidly.

	Last 10-K	*Trailing 12-month*
Revenues	$ 610 million	$1,117 million
EBIT	- $125 million	- $ 410 million

Normalizing Earnings: Amazon

Year	Revenues	Operating Margin	EBIT	
Tr12m	$1,117	-36.71%	-$410	
1	$2,793	-13.35%	-$373	
2	$5,585	-1.68%	-$94	
3	$9,774	4.16%	$407	
4	$14,661	7.08%	$1,038	
5	$19,059	8.54%	$1,628	
6	$23,862	9.27%	$2,212	
7	$28,729	9.64%	$2,768	
8	$33,211	9.82%	$3,261	
9	$36,798	9.91%	$3,646	
10	$39,006	9.95%	$3,883	
TY(11)	$41,346	**10.00%**	$4,135	Industry Average

Operating Leases at The Home Depot in 1998

■ The pre-tax cost of debt at the Home Depot is 6.25%

Yr	Operating Lease Expense	Present Value
1	$ 294	$ 277
2	$ 291	$ 258
3	$ 264	$ 220
4	$ 245	$ 192
5	$ 236	$ 174
6-15	$ 270	$ 1,450 (PV of 10-yr annuity)

Present Value of Operating Leases =$ 2,571

■ Debt outstanding at the Home Depot = $1,205 + $2,571 = $3,776 mil

(The Home Depot has other debt outstanding of $1,205 million)

■ Adjusted Operating Income = $2,016 + 2,571 (.0625) = $2,177 mil

Capitalizing R&D Expenses: BMW

- To capitalize R&D,
  - Specify an amortizable life for R&D (2 - 10 years)
  - Collect past R&D expenses for as long as the amortizable life
  - Sum up the unamortized R&D over the period. (Thus, if the amortizable life is 5 years, the research asset can be obtained by adding up 1/5th of the R&D expense from five years ago, 2/5th of the R&D expense from four years ago...:
- R & D was assumed to have a 3-year life at BMW.

Year	R&D Expense	Unamortized portion		Amortization this year
Current	2146.00	1.00	2146.00	
-1	2011.00	0.67	1340.67	$670.33
-2	1663.00	0.33	554.33	$554.33
-3	1556.00	0.00	0.00	$518.67
Value of Research Asset =			$4,041.00	
Amortization this year =				$1,743.33

Adjusted Operating Income = Operating Income + R&D - Amortization

= 3,052+ + 2,146 - 1,743 = 3,455 million

The Effect of Net Operating Losses: Amazon.com's Tax Rate

Year	1	2	3	4	5
EBIT	-$373	-$94	$407	$1,038	$1,628
Taxes	$0	$0	$0	$167	$570
EBIT(1-t)	-$373	-$94	$407	$871	$1,058
Tax rate	0%	0%	0%	16.13%	35%
NOL	$500	$873	$967	$560	$0

After year 5, the tax rate becomes 35%.

Estimating Actual FCFF: BMW

- EBIT = 3,455 million Euros
- Tax rate = 41.21%
- Net Capital expenditures = Cap Ex - Depreciation = 9,339 -8,652 = 687 million
- Change in Working Capital = + 583 million (Increase)

Estimating FCFF

Current EBIT * (1 - tax rate) =	3,455 (1-.4021) = 2,277 Million
- (Capital Spending - Depreciation)	687
- Change in Working Capital	583
Current FCFF	958 Million Euros

Estimating FCFF: Amazon.com

- EBIT (Trailing 1999) = -$ 410 million
- Tax rate used = 0% (Assumed Effective = Marginal)
- Capital spending (Trailing 1999) = $ 243 million
- Depreciation (Trailing 1999) = $ 31 million
- Non-cash Working capital Change (1999) = - 80 million
- Estimating FCFF (1999)

Current EBIT * (1 - tax rate) = - 410 (1-0)	= - $410 million
- (Capital Spending - Depreciation)	= $212 million
- Change in Working Capital	= -$ 80 million
Current FCFF	= - $542 million

IV. Expected Growth in EBIT and Fundamentals

■ Reinvestment Rate and Return on Capital

g_{EBIT} = (Net Capital Expenditures + Change in WC)/EBIT(1-t) * ROC

= Reinvestment Rate * ROC

■ **Proposition**: No firm can expect its operating income to grow over time without reinvesting some of the operating income in net capital expenditures and/or working capital.

■ **Proposition**: The net capital expenditure needs of a firm, for a given growth rate, should be inversely proportional to the quality of its investments.

Return on Capital Computation: BMW

Stated Book value of Equity
13,871 million

Research Asset
4,041 million

Book value of debt and equity from end of prior year

Book Value of Equity
13,871+4041 =
17,509 million Euros

Book Value of Debt
6,769 million Euros

After-tax Operating Income
2,227 million Euros

/

Book Value of Capital from end of prior year
17,509 + 6,769 = 24,278 million Euros

Return on Capital in 2003 = 9.17%
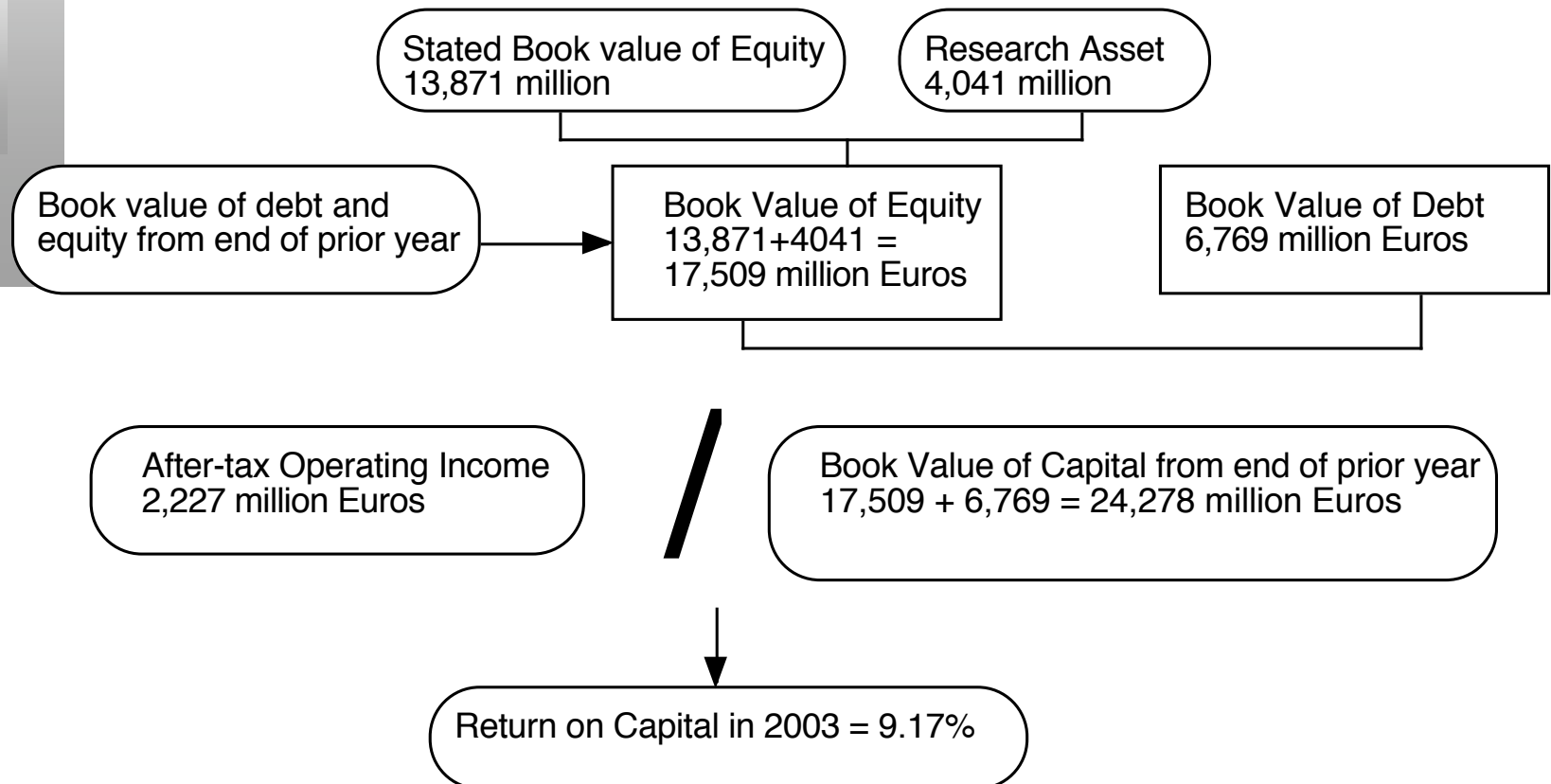
Reinvestment Rate Computation: BMW

Capital Expenditures net of asset divestitures
4115+5785-2707
=7,193 million

Depreciation and other non-cash charges
6,909 million

R& D net of amortization
2,146 - 1,743 = 403 million

Net Capital Expenditures
7,193 - 6909 + 403 =
687 million

+

Change in non-cash working capital
583 million

Reinvestment
Net Cap Ex + Change in WC
687 + 583 = 1270 million

/

After-tax Operating Income
2,227 million Euros

Return on Capital = 1270/2,227 = 57.00%

Revenue Growth and Operating Margins

- With negative operating income and a negative return on capital, the fundamental growth equation is of little use for Amazon.com

- For Amazon, the effect of reinvestment shows up in revenue growth rates and changes in expected operating margins:

 Expected Revenue Growth in $ = Reinvestment (in $ terms) * (Sales/ Capital)

- The effect on expected margins is more subtle. Amazon's reinvestments (especially in acquisitions) may help create barriers to entry and other competitive advantages that will ultimately translate into high operating margins and high profits.

Growth in Revenues, Earnings and Reinvestment: Amazon

Year	Revenue Growth	Chg in Revenue	Reinvestment	Chg Rev/ Chg Reinvestment	ROC
1	150.00%	$1,676	$559	3.00	-76.62%
2	100.00%	$2,793	$931	3.00	-8.96%
3	75.00%	$4,189	$1,396	3.00	20.59%
4	50.00%	$4,887	$1,629	3.00	25.82%
5	30.00%	$4,398	$1,466	3.00	21.16%
6	25.20%	$4,803	$1,601	3.00	22.23%
7	20.40%	$4,868	$1,623	3.00	22.30%
8	15.60%	$4,482	$1,494	3.00	21.87%
9	10.80%	$3,587	$1,196	3.00	21.19%
10	6.00%	$2,208	$736	3.00	20.39%

Assume that firm can earn high returns because of established economies of scale.

V. Growth Patterns

■ A key assumption in all discounted cash flow models is the period of high growth, and the pattern of growth during that period. In general, we can make one of three assumptions:

- there is no high growth, in which case the firm is already in stable growth
- there will be high growth for a period, at the end of which the growth rate will drop to the stable growth rate (2-stage)
- there will be high growth for a period, at the end of which the growth rate will decline gradually to a stable growth rate(3-stage)

Stable Growth	2-Stage Growth	3-Stage Growth
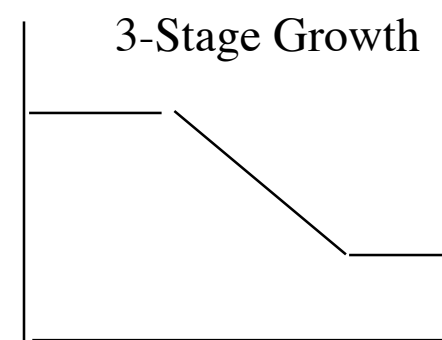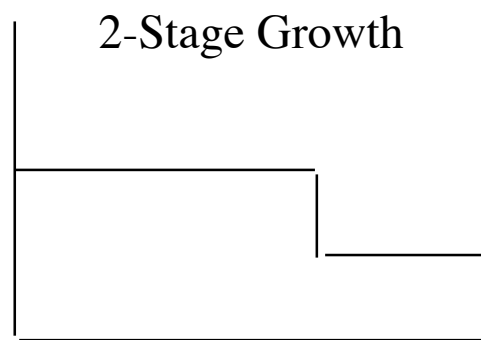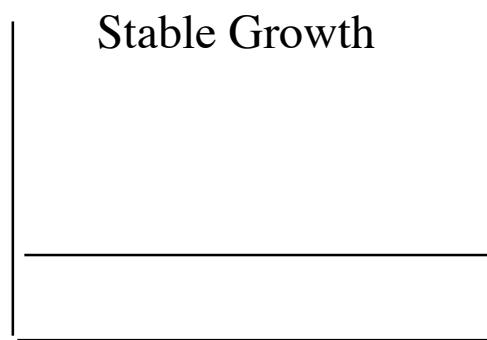
Determinants of Growth Patterns

■ Size of the firm
  - Success usually makes a firm larger. As firms <u>become larger</u>, it becomes much more difficult for them to maintain high growth rates

■ Current growth rate
  - While past growth is not always a reliable indicator of future growth, there is a <u>correlation between current growth and future growth</u>. Thus, a firm growing at 30% currently probably has higher growth and a longer expected growth period than one growing 10% a year now.

■ Barriers to entry and differential advantages
  - Ultimately, high growth comes from high project returns, which, in turn, comes from <u>barriers to entry</u> and <u>differential advantages</u>.
  - The question of how long growth will last and how high it will be can therefore be framed as a question about <u>what the barriers to entry are, how long they will stay up and how strong they will remain.</u>

Stable Growth Characteristics

■ In stable growth, firms should have the characteristics of other stable growth firms. In particular,

- The risk of the firm, as measured by beta and ratings, should reflect that of a stable growth firm.
    - Beta should move towards one
    - The cost of debt should reflect the safety of stable firms (BBB or higher)
- The debt ratio of the firm might increase to reflect the larger and more stable earnings of these firms.
    - The debt ratio of the firm might moved to the optimal or an industry average
    - If the managers of the firm are deeply averse to debt, this may never happen
- The reinvestment rate of the firm should reflect the expected growth rate and the firm's return on capital
    - Reinvestment Rate = Expected Growth Rate / Return on Capital

BMW and Amazon.com: Stable Growth Inputs

	High Growth	Stable Growth
■ **BMW**		
• Beta	1.14	1.00
• Debt Ratio	19.85%	19.85%
• Return on Capital	9.17%	7.15%
• Cost of Capital	7.43%	7.15%
• Expected Growth Rate	5.23%	2.00%
• Reinvestment Rate	57%	2/7.15% = 27.97%
■ Amazon.com		
• Beta	1.60	1.00
• Debt Ratio	1.20%	15%
• Return on Capital	Negative	20%
• Expected Growth Rate	NMF	6%
• Reinvestment Rate	>100%	6%/20% = 30%

Dealing with Cash and Marketable Securities

■ The simplest and most direct way of dealing with cash and marketable securities is to keep them out of the valuation - the cash flows should be before interest income from cash and securities, and the discount rate should not be contaminated by the inclusion of cash. (Use betas of the operating assets alone to estimate the cost of equity).

■ Once the firm has been valued, add back the value of cash and marketable securities.

   • If you have a particularly incompetent management, with a history of overpaying on acquisitions, markets may discount the value of this cash.

Dealing with Cross Holdings

■ When the holding is a majority, active stake, the value that we obtain from the cash flows includes the share held by outsiders. While their holding is measured in the balance sheet as a minority interest, it is at book value. To get the correct value, we need to subtract out the estimated market value of the minority interests from the firm value.

■ When the holding is a minority, passive interest, the problem is a different one. The firm shows on its income statement only the share of dividends it receives on the holding. Using only this income will understate the value of the holdings. In fact, we have to value the subsidiary as a separate entity to get a measure of the market value of this holding.

■ **Proposition 1**: It is almost impossible to correctly value firms with minority, passive interests in a large number of private subsidiaries.

Non-debt Obligations

- *Pension fund obligations*: If pension fund assets are not intermingled with other assets, only the underfunded portion of pension fund liabilities should be considered. If pension fund assets are intermingled, all of the pension fund obligations should be considered.

- *Lawsuit obligations*: If lawsuits are pending against the firm, the expected value (based on the likelihood of losing the lawsuits and the penalty if that occurs) of the lawsuits should be deducted.

- *Other obligations*: Deferred tax liabilities, employee health care benefits and social cost obligations can also be deducted, though the rationale has to be clearly specified.

BMW: Towards the final value

Present Value of FCFF in high growth phase =	$4,497.35
Present Value of Terminal Value of Firm =	$30,133.44
Value of operating assets of the firm =	$34,630.79
Value of Cash, Marketable Securities & Non-operating assets =	$4,123.00
Value of Firm =	$38,753.79
Market Value of outstanding debt =	$5,597.04
Non-debt obligations and liabilities =	$7,517.00
Market Value of Equity =	$25,639.75
Market Value of Equity/share =	$38.07

Amazon: Estimating the Value of Equity Options

■ Details of options outstanding

- Average strike price of options outstanding = $ 13.375
- Average maturity of options outstanding = 8.4 years
- Standard deviation in ln(stock price) = 50.00%
- Annualized dividend yield on stock = 0.00%
- Treasury bond rate = 6.50%
- Number of options outstanding = 38 million
- Number of shares outstanding = 340.79 million

■ Value of options outstanding (using dilution-adjusted Black-Scholes model)

- Value of equity options = $ 2,892 million

Reinvestment:
Cap ex includes acquisitions
Working capital is 3% of revenues

Current Revenue $ 1,117

Current Margin: -36.71%

EBIT -410m

NOL: 500 m

Sales Turnover Ratio: 3.00

Revenue Growth: 42%

Competitive Advantages

Expected Margin: -> 10.00%

Stable Growth

Stable Revenue Growth: 6%

Stable Operating Margin: 10.00%

Stable ROC=20% Reinvest 30% of EBIT(1-t)

Terminal Value= 1881/(.0961-.06) =52,148

	1	2	3	4	5	6	7	8	9	10	Term. Year
Revenues	$2,793	5,585	9,774	14,661	19,059	23,862	28,729	33,211	36,798	39,006	$41,346
EBIT	-$373	-$94	$407	$1,038	$1,628	$2,212	$2,768	$3,261	$3,646	$3,883	10.00%
EBIT (1-t)	-$373	-$94	$407	$871	$1,058	$1,438	$1,799	$2,119	$2,370	$2,524	35.00%
- Reinvestment	$559	$931	$1,396	$1,629	$1,466	$1,601	$1,623	$1,494	$1,196	$736	$2,688
FCFF	-$931	-$1,024	-$989	-$758	-$408	-$163	$177	$625	$1,174	$1,788	$ 807
											$1,881

Forever

	Value
Value of Op Assets	$ 14,910
+ Cash	$ 26
= Value of Firm	$14,936
- Value of Debt	$ 349
= Value of Equity	$14,587
- Equity Options	$ 2,892
Value per share	$ 34.32

	1	2	3	4	5	6	7	8	9	10
Cost of Equity	12.90%	12.90%	12.90%	12.90%	12.90%	12.42%	12.30%	12.10%	11.70%	10.50%
Cost of Debt	8.00%	8.00%	8.00%	8.00%	8.00%	7.80%	7.75%	7.67%	7.50%	7.00%
AT cost of debt	8.00%	8.00%	8.00%	6.71%	5.20%	5.07%	5.04%	4.98%	4.88%	4.55%
Cost of Capital	12.84%	12.84%	12.84%	12.83%	12.81%	12.13%	11.96%	11.69%	11.15%	9.61%

Cost of Equity 12.90%

Cost of Debt
6.5%+1.5%=8.0%
Tax rate = 0% -> 35%

Weights
Debt= 1.2% -> 15%

Riskfree Rate :
T. Bond rate = 6.5%

Beta
1.60 -> 1.00

X

Risk Premium
4%

+

Internet/ Retail

Operating Leverage

Current D/E: 1.21%

Base Equity Premium

Country Risk Premium
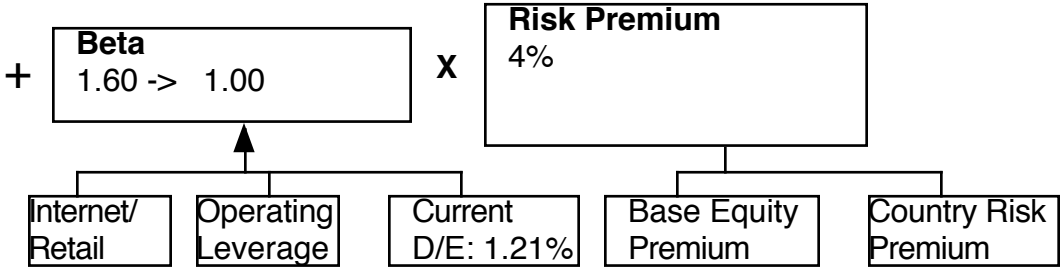
Amazon.com: Break Even at $84?

	6%	8%	10%	12%	14%
30%	$ (1.94)	$ 2.95	$ 7.84	$ 12.71	$ 17.57
35%	$ 1.41	$ 8.37	$ 15.33	$ 22.27	$ 29.21
40%	$ 6.10	$ 15.93	$ 25.74	$ 35.54	$ 45.34
45%	$ 12.59	$ 26.34	$ 40.05	$ 53.77	$ 67.48
50%	$ 21.47	$ 40.50	$ 59.52	$ 78.53	$ 97.54
55%	$ 33.47	$ 59.60	$ 85.72	$ 111.84	$ 137.95
60%	$ 49.53	$ 85.10	$ 120.66	$ 156.22	$ 191.77

Reinvestment:
Cap ex includes acquisitions
Working capital is 3% of revenues

Stable Growth

Current Revenue $ 2,465	Current Margin: -34.60%

Stable Revenue Growth: 5%

Stable Operating Margin: 9.32%

Stable ROC=16.94% Reinvest 29.5% of EBIT(1-t)

EBIT -853m

Sales Turnover Ratio: 3.02

Competitive Advantages

NOL: 1,289 m

Revenue Growth: 25.41%

Expected Margin: -> 9.32%

Terminal Value= 1064/(.0876-.05) =$ 28,310

											Term. Year
Revenues	$4,314	$6,471	$9,059	$11,777	$14,132	$16,534	$18,849	$20,922	$22,596	$23,726	$24,912
EBIT	-$703	-$364	$54	$499	$898	$1,255	$1,566	$1,827	$2,028	$2,164	$2,322
EBIT(1-t)	-$703	-$364	$54	$499	$898	$1,133	$1,018	$1,187	$1,318	$1,406	$1,509
- Reinvestment	$612	$714	$857	$900	$780	$796	$766	$687	$554	$374	$445
FCFF	-$1,315	-$1,078	-$803	-$401	$118	$337	$252	$501	$764	$1,032	$1,064

Term. Year column: $24,912; $2,322; $1,509; $ 445; $1,064

Value of Op Assets	$ 7,967
+ Cash & Non-op	$ 1,263
= Value of Firm	$ 9,230
- Value of Debt	$ 1,890
= Value of Equity	$ 7,340
- Equity Options	$ 748
Value per share	$ 18.74

Timeline: 1 2 3 4 5 6 7 8 9 10 Forever

	1	2	3	4	5	6	7	8	9	10
Debt Ratio	27.27%	27.27%	27.27%	27.27%	27.27%	24.81%	24.20%	23.18%	21.13%	15.00%
Beta	2.18	2.18	2.18	2.18	2.18	1.96	1.75	1.53	1.32	1.10
Cost of Equity	13.81%	13.81%	13.81%	13.81%	13.81%	12.95%	12.09%	11.22%	10.36%	9.50%
AT cost of debt	10.00%	10.00%	10.00%	10.00%	9.06%	6.11%	6.01%	5.85%	5.53%	4.55%
Cost of Capital	12.77%	12.77%	12.77%	12.77%	12.52%	11.25%	10.62%	9.98%	9.34%	8.76%

Cost of Equity 13.81%

Cost of Debt 5.1%+4.75%= 9.85% Tax rate = 0% -> 35%

Weights Debt= 27.38% -> 15%

Riskfree Rate : T. Bond rate = 5.1%

+ **Beta** 2.18-> 1.10 X **Risk Premium** 4%

Internet/ Retail | Operating Leverage | Current D/E: 37.5% | Base Equity Premium | Country Risk Premium
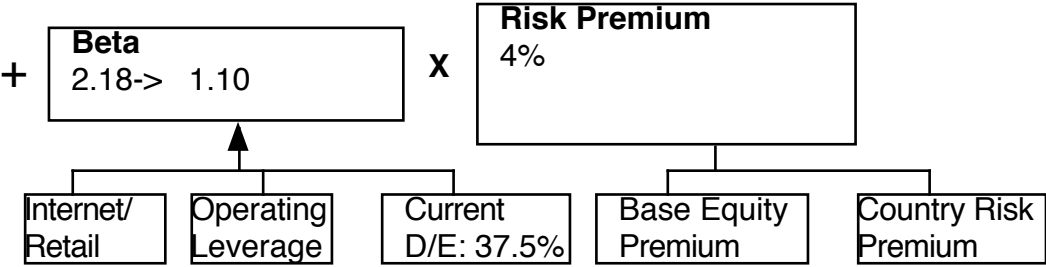
Amazon.com January 2001 Stock price = $14

BMW: Status Quo (Euros)

Current Cashflow to Firm
EBIT(1-t) :   2,227
- Nt CpX   687
- Chg WC   583
= FCFF   € 958
Reinvestment Rate=(687+583)/2227
                    = 57%

Reinvestment Rate
57%

Return on Capital
9.17%

**Expected Growth
in EBIT (1-t)**
.57*.0917=.0523
5.23%

Stable Growth
g = 2%; Beta = 1.00;
Country Premium= 1.5%
Cost of capital = 7.15%
ROC= 7.15%; Tax rate=37%
Reinvestment Rate=g/ROC
        =2/ 7.15= 27.97%

Terminal Value5= 2225/(.0715-.02) = 43,205

Op. Assets€ 34,631
+ Cash: 4,123
- Debt   5,597
- Non-Debt   7,517
=Equity   25,640

Value/Sh   € 38.07

Euro Cashflows

Year	1	2	3	4	5	
EBIT (1-t)	€ 2,344	€ 2,467	€ 2,596	€ 2,731	€ 2,874	
Reinvestment	€ 1,336	€ 1,406	€ 1,479	€ 1,557	€ 1,638	g=2%
FCFF	€ 1,008	€ 1,061	€ 1,116	€ 1,174	€ 1,236	Tax rate changes

Term Yr
3089
- 864
= 2225

Discount at $ Cost of Capital (WACC) = 8.52% (.8015) + 3.26% (0.1985) = 7.47%

On Sept 23, 2004
BMW Common = 33.50 Eu

**Cost of Equity
8.52%**

Cost of Debt
(3.95%+1.50%)(1-.4021)
= 3.26%

Weights
E = 80.15% D = 19.85%

Riskfree Rate:
Euro Riskfree Rate= 3.95%

+

Beta
1.14

X

**Mature market
premium**
3.83 %

+

Lambda
0.08

X

Emerg Market Equity
Risk Premium
2.50%

Unlevered Beta for
Sectors: 0.99

Firm's D/E
Ratio: 24.77%
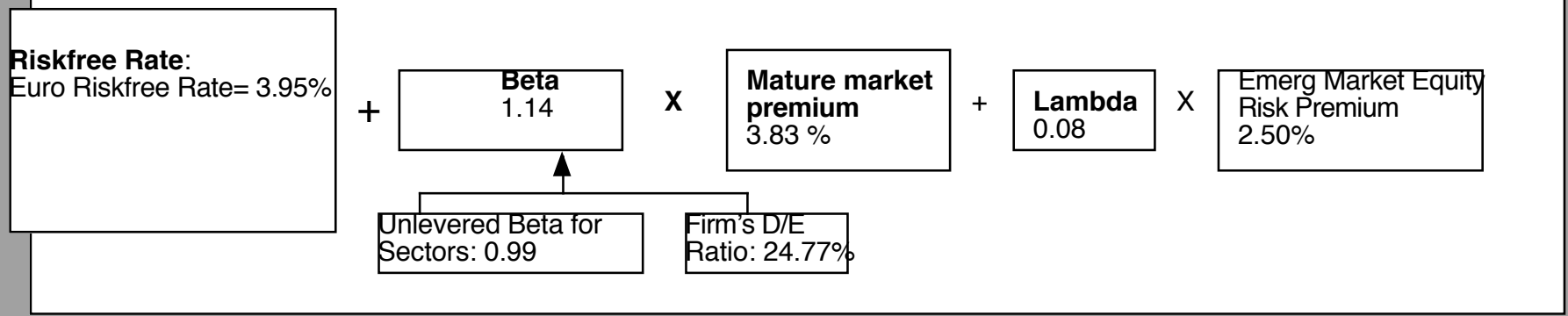
Value Enhancement: Back to Basics

Aswath Damodaran

http://www.damodaran.com

Price Enhancement versus Value Enhancement

Stock price performance of companies that changed their names to include Web-oriented designations like ".com," from 30 trading days before the name-change announcement to 30 days after. The study looked at stocks of companies that changed their names from January 1998 through March 26, 1999.

Source: "A Rose.com by Any Other Name," by Michael J. Cooper, P. Raghavendra Rau and Orlin Dimitrov of Purdue University

NAME THAT STOCK

New Markets, New Names
In the bull market, adding dot-com to a company name made a stock soar. Lately those zippy new monikers are disappearing.

New Name, Higher Price
But the stocks still get a bounce when dot-com goes away. Chart shows returns in the days before and after the name change.

Sources: Thomson Datastream; P. Raghavendra Rau, Michael J. Cooper, Igor Osobov, Purdue Univ.; Ajay Khorana, Virginia Univ.; Ajay Patel, Wake Forest Univ.

The Paths to Value Creation

■ Using the DCF framework, there are four basic ways in which the value of a firm can be enhanced:

- The cash flows from existing assets to the firm can be increased, by either
    - increasing after-tax earnings from assets in place or
    - reducing reinvestment needs (net capital expenditures or working capital)
- The expected growth rate in these cash flows can be increased by either
    - Increasing the rate of reinvestment in the firm
    - Improving the return on capital on those reinvestments
- The length of the high growth period can be extended to allow for more years of high growth.
- The cost of capital can be reduced by
    - Reducing the operating risk in investments/assets
    - Changing the financial mix
    - Changing the financing composition

A Basic Proposition

■ For an action to affect the value of the firm, it has to

- Affect current cash flows (or)
- Affect future growth (or)
- Affect the length of the high growth period (or)
- Affect the discount rate (cost of capital)

■ **Proposition 1: Actions that do not affect current cash flows, future growth, the length of the high growth period or the discount rate cannot affect value.**

Value-Neutral Actions

- Stock splits and stock dividends change the number of units of equity in a firm, but cannot affect firm value since they do not affect cash flows, growth or risk.
- Accounting decisions that affect reported earnings but not cash flows should have no effect on value.
  - Changing inventory valuation methods from FIFO to LIFO or vice versa in financial reports but not for tax purposes
  - Changing the depreciation method used in financial reports (but not the tax books) from accelerated to straight line depreciation
  - Major non-cash restructuring charges that reduce reported earnings but are not tax deductible
  - Using pooling instead of purchase in acquisitions cannot change the value of a target firm.
- Decisions that create new securities on the existing assets of the firm (without altering the financial mix) such as tracking stock cannot create value, though they might affect perceptions and hence the price.

I. Ways of Increasing Cash Flows from Assets in Place

More efficient operations and cost cuttting: Higher Margins

Divest assets that have negative EBIT

Reduce tax rate
- moving income to lower tax locales
- transfer pricing
- risk management

Revenues

* Operating Margin

= EBIT

- Tax Rate * EBIT

= EBIT (1-t)

+ Depreciation
- Capital Expenditures
- Chg in Working Capital
= FCFF

Live off past over-investment

Better inventory management and tighter credit policies

II. Value Enhancement through Growth

Reinvest more in projects

Do acquisitions

Increase operating margins

Increase capital turnover ratio

Reinvestment Rate

* Return on Capital

= Expected Growth Rate
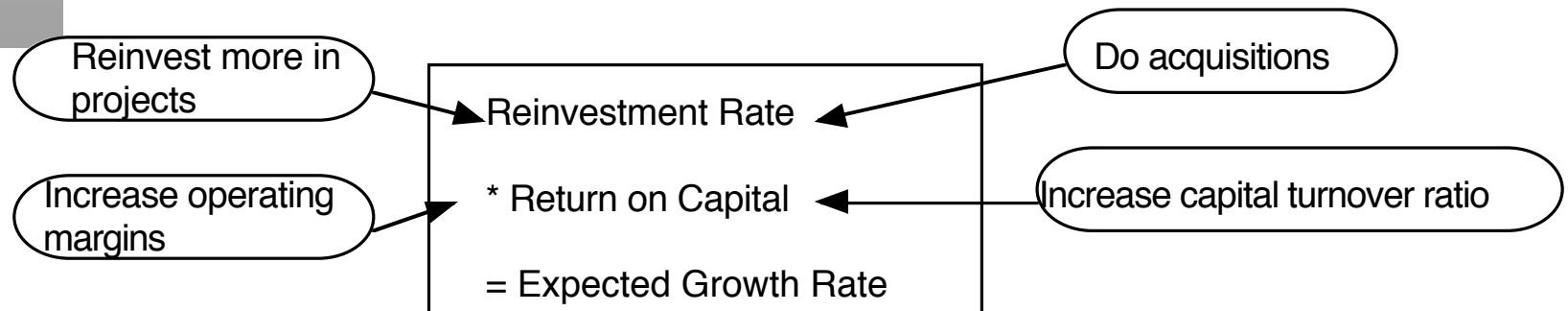
III. Building Competitive Advantages: Increase length of the growth period

Increase length of growth period

Build on existing competitive advantages

Find new competitive advantages

Brand name

Legal Protection

Switching Costs
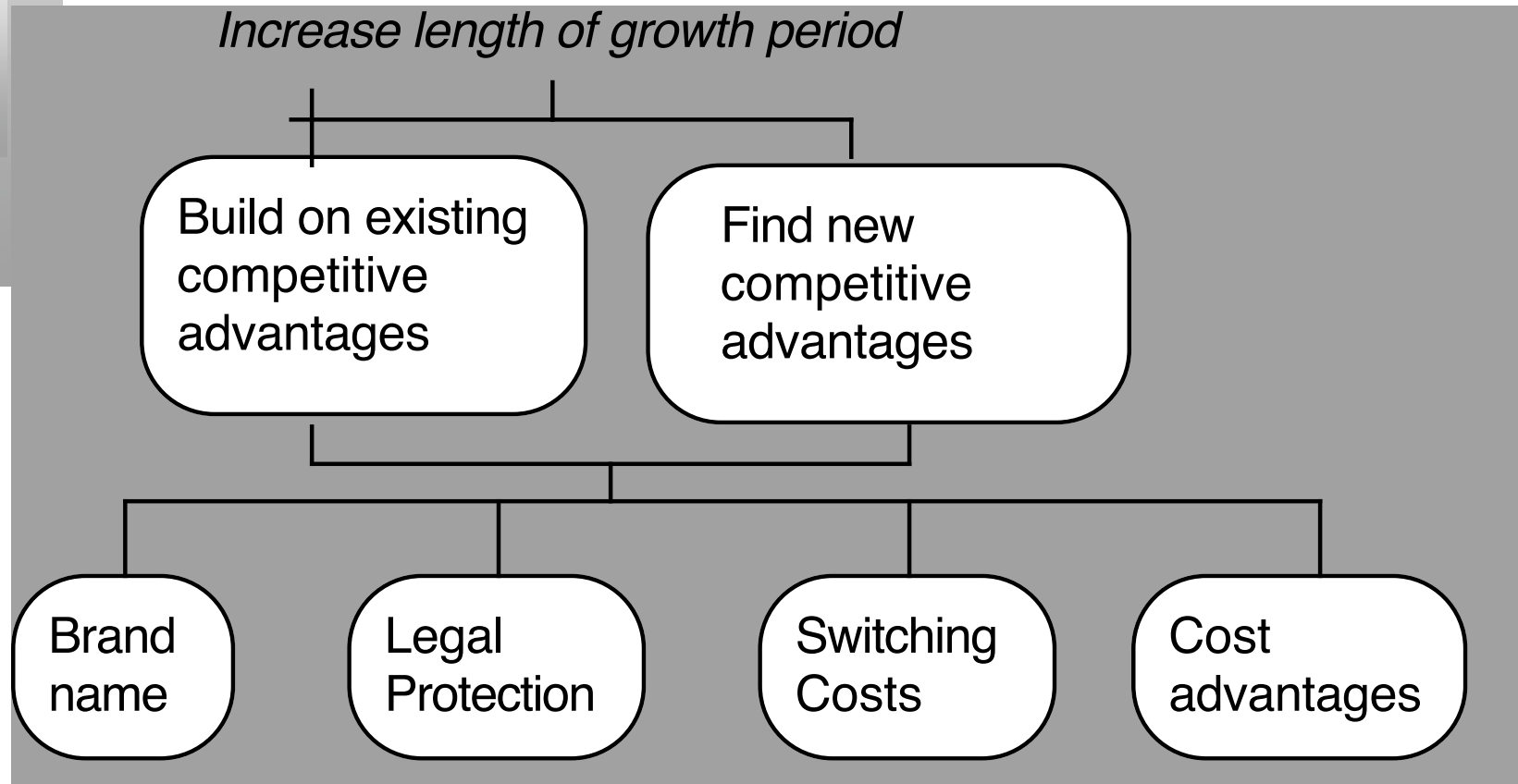
Cost advantages

3.1: The Brand Name Advantage

■ Some firms are able to sustain above-normal returns and growth because they have well-recognized brand names that allow them to charge higher prices than their competitors and/or sell more than their competitors.

■ Firms that are able to improve their brand name value over time can increase both their growth rate and the period over which they can expect to grow at rates above the stable growth rate, thus increasing value.

Illustration: Valuing a brand name: Coca Cola

	Coca Cola	Generic Cola Company
AT Operating Margin	**18.56%**	**7.50%**
Sales/BV of Capital	1.67	1.67
ROC	31.02%	12.53%
Reinvestment Rate	65.00% (19.35%)	65.00% (47.90%)
Expected Growth	20.16%	8.15%
Length	10 years	10 yea
Cost of Equity	12.33%	12.33%
E/(D+E)	97.65%	97.65%
AT Cost of Debt	4.16%	4.16%
D/(D+E)	2.35%	2.35%
Cost of Capital	12.13%	12.13%
Value	**$115**	**$13**

3.2: Patents and Legal Protection

■ The most complete protection that a firm can have from competitive pressure is to own a patent, copyright or some other kind of legal protection allowing it to be the sole producer for an extended period.

■ Note that patents only provide partial protection, since they cannot protect a firm against a competitive product that meets the same need but is not covered by the patent protection.

■ Licenses and government-sanctioned monopolies also provide protection against competition. They may, however, come with restrictions on excess returns; utilities in the United States, for instance, are monopolies but are regulated when it comes to price increases and returns.

3.3: Switching Costs

- Another potential barrier to entry is the cost associated with switching from one firm's products to another.

- The greater the switching costs, the more difficult it is for competitors to come in and compete away excess returns.

- Firms that devise ways to increase the cost of switching from their products to competitors' products, while reducing the costs of switching from competitor products to their own will be able to increase their expected length of growth.

3.4: Cost Advantages

■ There are a number of ways in which firms can establish a cost advantage over their competitors, and use this cost advantage as a barrier to entry:

- In businesses, where scale can be used to reduce costs, economies of scale can give bigger firms advantages over smaller firms
- Owning or having exclusive rights to a distribution system can provide firms with a cost advantage over its competitors.
- Owning or having the rights to extract a natural resource which is in restricted supply (The undeveloped reserves of an oil or mining company, for instance)

■ These cost advantages will show up in valuation in one of two ways:

- The firm may charge the same price as its competitors, but have a much higher operating margin.
- The firm may charge lower prices than its competitors and have a much higher capital turnover ratio.

Gauging Barriers to Entry

- ■ Which of the following barriers to entry are most likely to work for BMW?
  - ❑ Brand Name
  - ❑ Patents and Legal Protection
  - ❑ Switching Costs
  - ❑ Cost Advantages
- ■ What about for Amazon.com?
  - ❑ Brand Name
  - ❑ Patents and Legal Protection
  - ❑ Switching Costs
  - ❑ Cost Advantages

Reducing Cost of Capital

Outsourcing

Flexible wage contracts & cost structure

Reduce operating leverage

Change financing mix

Cost of Equity (E/(D+E) + Pre-tax Cost of Debt (D./(D+E)) = Cost of Capital

Make product or service less discretionary to customers

Match debt to assets, reducing default risk

Changing product characteristics

More effective advertising

Swaps

Derivatives

Hybrids
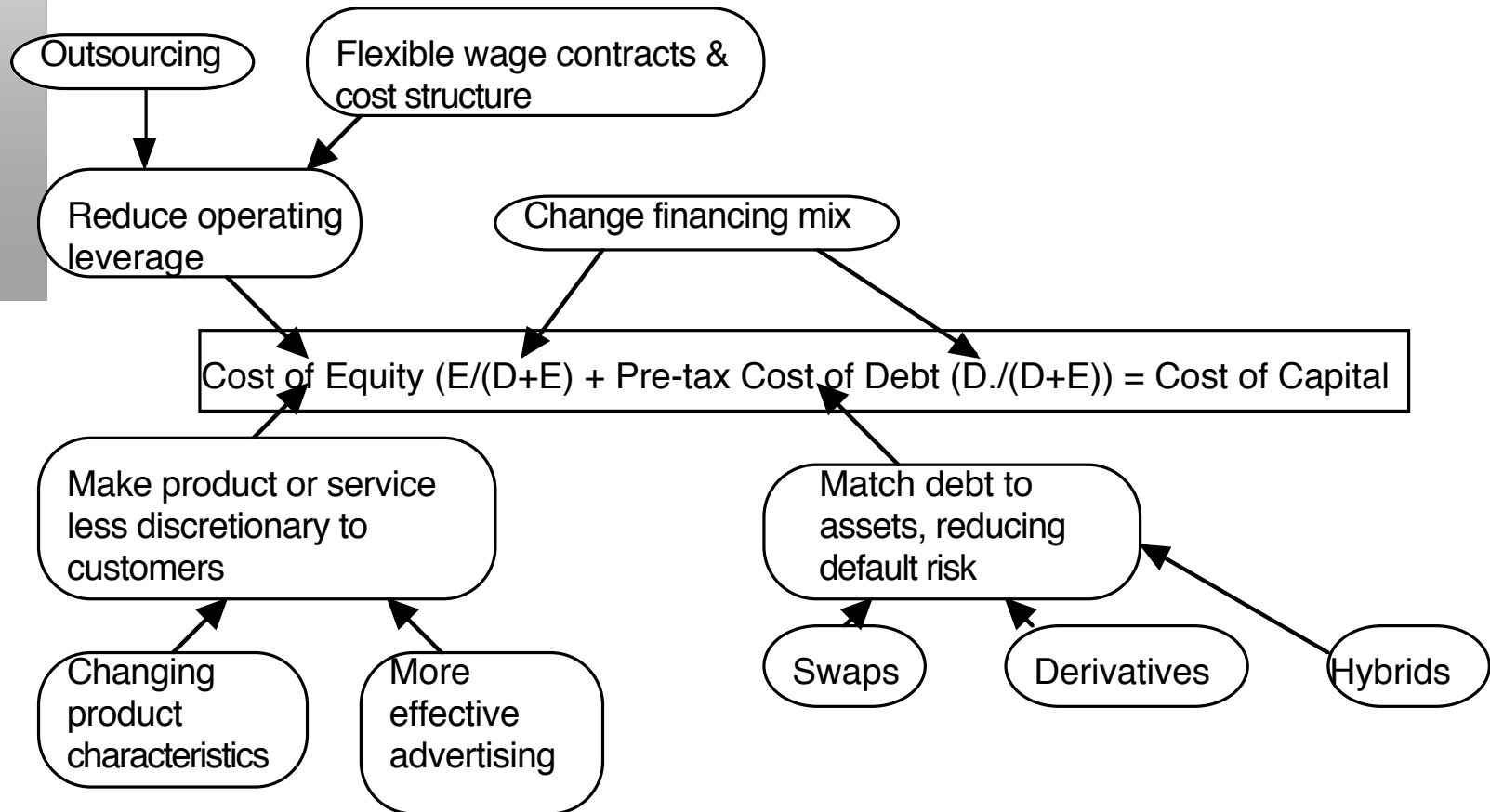
Amazon.com: Optimal Debt Ratio

Debt Ratio	Beta	Cost of Equity	Bond Rating	Interest rate on debt	Tax Rate	Cost of Debt (after-tax)	WACC	Firm Value (G)
0%	1.58	12.82%	AAA	6.80%	0.00%	6.80%	12.82%	$29,192
10%	1.76	13.53%	D	18.50%	0.00%	18.50%	14.02%	$24,566
20%	1.98	14.40%	D	18.50%	0.00%	18.50%	15.22%	$21,143
30%	2.26	15.53%	D	18.50%	0.00%	18.50%	16.42%	$18,509
40%	2.63	17.04%	D	18.50%	0.00%	18.50%	17.62%	$16,419
50%	3.16	19.15%	D	18.50%	0.00%	18.50%	18.82%	$14,719
60%	3.95	22.31%	D	18.50%	0.00%	18.50%	20.02%	$13,311
70%	5.27	27.58%	D	18.50%	0.00%	18.50%	21.22%	$12,125
80%	7.90	38.11%	D	18.50%	0.00%	18.50%	22.42%	$11,112
90%	15.81	69.73%	D	18.50%	0.00%	18.50%	23.62%	$10,237

BMW : Optimal Capital Structure

Debt Ratio	Beta	Cost of Equity	Bond Rating	Interest rate on debt	Tax Rate	Cost of Debt (after-tax)	WACC	Firm Value (G)
0%	0.99	7.95%	AAA	4.30%	40.21%	2.57%	7.95%	$25,604
10%	1.06	8.22%	AAA	4.30%	40.21%	2.57%	7.65%	$26,945
20%	1.14	8.55%	AAA	4.30%	40.21%	2.57%	7.35%	$28,432
30%	1.25	8.98%	A+	4.65%	40.21%	2.78%	7.12%	$29,725
40%	1.39	9.55%	A-	4.95%	40.21%	2.96%	6.91%	$30,953
50%	1.59	10.34%	BB+	5.95%	40.21%	3.56%	6.95%	$30,713
60%	1.88	11.54%	B+	7.20%	40.21%	4.30%	7.20%	$29,268
70%	2.38	13.53%	B-	9.95%	40.21%	5.95%	8.22%	$24,488
80%	3.42	17.71%	CC	13.95%	39.00%	8.51%	10.35%	$18,247
90%	6.83	31.48%	CC	13.95%	34.67%	9.11%	11.35%	$16,275

BMW: Restructured

Grow more in emerging markets

Current Cashflow to Firm
EBIT(1-t) :   2,227
- Nt CpX   687
- Chg WC   583
= FCFF   € 958
Reinvestment Rate=(687+583)/2227
                  = 57%

Reinvestment Rate 70%

Expected Growth in EBIT (1-t)
.70*.12=.084
8.40%

Return on Capital 12.00%

Stable Growth
g = 2%; Beta = 1.00;
Country Premium= 1.5%
Cost of capital = 6.49%
ROC= 6.49%; Tax rate=37%
Reinvestment Rate=g/ROC
        =2/ 6.49= 30.80%

Terminal Value$_5$= 2480/(.0649-.02) = 43,205

Euro Cashflows

Year	1	2	3	4	5		Term Yr
EBIT (1-t)	€ 2,415	€ 2,617	€ 2,837	€ 3,076	€ 3,334		3583
- Reinvestment	€ 1,690	€ 1,832	€ 1,986	€ 2,153	€ 2,334	g=2%	-1103
= FCFF	€ 724	€ 785	€ 851	€ 923	€ 1,000	Tax rate changes	= 2480

Op. Assets € 42,118
+ Cash: 4,123
- Debt   5,523
- Non-Debt   7,517
=Equity   33,201

Value/Sh   € 49.30

Discount at $ Cost of Capital (WACC) = 9.90% (.60) + 3.56% (0.40) = 7.36%

On Sept 23, 2004
BMW Common = 33.50 Eu

Change financing mix

Cost of Equity
9.90%

Cost of Debt
(3.95%+2.00%)(1-.4021)
= 3.56%

Weights
E = 60% D = 40%

Riskfree Rate:
Euro Riskfree Rate= 3.95%

+

Beta
1.39

X

Mature market premium
3.83 %

+

Lambda
0.25

X

Emerg Market Equity Risk Premium
2.50%

Unlevered Beta for Sectors: 0.99

Firm's D/E Ratio: 24.77%

Increased risk from emerging markets
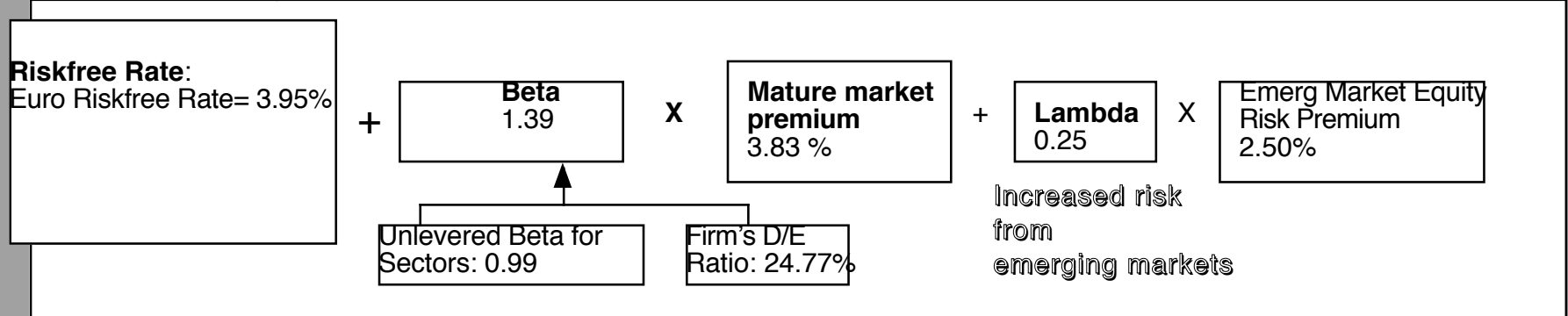
The Value of Control?

- If the value of a firm run optimally is significantly higher than the value of the firm with the status quo (or incumbent management), you can write the value that you should be willing to pay as:

- Value of control = Value of firm optimally run - Value of firm with status quo

- Implications:
  - The value of control is greatest at poorly run firms.
  - Voting shares in poorly run firms should trade at a premium on non-voting shares if the votes associated with the shares will give you a chance to have a say in a hostile acquisition.
  - When valuing private firms, your estimate of value will vary depending upon whether you gain control of the firm. For example, 49% of a private firm may be worth less than 51% of the same firm.

    49% stake = 49% of status quo value

    51% stake = 51% of optimal value

Relative Valuation

Aswath Damodaran

What is relative valuation?

■ In relative valuation, the value of an asset is compared to the values assessed by the market for similar or comparable assets.

■ To do relative valuation then,

- we need to identify comparable assets and obtain market values for these assets
- convert these market values into standardized values, since the absolute prices cannot be compared This process of standardizing creates price multiples.
- compare the standardized value or multiple for the asset being analyzed to the standardized values for comparable asset, controlling for any differences between the firms that might affect the multiple, to judge whether the asset is under or over valued

Relative valuation is pervasive…

- Most valuations on Wall Street are relative valuations.
  - Almost 85% of equity research reports are based upon a multiple and comparables.
  - More than 50% of all acquisition valuations are based upon multiples
  - Rules of thumb based on multiples are not only common but are often the basis for final valuation judgments.
- While there are more discounted cashflow valuations in consulting and corporate finance, they are often relative valuations masquerading as discounted cash flow valuations.
  - The objective in many discounted cashflow valuations is to back into a number that has been obtained by using a multiple.
  - The terminal value in a significant number of discounted cashflow valuations is estimated using a multiple.

Why relative valuation?

"If you think I'm crazy, you should see the guy who lives across the hall"
Jerry Seinfeld talking about Kramer in a Seinfeld episode

" A little inaccuracy sometimes saves tons of explanation"

H.H. Munro

" If you are going to screw up, make sure that you have lots of company"

Ex-portfolio manager

So, you believe only in intrinsic value? Here's why you should still care about relative value

■ Even if you are a true believer in discounted cashflow valuation, presenting your findings on a relative valuation basis will make it more likely that your findings/recommendations will reach a receptive audience.

■ In some cases, relative valuation can help find weak spots in discounted cash flow valuations and fix them.

■ The problem with multiples is not in their use but in their abuse. If we can find ways to frame multiples right, we should be able to use them better.

Standardizing Value

■ You can standardize either the equity value of an asset or the value of the asset itself, which goes in the numerator.

■ You can standardize by dividing by the
- Earnings of the asset
  - Price/Earnings Ratio (PE) and variants (PEG and Relative PE)
  - Value/EBIT
  - Value/EBITDA
  - Value/Cash Flow
- Book value of the asset
  - Price/Book Value(of Equity) (PBV)
  - Value/ Book Value of Assets
  - Value/Replacement Cost (Tobin's Q)
- Revenues generated by the asset
  - Price/Sales per Share (PS)
  - Value/Sales
- Asset or Industry Specific Variable (Price/kwh, Price per ton of steel ....)

The Four Steps to Understanding Multiples

- Define the multiple
    - In use, the same multiple can be defined in <u>different ways</u> by different users. When comparing and using multiples, estimated by someone else, it is critical that we <u>understand how the multiples have been estimated</u>
- Describe the multiple
    - Too many people who use a multiple have <u>no idea what its cross sectional distribution</u> is. If you do not know what the cross sectional distribution of a multiple is, it is difficult to look at a number and pass judgment on whether it is too high or low.
- Analyze the multiple
    - It is critical that we <u>understand the fundamentals</u> that drive each multiple, and the <u>nature of the relationship</u> between the multiple and each variable.
- Apply the multiple
    - Defining the <u>comparable universe</u> and <u>controlling for differences</u> is far more difficult in practice than it is in theory.

Definitional Tests

- Is the multiple consistently defined?
  - **Proposition 1: Both the value (the numerator) and the standardizing variable (the denominator) should be to the same claimholders in the firm. In other words, the value of equity should be divided by equity earnings or equity book value, and firm value should be divided by firm earnings or book value.**
- Is the multiple uniformly estimated?
  - The variables used in defining the multiple <u>should be estimated uniformly</u> across assets in the "comparable firm" list.
  - If earnings-based multiples are used, the <u>accounting rules</u> to measure earnings should be applied consistently across assets. The same rule applies with book-value based multiples.

Descriptive Tests

- What is the <u>average and standard deviation</u> for this multiple, across the universe (market)?

- What is the <u>median</u> for this multiple?
  - The median for this multiple is often a more reliable comparison point.

- How <u>large are the outliers</u> to the distribution, and <u>how do we deal</u> with the outliers?
  - Throwing out the outliers may seem like an obvious solution, but if the outliers all lie on one side of the distribution (they usually are large positive numbers), this can lead to a biased estimate.

- Are there cases where the multiple <u>cannot be estimated</u>? Will ignoring these cases lead to a <u>biased estimate</u> of the multiple?

- How has this multiple <u>changed over time</u>?

Analytical Tests

- What are the <u>fundamentals</u> that determine and drive these multiples?
  - Proposition 2: Embedded in every multiple are all of the variables that drive every discounted cash flow valuation - growth, risk and cash flow patterns.
  - In fact, using a simple discounted cash flow model and basic algebra should yield the fundamentals that drive a multiple
- How do <u>changes in these fundamentals</u> change the multiple?
  - The relationship between a fundamental (like growth) and a multiple (such as PE) is seldom linear. For example, if firm A has twice the growth rate of firm B, it will generally not trade at twice its PE ratio
  - **Proposition 3: It is impossible to properly compare firms on a multiple, if we do not know the nature of the relationship between fundamentals and the multiple.**

Application Tests

■ Given the firm that we are valuing, what is a "comparable" firm?

- While traditional analysis is built on the premise that firms in the same sector are comparable firms, valuation theory would suggest that a comparable firm is one which is similar to the one being analyzed in terms of fundamentals.

- **Proposition 4: There is no reason why a firm cannot be compared with another firm in a very different business, if the two firms have the same risk, growth and cash flow characteristics.**

■ Given the comparable firms, how do we adjust for differences across firms on the fundamentals?

- **Proposition 5: It is impossible to find an exactly identical firm to the one you are valuing.**

Price Earnings Ratio: Definition

PE = Market Price per Share / Earnings per Share

■ There are a number of variants on the basic PE ratio in use. They are based upon how the price and the earnings are defined.

■ Price: is usually the current price

is sometimes the average price for the year

■ EPS: earnings per share in most recent financial year

earnings per share in trailing 12 months (Trailing PE)

forecasted earnings per share next year (Forward PE)

forecasted earnings per share in future year

PE Ratio: Distribution for the US: January 2004
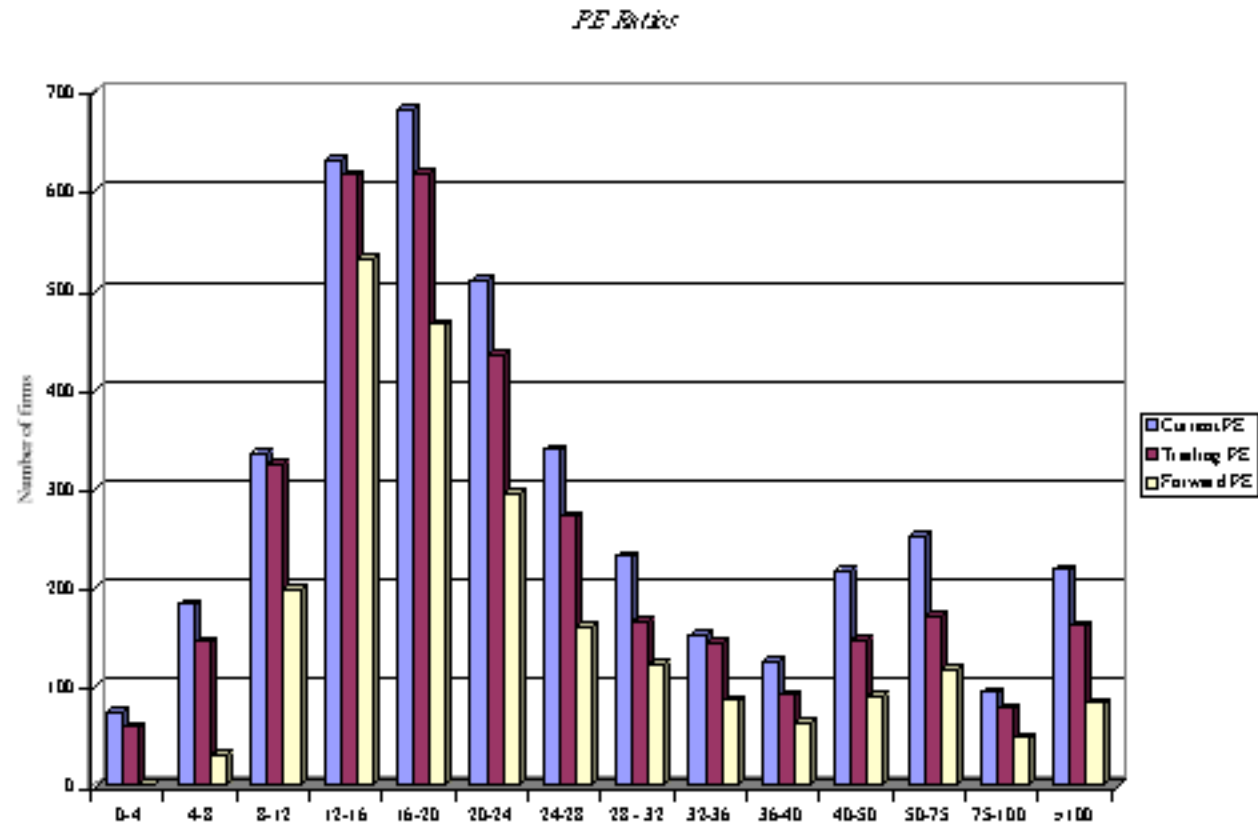
PE: Deciphering the Distribution

	Current PE	Trailing PE	Forward PE
Mean	41.41	41.53	30.90
Standard Error	2.42	3.64	1.10
Median	20.76	19.39	19.21
Kurtosis	1062.81	700.63	252.62
Skewness	27.78	24.21	12.48
Minimum	0.40	1.22	2.57
Maximum	6841.25	7184.00	1430.00
Count	4032	3492	2281
500th largest	54.50	43.98	31.13
500th smallest	11.31	11.13	14.29

Comparing PE Ratios: Europe, Japan and Emerging Markets
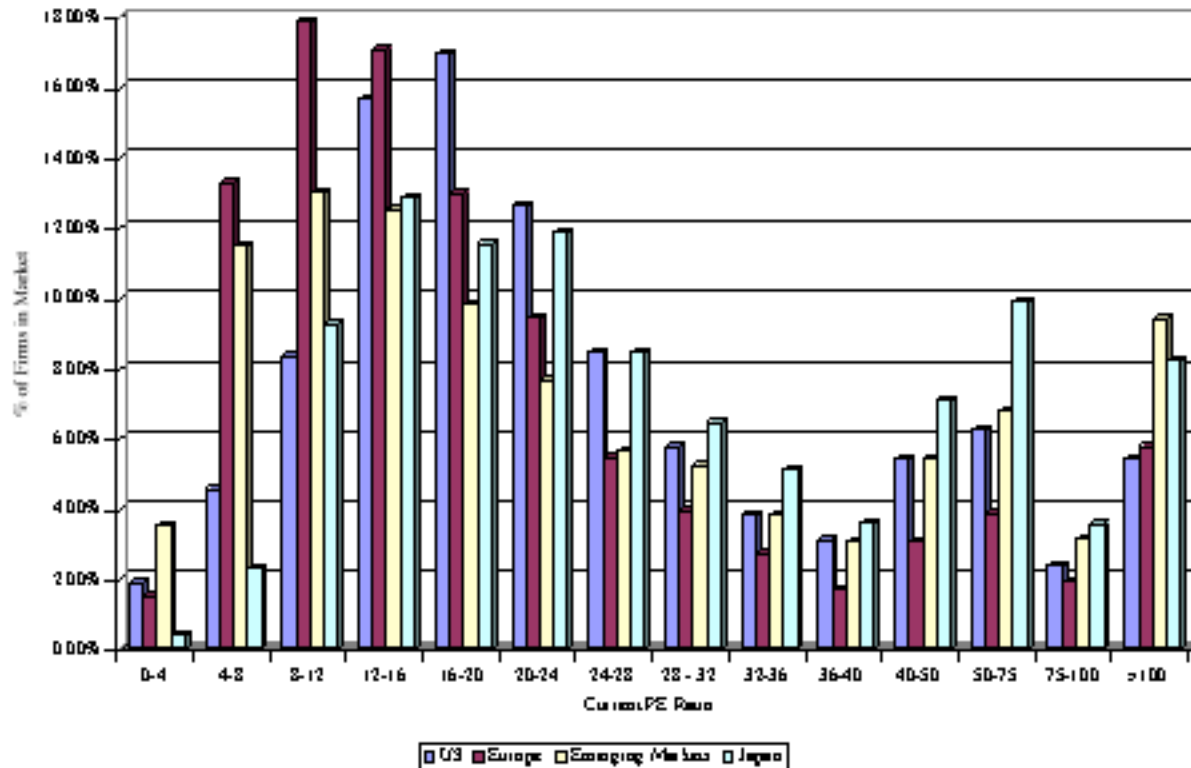
Median PE
Japan = 24.74
US = 20.76
Em. Mkts = 18.87
Europe = 15.99

PE Ratio: Germany in September 2004

PE Ratios: Germany in September 2004

119 German firms (about 25% of sample) had no PE ratios

Average PE across all German stocks =26.50
Median PE across all German stocks =16.50

Novasoft PE =1355

Daimler Chrysler PE = 76.64

BMW PE =11.36
Volkswagen PE = 11.36
Audi PE = 11.36

Aver

Number of firms

PE Ratio

0-4 4-8 8-12 12-16 16-20 20-24 24-28 28-32 32-36 36-40 >40
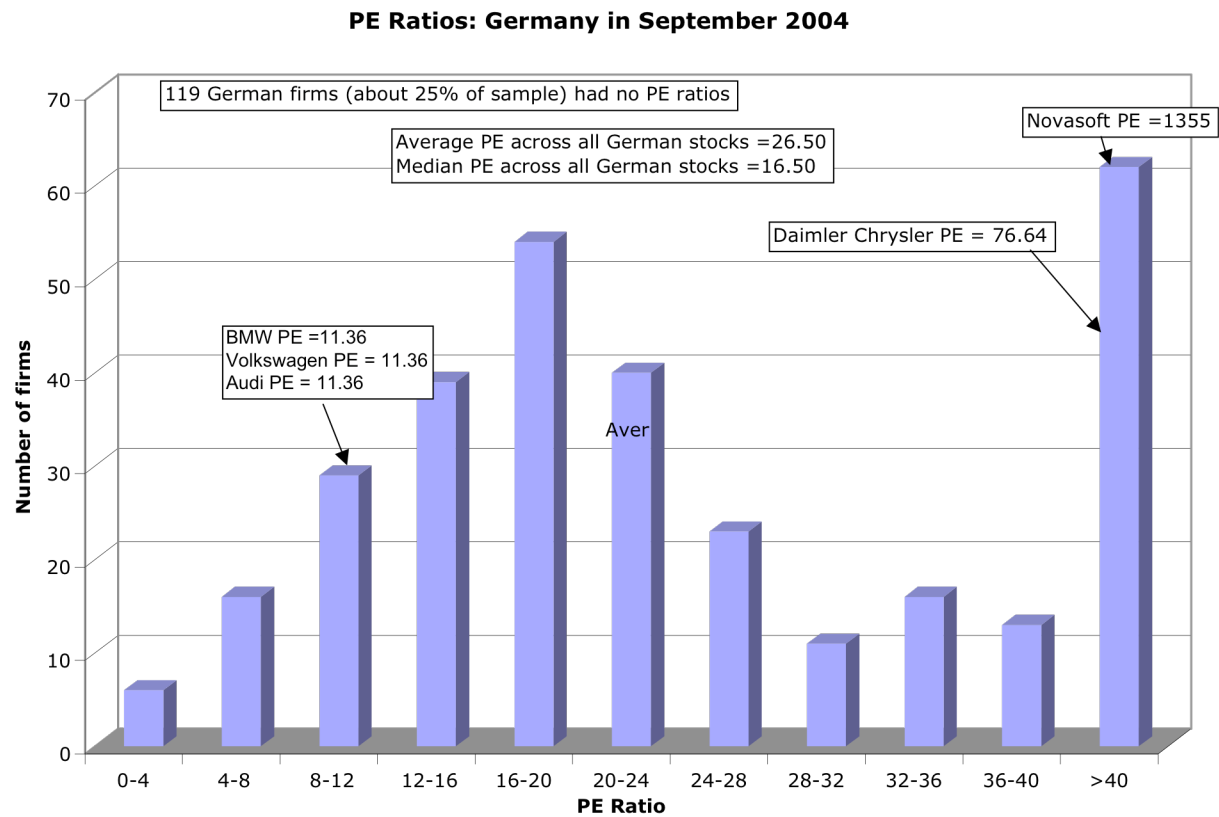
PE Ratio: Understanding the Fundamentals

- To understand the fundamentals, start with a basic <u>equity</u> discounted cash flow model.

- With the dividend discount model,

$$P_0 = \frac{DPS_1}{r - g_n}$$

- Dividing both sides by the earnings per share,

$$\frac{P_0}{EPS_0} = PE = \frac{Payout\ Ratio * (1 + g_n)}{r - g_n}$$

- If this had been a FCFE Model,

$$P_0 = \frac{FCFE_1}{r - g_n}$$

$$\frac{P_0}{EPS_0} = PE = \frac{(FCFE/Earnings) * (1 + g_n)}{r - g_n}$$

PE Ratio and Fundamentals

■ **Proposition: Other things held equal, <u>higher growth firms </u>will have higher PE ratios than lower growth firms.**

■ **Proposition: Other things held equal, <u>higher risk firms </u>will have lower PE ratios than lower risk firms**

■ **Proposition: Other things held equal, <u>firms with lower reinvestment needs </u>will have higher PE ratios than firms with higher reinvestment rates.**

■ Of course, other things are difficult to hold equal since high growth firms, tend to have risk and high reinvestment rats.

Using the Fundamental Model to Estimate PE For a High Growth Firm

■ The price-earnings ratio for a high growth firm can also be related to fundamentals. In the special case of the two-stage dividend discount model, this relationship can be made explicit fairly simply:

$$P_0 = \frac{EPS_0 * \text{Payout Ratio} * (1+g) * \left(1 - \frac{(1+g)^n}{(1+r)^n}\right)}{r - g} + \frac{EPS_0 * \text{Payout Ratio}_n * (1+g)^n * (1+g_n)}{(r - g_n)(1+r)^n}$$

- For a firm that does not pay what it can afford to in dividends, substitute FCFE/Earnings for the payout ratio.

■ Dividing both sides by the earnings per share:

$$\frac{P_0}{EPS_0} = \frac{\text{Payout Ratio} * (1+g) * \left(1 - \frac{(1+g)^n}{(1+r)^n}\right)}{r - g} + \frac{\text{Payout Ratio}_n * (1+g)^n * (1+g_n)}{(r - g_n)(1+r)^n}$$

Expanding the Model

- In this model, the PE ratio for a high growth firm is a function of growth, risk and payout, exactly the same variables that it was a function of for the stable growth firm.

- The only difference is that these inputs have to be estimated for two phases - the high growth phase and the stable growth phase.

- Expanding to more than two phases, say the three stage model, will mean that risk, growth and cash flow patterns in each stage.

A Simple Example

■ Assume that you have been asked to estimate the PE ratio for a firm which has the following characteristics:

Variable	High Growth Phase	Stable Growth Phase
Expected Growth Rate	25%	8%
Payout Ratio	20%	50%
Beta	1.00	1.00
Number of years	5 years	Forever after year 5

■ Riskfree rate = T.Bond Rate = 6%

■ Required rate of return = 6% + 1(5.5%)= 11.5%

$$PE = \frac{0.2 * (1.25) * \left(1 - \frac{(1.25)^5}{(1.115)^5}\right)}{(.115 - .25)} + \frac{0.5 * (1.25)^5 * (1.08)}{(.115 - .08)(1.115)^5} = 28.75$$

PE and Growth: Firm grows at x% for 5 years, 8% thereafter
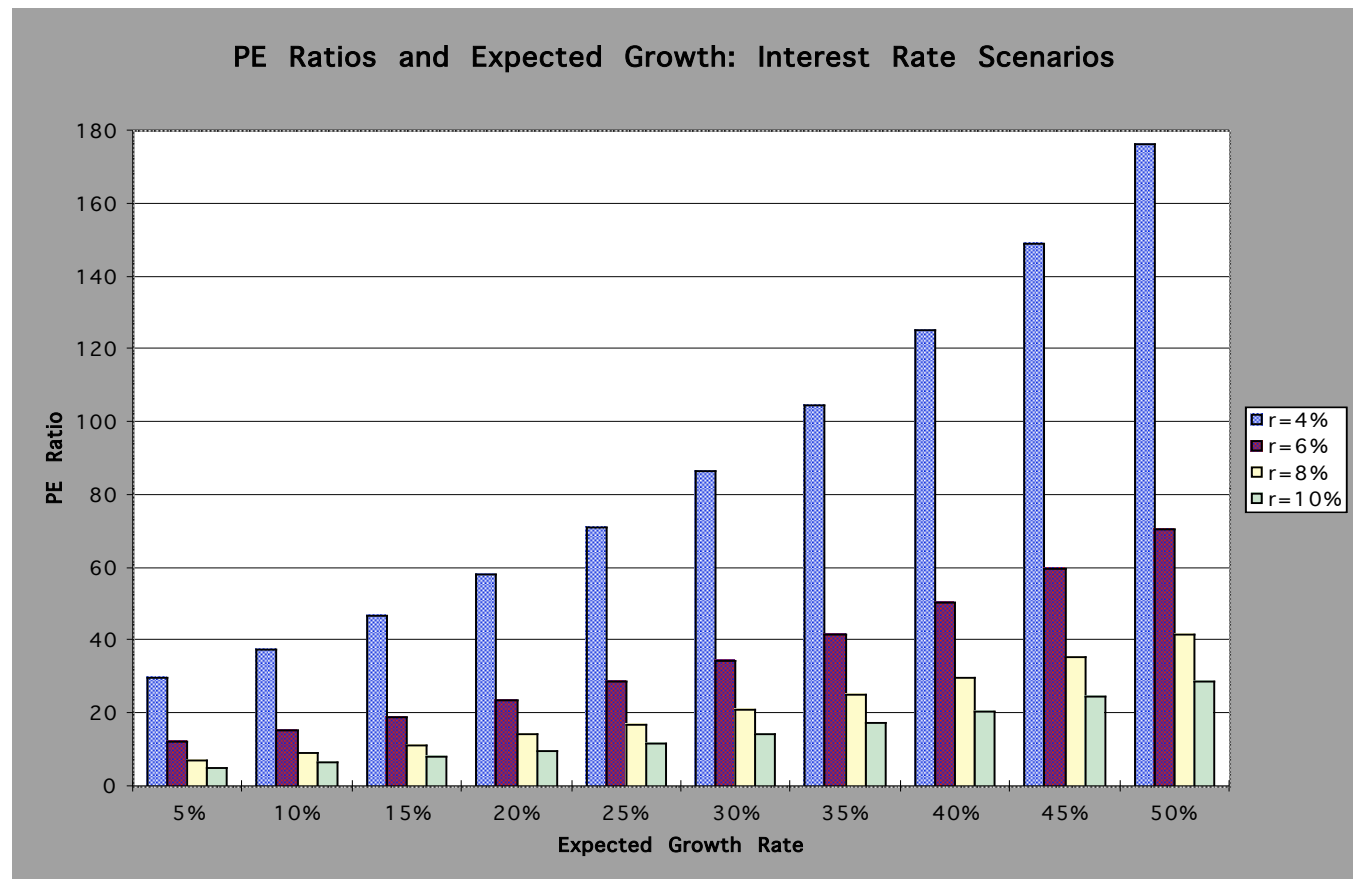
PE Ratios and Length of High Growth: 25% growth for n years; 8% thereafter

PE Ratios and Length of High Growth Period
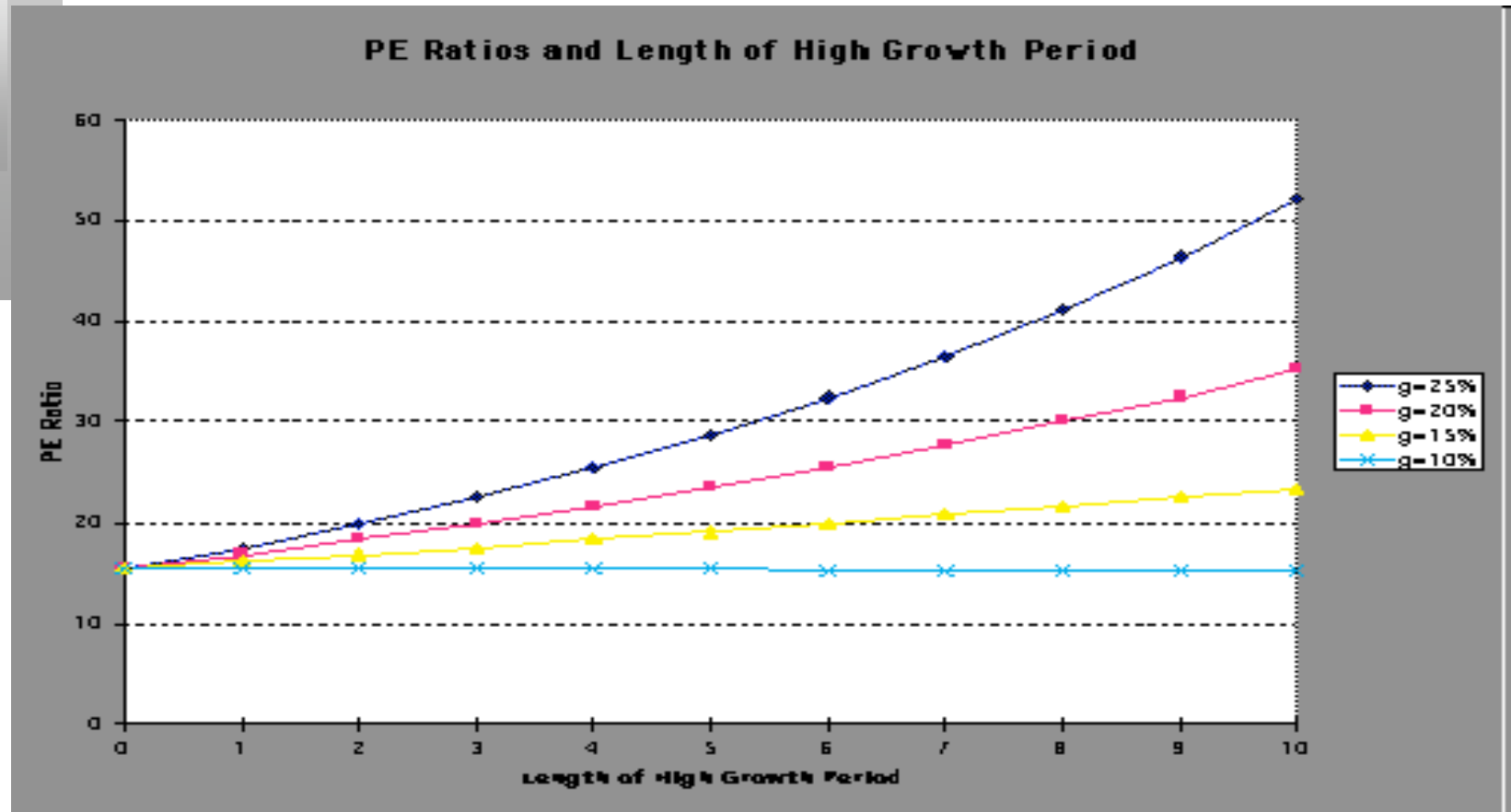
PE and Risk: Effects of Changing Betas on PE Ratio:

Firm with x% growth for 5 years; 8% thereafter

PE and Payout

PE Ratios and Payour Ratios: Growth Scenarios
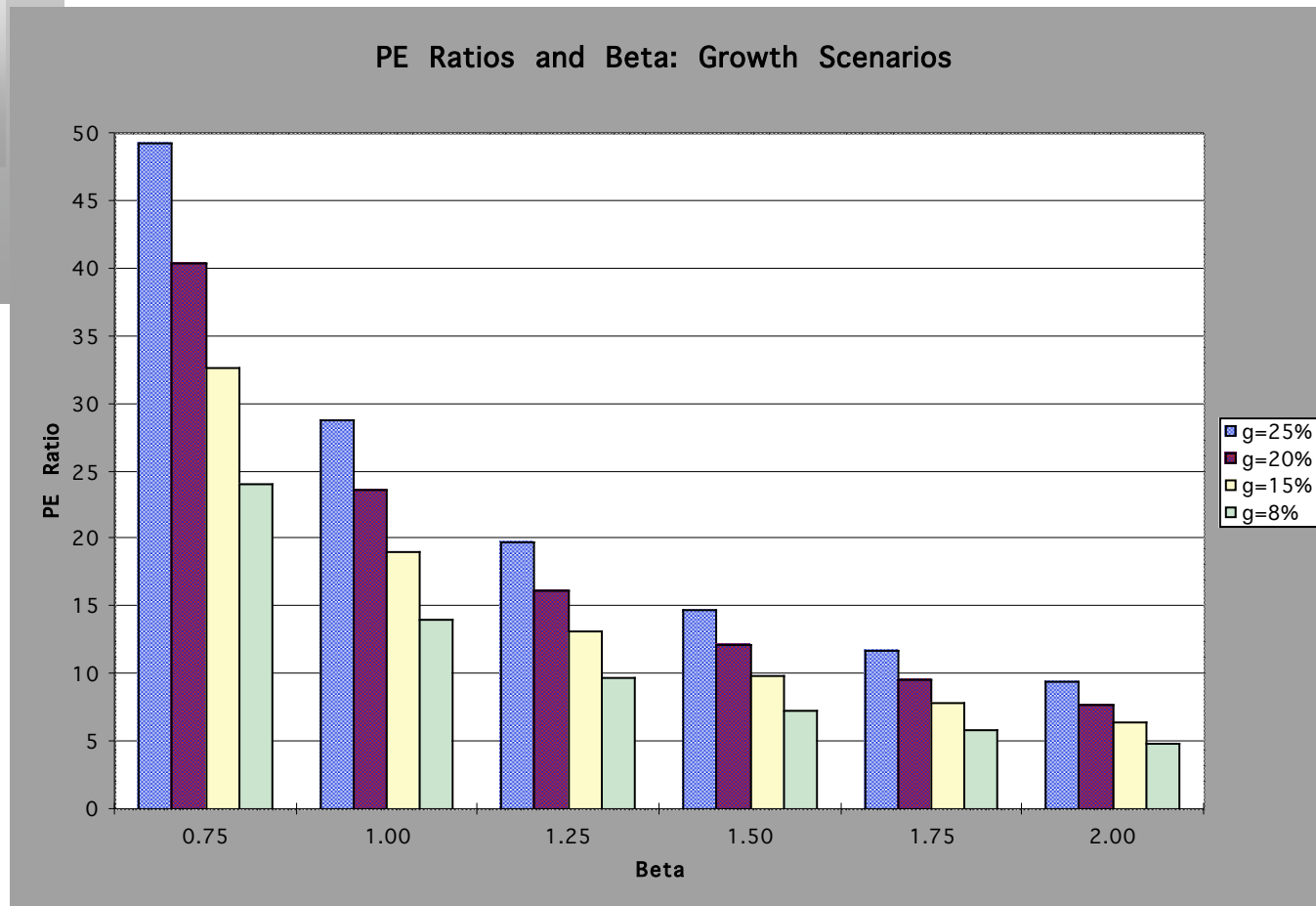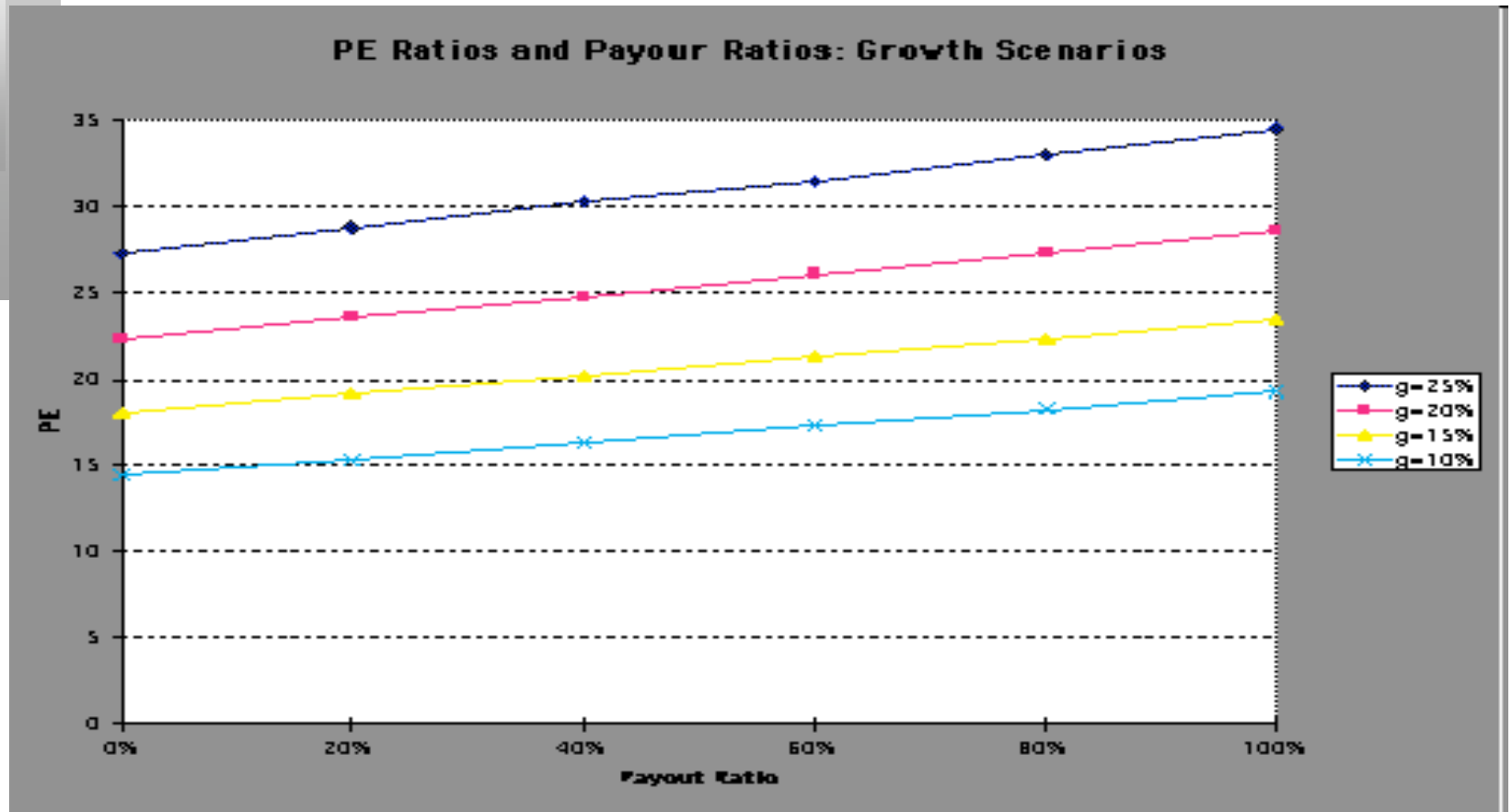
I. Comparisons of PE across time: PE Ratio for the S&P 500

PE Ratio: 1960-2(
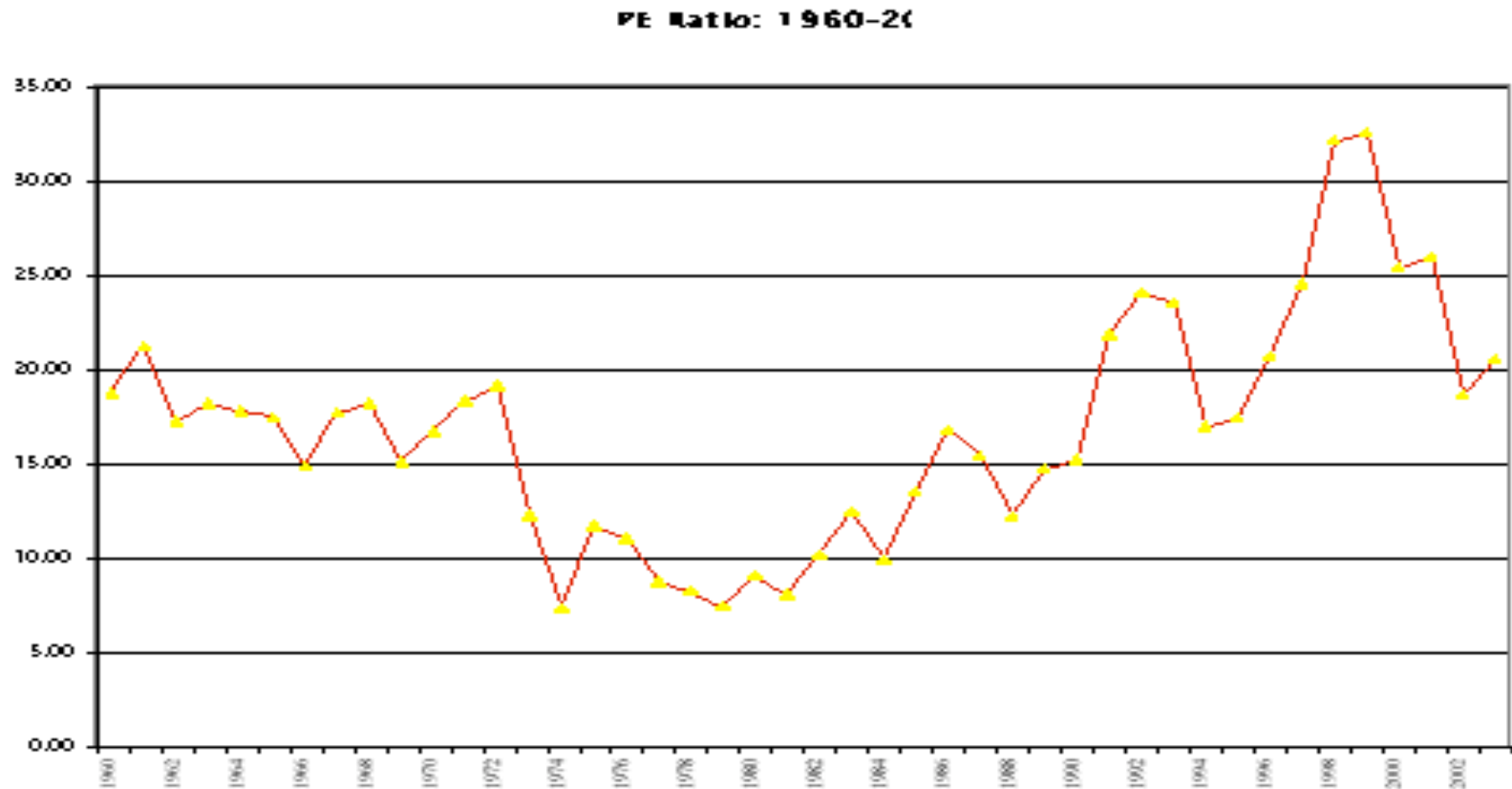
Is low (high) PE cheap (expensive)?

- A market strategist argues that stocks are over priced because the PE ratio today is too high relative to the average PE ratio across time. Do you agree?
  - ❑ Yes
  - ❑ No
- If you do not agree, what factors might explain the higher PE ratio today?

E/P Ratios , T.Bond Rates and Term Structure

EP Ratios and Interest Rates: 1960-2003
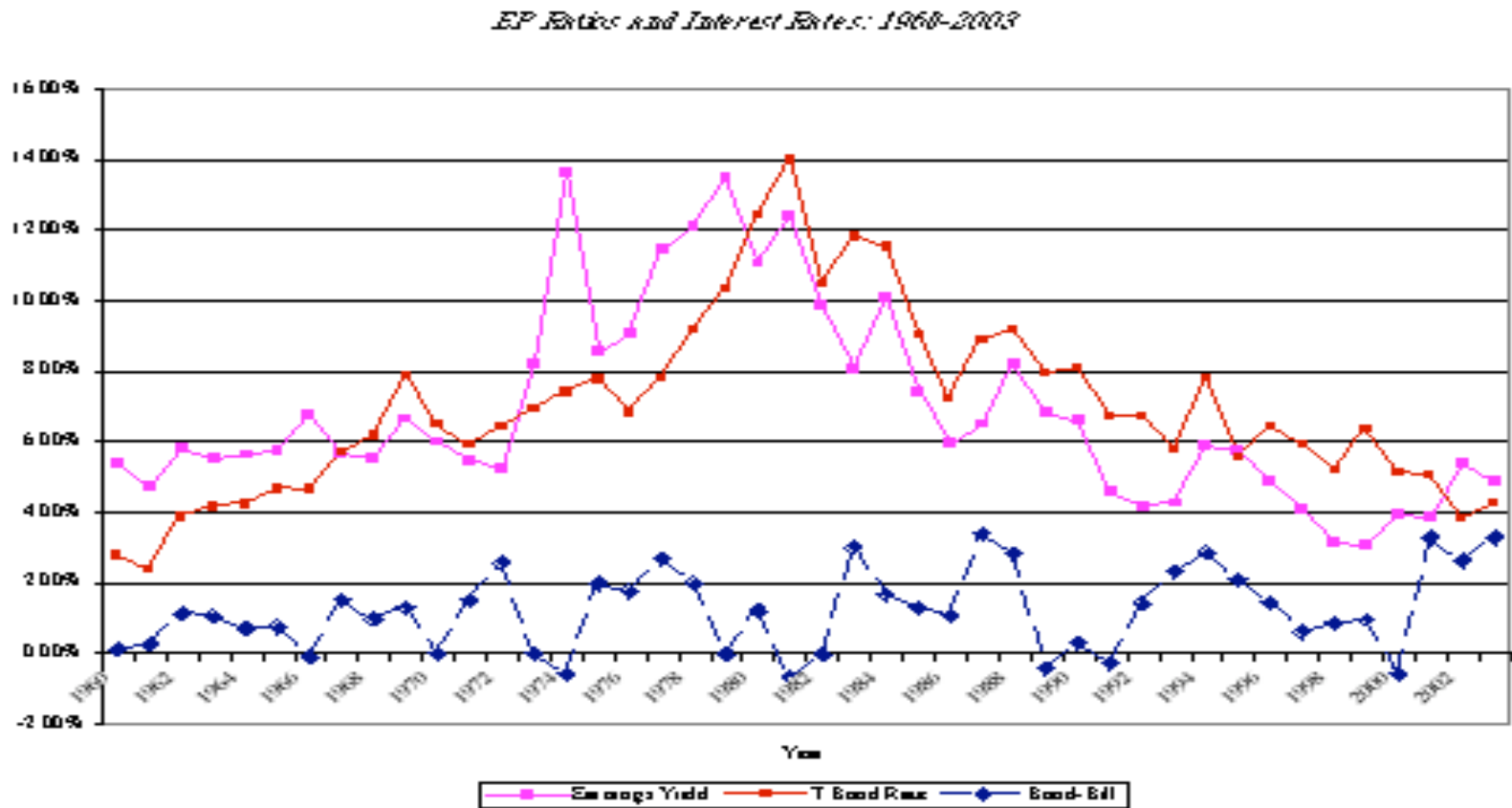
Regression Results

■ There is a strong positive relationship between E/P ratios and T.Bond rates, as evidenced by the correlation of 0.69 between the two variables.,

■ In addition, there is evidence that the term structure also affects the PE ratio.

■ In the following regression, using 1960-2003 data, we regress E/P ratios against the level of T.Bond rates and a term structure variable (T.Bond - T.Bill rate)

  E/P = 2.03% + 0.753 T.Bond Rate - 0.355 (T.Bond Rate-T.Bill Rate)
      (2.19)   (6.38)   (-1.38)

  R squared = 50.85%

II. Comparing PE Ratios across a Sector

Company Name	PE	Growth
PT Indosat ADR	7.8	0.06
Telebras ADR	8.9	0.075
Telecom Corporation of New Zealand ADR	11.2	0.11
Telecom Argentina Stet - France Telecom SA ADR B	12.5	0.08
Hellenic Telecommunication Organization SA ADR	12.8	0.12
Telecomunicaciones de Chile ADR	16.6	0.08
Swisscom AG ADR	18.3	0.11
Asia Satellite Telecom Holdings ADR	19.6	0.16
Portugal Telecom SA ADR	20.8	0.13
Telefonos de Mexico ADR L	21.1	0.14
Matav RT ADR	21.5	0.22
Telstra ADR	21.7	0.12
Gilat Communications	22.7	0.31
Deutsche Telekom AG ADR	24.6	0.11
British Telecommunications PLC ADR	25.7	0.07
Tele Danmark AS ADR	27	0.09
Telekomunikasi Indonesia ADR	28.4	0.32
Cable & Wireless PLC ADR	29.8	0.14
APT Satellite Holdings ADR	31	0.33
Telefonica SA ADR	32.5	0.18
Royal KPN NV ADR	35.7	0.13
Telecom Italia SPA ADR	42.2	0.14
Nippon Telegraph & Telephone ADR	44.3	0.2
France Telecom SA ADR	45.2	0.19
Korea Telecom ADR	71.3	0.44

PE, Growth and Risk

Dependent variable is: PE

R squared = 66.2%   R squared (adjusted) = 63.1%

Variable	Coefficient	SE	t-ratio	prob
Constant	13.1151	3.471	3.78	0.0010
Growth rate	121.223	19.27	6.29	≤ 0.0001
Emerging Market	-13.8531	3.606	-3.84	0.0009

Emerging Market is a dummy: 1 if emerging market

0 if not

Is Telebras under valued?

- Predicted PE = 13.12 + 121.22 (.075) - 13.85 (1) = 8.35
- At an actual price to earnings ratio of 8.9, Telebras is slightly overvalued.

- What about Deutsche Telecom?
  - If viewed as a developed market telecom

  13.12 + 121.22 (0.11) -13.85 (0) = 26.45

  It is slightly undervalued at 24.6 times earnings

Using the entire crosssection: A regression approach

- In contrast to the 'comparable firm' approach, the information in the entire cross-section of firms can be used to predict PE ratios.
- The simplest way of summarizing this information is with a multiple regression, with the PE ratio as the dependent variable, and proxies for risk, growth and payout forming the independent variables.

PE versus Growth

Current PE vs Expected Growth in EPS

January 2004: US Companies

Expected Growth in EPS: next 5 years

Aswath Damodaran
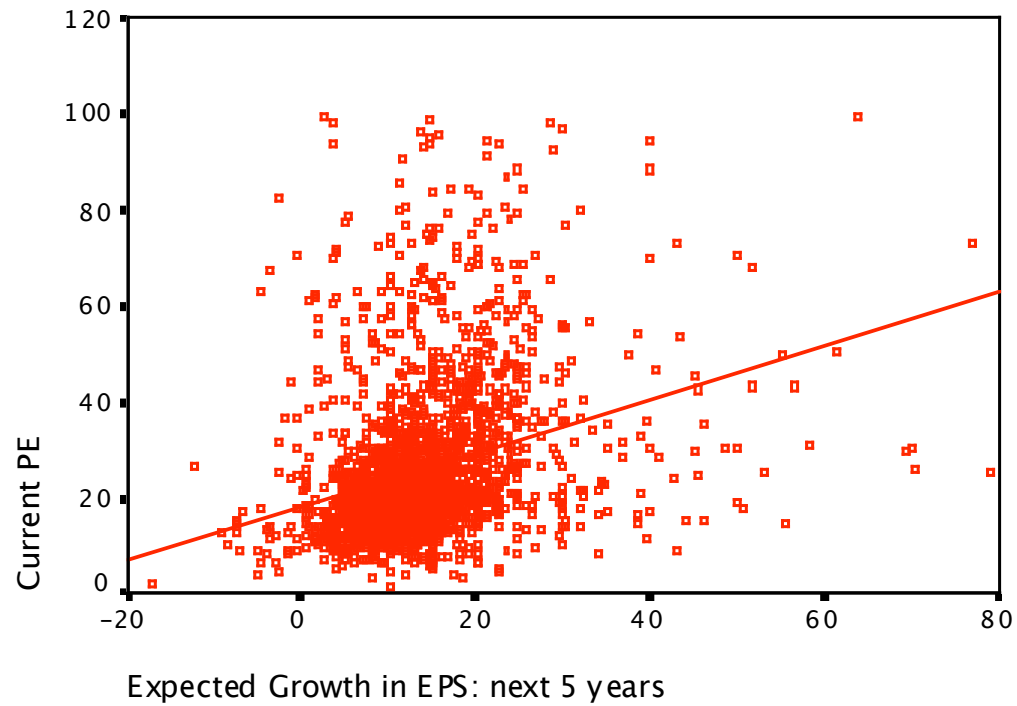
PE Ratio: Standard Regression for US stocks - January 2004

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.467[a]	.218	.217	1049.7506205340

a. Predictors: (Constant), PAYOUT, Regression Beta, Expected Growth in EPS: next 5 years

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	9.475	.961		9.862	.000
	Expected Growth in EPS: next 5 years	.814	.046	.375	17.558	.000
	Regression Beta	6.283	.437	.298	14.375	.000
	PAYOUT	6.E-02	.014	.092	4.161	.000

a. Dependent Variable: Current PE

b. Weighted Least Squares Regression – Weighted by Market Cap

Problems with the regression methodology

■ The basic regression assumes a <u>linear relationship</u> between PE ratios and the financial proxies, and that might not be appropriate.

■ The basic relationship between PE ratios and financial variables itself <u>might not be stable</u>, and if it shifts from year to year, the predictions from the model may not be reliable.

■ The independent variables are <u>correlated with each other</u>. For example, high growth firms tend to have high risk. This multi-collinearity makes the coefficients of the regressions unreliable and may explain the large changes in these coefficients from period to period.

The Multicollinearity Problem

Correlations

		Expected Growth in Revenues: next 5 years	Regression Beta	PAYOUT
Expected Growth in Revenues: next 5 years	Pearson Correlation	1	.031	−.325**
	Sig. (2−tailed)	.	.228	.000
	N	1472	1472	1185
Regression Beta	Pearson Correlation	.031	1	−.183**
	Sig. (2−tailed)	.228	.	.000
	N	1472	6933	4187
PAYOUT	Pearson Correlation	−.325**	−.183**	1
	Sig. (2−tailed)	.000	.000	.
	N	1185	4187	4187

**. Correlation is significant at the 0.01 level (2−tailed).

Using the PE ratio regression

- Assume that you were given the following information for Dell. The firm has an expected growth rate of 10%, a beta of 1.20 and pays no dividends. Based upon the regression, estimate the predicted PE ratio for Dell.

  Predicted PE =

- Dell is actually trading at 22 times earnings. What does the predicted PE tell you?

The value of growth

Time Period	Value of extra 1% of growth	Equity Risk Premium
January 2004	0.812	3.69%
July 2003	1.228	3.88%
January 2003	2.621	4.10%
July 2002	0.859	4.35%
January 2002	1.003	3.62%
July 2001	1.251	3.05%
January 2001	1.457	2.75%
July 2000	1.761	2.20%
January 2000	2.105	2.05%

The value of growth is in terms of additional PE…

PE Regression: Germany in September 2004

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.580[a]	.336	.322	1113.20214914868300

a. Predictors: (Constant), IBES Est Long Term Growth, RAW_BETA

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.535	4.983		.709	.480
	RAW_BETA	5.452	4.085	.114	1.335	.185
	IBES Est Long Term Growth	1.697	.251	.577	6.774	.000

a. Dependent Variable: PE

b. Weighted Least Squares Regression – Weighted by Market Cap

Value/Earnings and Value/Cashflow Ratios

■ While Price earnings ratios look at the market value of equity relative to earnings to equity investors, Value earnings ratios look at the market value of the firm relative to operating earnings. Value to cash flow ratios modify the earnings number to make it a cash flow number.

■ The form of value to cash flow ratios that has the closest parallels in DCF valuation is the value to Free Cash Flow to the Firm, which is defined as:

$$\text{Value/FCFF} = \frac{\text{(Market Value of Equity + Market Value of Debt-Cash)}}{\text{EBIT (1-t) - (Cap Ex - Deprecn) - Chg in WC}}$$

■ Consistency Tests:

- If the numerator is net of cash (or if net debt is used, then the interest income from the cash should not be in denominator
- The interest expenses added back to get to EBIT should correspond to the debt in the numerator. If only long term debt is considered, only long term interest should be added back.

Value of Firm/FCFF: Determinants

■ Reverting back to a two-stage FCFF DCF model, we get:

$$V_0 = \frac{FCFF_0\,(1+g)\left(1 - \dfrac{(1+g)^n}{(1+WACC)^n}\right)}{WACC - g} + \frac{FCFF_0\,(1+g)^n(1+g_n)}{(WACC - g_n)(1+WACC)^n}$$

- V_0 = Value of the firm (today)
- $FCFF_0$ = Free Cashflow to the firm in current year
- g = Expected growth rate in FCFF in extraordinary growth period (first n years)
- WACC = Weighted average cost of capital
- g_n = Expected growth rate in FCFF in stable growth period (after n years)

Value Multiples

■ Dividing both sides by the FCFF yields,

$$\frac{V_0}{FCFF_0} = \frac{(1+g)\left(1 - \dfrac{(1+g)^n}{(1+WACC)^n}\right)}{WACC - g} + \frac{(1+g)^n(1+g_n)}{(WACC - g_n)(1+WACC)^n}$$

■ The value/FCFF multiples is a function of
  - the cost of capital
  - the expected growth

Value/FCFF Multiples and the Alternatives

■ Assume that you have computed the value of a firm, using discounted cash flow models. Rank the following multiples in the order of magnitude from lowest to highest?

❏ Value/EBIT

❏ Value/EBIT(1-t)

❏ Value/FCFF

❏ Value/EBITDA

■ What assumption(s) would you need to make for the Value/EBIT(1-t) ratio to be equal to the Value/FCFF multiple?

Illustration: Using Value/FCFF Approaches to value a firm: MCI Communications

- MCI Communications had earnings before interest and taxes of $3356 million in 1994 (Its net income after taxes was $855 million).
- It had capital expenditures of $2500 million in 1994 and depreciation of $1100 million; Working capital increased by $250 million.
- It expects free cashflows to the firm to grow 15% a year for the next five years and 5% a year after that.
- The cost of capital is 10.50% for the next five years and 10% after that.
- The company faces a tax rate of 36%.

$$\frac{V_0}{FCFF_0} = \frac{(1.15)\left[1 - \frac{(1.15)^5}{(1.105)^5}\right]}{.105 - .15} + \frac{(1.15)^5(1.05)}{(.10 - .05)(1.105)^5} = 31.28$$

Multiple Magic

■ In this case of MCI there is a big difference between the FCFF and short cut measures. For instance the following table illustrates the appropriate multiple using short cut measures, and the amount you would overpay by if you used the FCFF multiple.

Free Cash Flow to the Firm

= EBIT (1-t) - Net Cap Ex - Change in Working Capital

= 3356 (1 - 0.36) + 1100 - 2500 - 250 = $ 498 million

	$ Value	Correct Multiple
FCFF	$498	31.28382355
EBIT (1-t)	$2,148	7.251163362
EBIT	$ 3,356	4.640744552
EBITDA	$4,456	3.49513885

Reasons for Increased Use of Value/EBITDA

1. The multiple <u>can be computed</u> even for firms that are reporting net losses, since earnings before interest, taxes and depreciation are usually positive.

2. For firms in <u>certain industries</u>, such as cellular, which require a substantial investment in infrastructure and long gestation periods, this multiple seems to be more appropriate than the price/earnings ratio.

3. In <u>leveraged buyouts</u>, where the key factor is cash generated by the firm prior to all discretionary expenditures, the EBITDA is the measure of cash flows from operations that can be used to support debt payment at least in the short term.

4. By looking at cashflows prior to capital expenditures, it may provide a better estimate of "optimal value", especially <u>if the capital expenditures are unwise</u> or earn substandard returns.

5. By looking at the value of the firm and cashflows to the firm it allows for comparisons across <u>firms with different financial leverage.</u>

Value/EBITDA Multiple

■ The Classic Definition

$$\frac{\text{Value}}{\text{EBITDA}} = \frac{\text{Market Value of Equity} + \text{Market Value of Debt}}{\text{Earnings before Interest, Taxes and Depreciation}}$$

■ The No-Cash Version

$$\frac{\text{Enterprise Value}}{\text{EBITDA}} = \frac{\text{Market Value of Equity} + \text{Market Value of Debt} - \text{Cash}}{\text{Earnings before Interest, Taxes and Depreciation}}$$

■ When cash and marketable securities are netted out of value, none of the income from the cash and securities should be reflected in the denominator.

Enterprise Value/EBITDA Distribution - Germany in September 2004

EV/EBITDA Multiple: German Stocks in September 2004

BMW: 6.02
Volkswagen: 6.59
Daimler: 7.02

Average EV/EBITDA across all German stocks =16.29
Median EV./EBITDA across all German stocks =7.13

Audi: 3.30

Number of firms
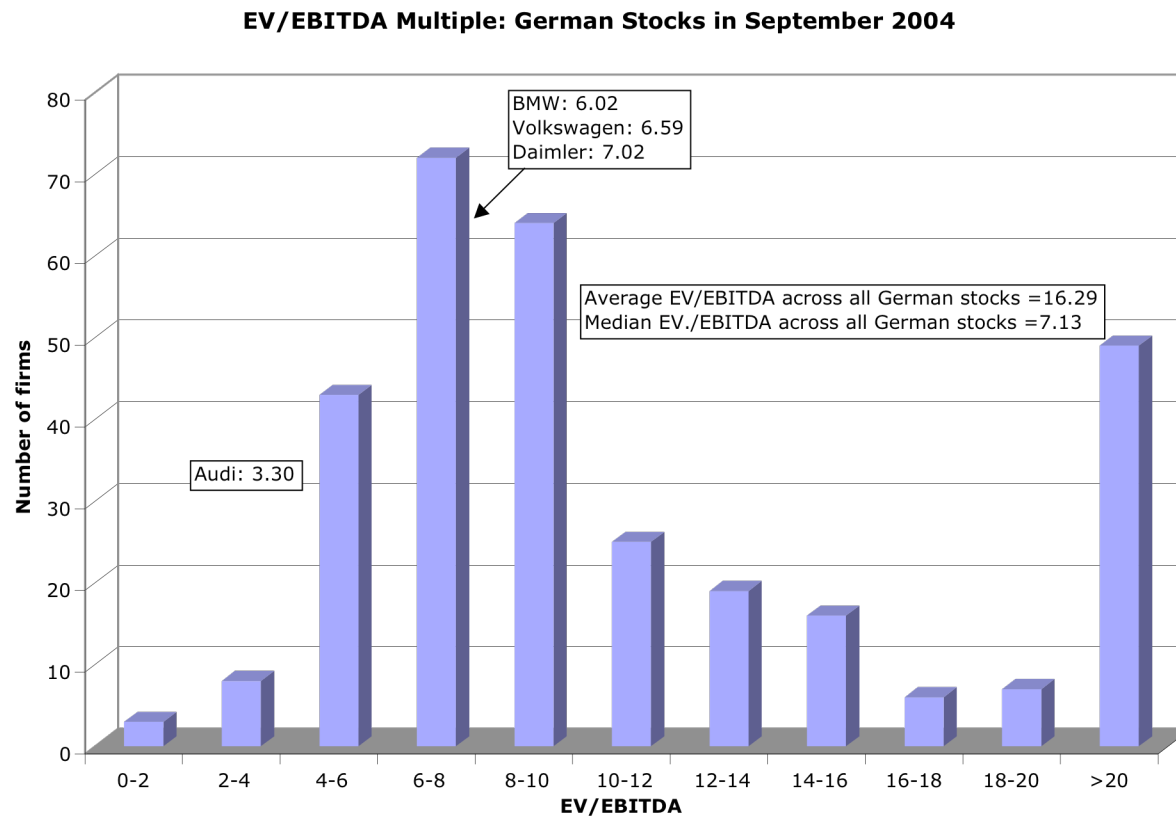
EV/EBITDA

Value/EBITDA Distribution: Rest of the World

EV/EBITDA Distribution Differences
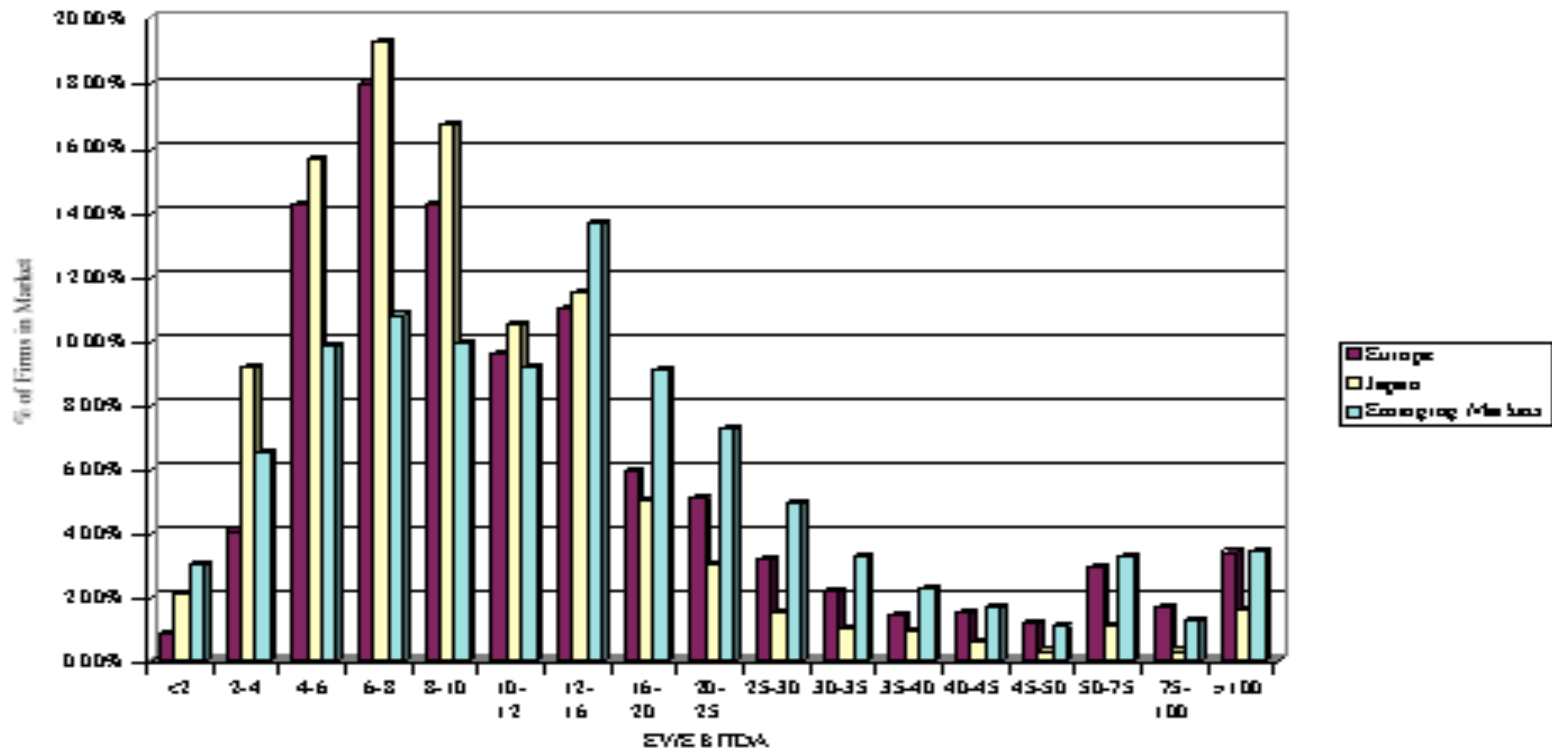
The Determinants of Value/EBITDA Multiples: Linkage to DCF Valuation

■ Firm value can be written as:

$$V_0 = \frac{FCFF_1}{WACC - g}$$

■ The numerator can be written as follows:

FCFF   = EBIT (1-t) - (Cex - Depr) - Δ Working Capital

               = (EBITDA - Depr) (1-t) - (Cex - Depr) - Δ Working Capital

               = EBITDA (1-t) + Depr (t) - Cex - Δ Working Capital

From Firm Value to EBITDA Multiples

■ Now the Value of the firm can be rewritten as,

$$Value = \frac{EBITDA\,(1-t)\ +\ Depr\,(t)\ -\ Cex\ -\ \Delta\,Working\,Capital}{WACC - g}$$

■ Dividing both sides of the equation by EBITDA,

$$\frac{Value}{EBITDA} = \frac{(1-t)}{WACC-g} + \frac{Depr\,(t)/EBITDA}{WACC-g} - \frac{CEx/EBITDA}{WACC-g} - \frac{\Delta\,Working\,Capital/EBITDA}{WACC-g}$$

A Simple Example

■ Consider a firm with the following characteristics:

- Tax Rate = 36%
- Capital Expenditures/EBITDA = 30%
- Depreciation/EBITDA = 20%
- Cost of Capital = 10%
- The firm has no working capital requirements
- The firm is in stable growth and is expected to grow 5% a year forever.

Calculating Value/EBITDA Multiple

■ In this case, the Value/EBITDA multiple for this firm can be estimated as follows:

$$\frac{\text{Value}}{\text{EBITDA}} = \frac{(1 - .36)}{.10 - .05} + \frac{(0.2)(.36)}{.10 - .05} - \frac{0.3}{.10 - .05} - \frac{0}{.10 - .05} = 8.24$$

Value/EBITDA Multiples and Taxes
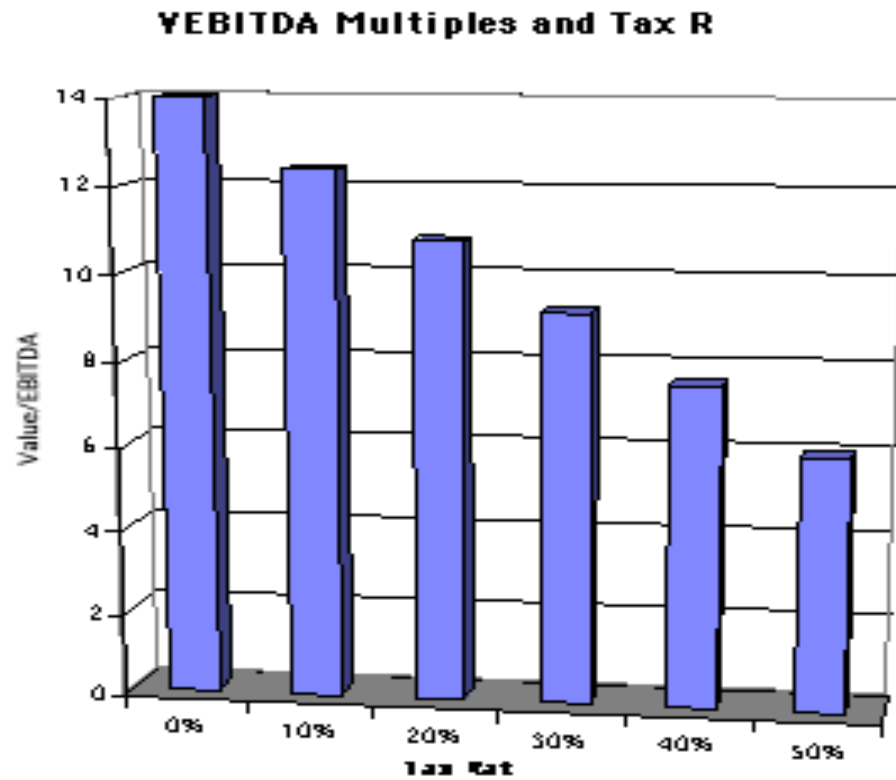
Value/EBITDA and Net Cap Ex
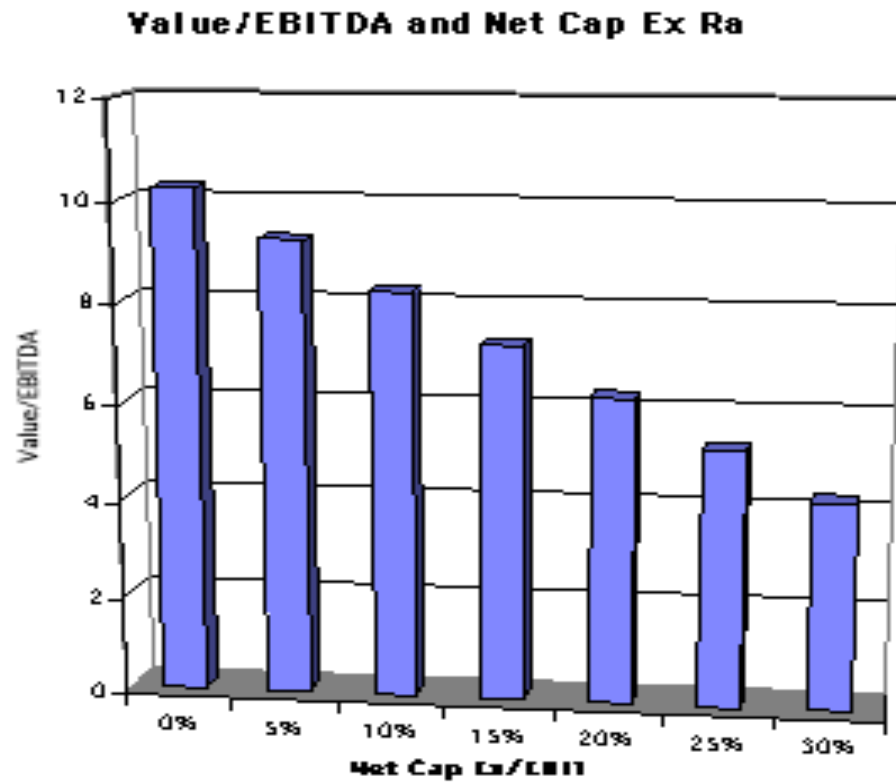
Value/EBITDA Multiples and Return on Capital
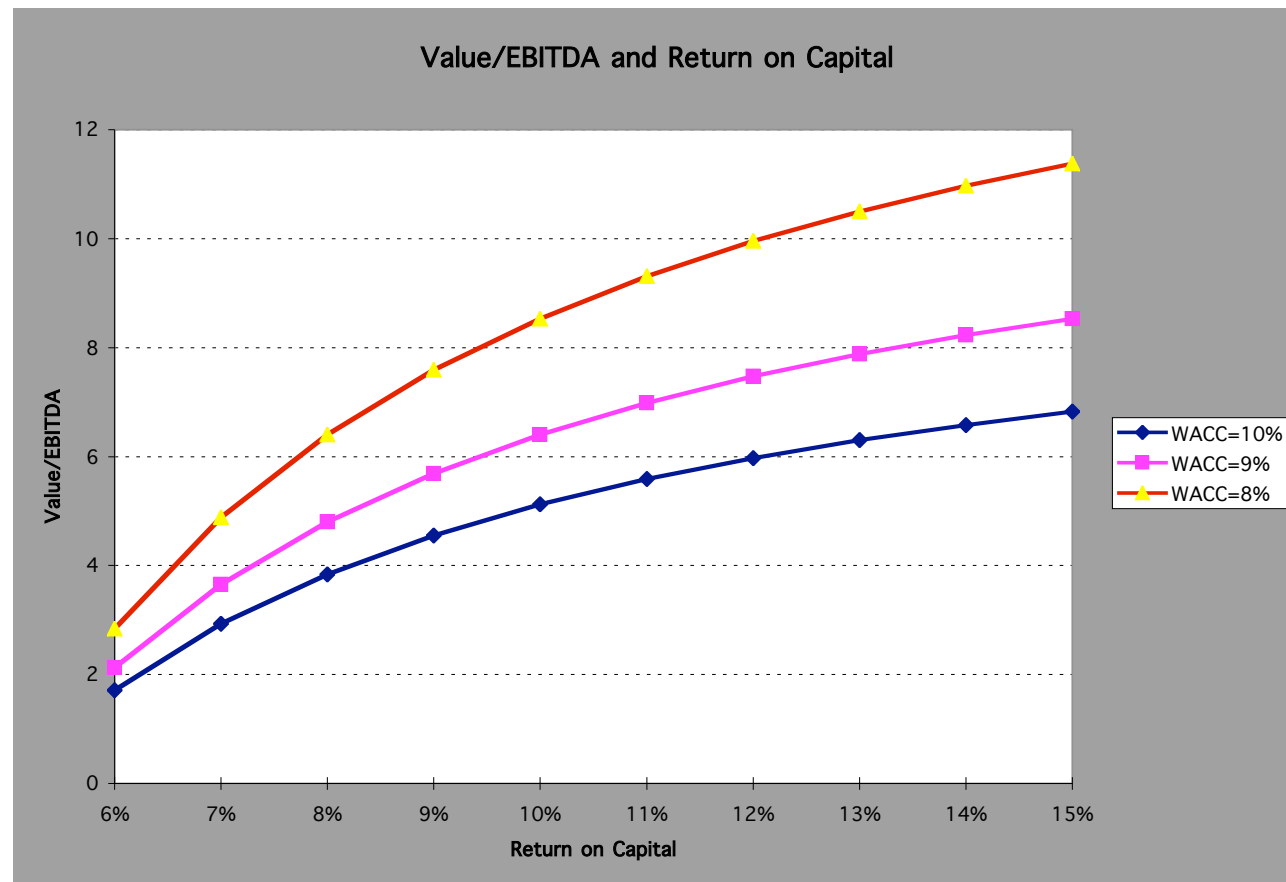
Value/EBITDA Multiple: Trucking Companies

Company Name	Value	EBITDA	Value/EBITDA
KLLM Trans. Svcs.	$ 114.32	$ 48.81	2.34
Ryder System	$ 5,158.04	$ 1,838.26	2.81
Rollins Truck Leasing	$ 1,368.35	$ 447.67	3.06
Cannon Express Inc.	$ 83.57	$ 27.05	3.09
Hunt (J.B.)	$ 982.67	$ 310.22	3.17
Yellow Corp.	$ 931.47	$ 292.82	3.18
Roadway Express	$ 554.96	$ 169.38	3.28
Marten Transport Ltd.	$ 116.93	$ 35.62	3.28
Kenan Transport Co.	$ 67.66	$ 19.44	3.48
M.S. Carriers	$ 344.93	$ 97.85	3.53
Old Dominion Freight	$ 170.42	$ 45.13	3.78
Trimac Ltd	$ 661.18	$ 174.28	3.79
Matlack Systems	$ 112.42	$ 28.94	3.88
XTRA Corp.	$ 1,708.57	$ 427.30	4.00
Covenant Transport Inc	$ 259.16	$ 64.35	4.03
Builders Transport	$ 221.09	$ 51.44	4.30
Werner Enterprises	$ 844.39	$ 196.15	4.30
Landstar Sys.	$ 422.79	$ 95.20	4.44
AMERCO	$ 1,632.30	$ 345.78	4.72
USA Truck	$ 141.77	$ 29.93	4.74
Frozen Food Express	$ 164.17	$ 34.10	4.81
Arnold Inds.	$ 472.27	$ 96.88	4.87
Greyhound Lines Inc.	$ 437.71	$ 89.61	4.88
USFreightways	$ 983.86	$ 198.91	4.95
Golden Eagle Group Inc.	$ 12.50	$ 2.33	5.37
Arkansas Best	$ 578.78	$ 107.15	5.40
Airlease Ltd.	$ 73.64	$ 13.48	5.46
Celadon Group	$ 182.30	$ 32.72	5.57
Amer. Freightways	$ 716.15	$ 120.94	5.92
Transfinancial Holdings	$ 56.92	$ 8.79	6.47
Vitran Corp. 'A'	$ 140.68	$ 21.51	6.54
Interpool Inc.	$ 1,002.20	$ 151.18	6.63
Intrenet Inc.	$ 70.23	$ 10.38	6.77
Swift Transportation	$ 835.58	$ 121.34	6.89
Landair Services	$ 212.95	$ 30.38	7.01
CNF Transportation	$ 2,700.69	$ 366.99	7.36
Budget Group Inc	$ 1,247.30	$ 166.71	7.48
Caliber System	$ 2,514.99	$ 333.13	7.55
Knight Transportation Inc	$ 269.01	$ 28.20	9.54
Heartland Express	$ 727.50	$ 64.62	11.26
Greyhound CDA Transn Corp	$ 83.25	$ 6.99	11.91
Mark VII	$ 160.45	$ 12.96	12.38
Coach USA Inc	$ 678.38	$ 51.76	13.11
US 1 Inds Inc.	$ 5.60	$ (0.17)	NA
Average			**5.61**

A Test on EBITDA

■ Ryder System looks very cheap on a Value/EBITDA multiple basis, relative to the rest of the sector. What explanation (other than misvaluation) might there be for this difference?

US Market: Cross Sectional Regression
January 2004

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.583[a]	.340	.338	653.80185507239

a. Predictors: (Constant), Reinvestment Rate, Expected Growth in Revenues: next 5 years, Eff Tax Rate

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	10.073	.768		13.121	.000
	Eff Tax Rate	−.152	.022	−.174	−6.878	.000
	Expected Growth in Revenues: next 5 years	.907	.039	.563	23.464	.000
	Reinvestment Rate	−.015	.006	−.062	−2.420	.016

a. Dependent Variable: EV/EBITDA

b. Weighted Least Squares Regression – Weighted by Market Cap

Europe: Cross Sectional Regression
January 2004

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.542[a]	.293	.292	1581.333005721082000

a. Predictors: (Constant), Tax Rate, Reinv Rate, Market Debt to Capital

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8.419	1.279		6.580	.000
	Market Debt to Capital	.589	.021	.511	28.035	.000
	Reinv Rate	−.051	.009	−.099	−5.472	.000
	Tax Rate	−.152	.029	−.095	−5.236	.000

a. Dependent Variable: EV/EBITDA

b. Weighted Least Squares Regression – Weighted by Market Capitalization

Price-Book Value Ratio: Definition

■ The price/book value ratio is the ratio of the market value of equity to the book value of equity, i.e., the measure of shareholders' equity in the balance sheet.

■ Price/Book Value = $\dfrac{\text{Market Value of Equity}}{\text{Book Value of Equity}}$

■ Consistency Tests:

• If the market value of equity refers to the market value of equity of common stock outstanding, the book value of common equity should be used in the denominator.

• If there is more that one class of common stock outstanding, the market values of all classes (even the non-traded classes) needs to be factored in.

Price to Book Value: German Stocks in September 2004

Price to Book Ratio: German stocks in September 2004

Daimler PBV = 1.00
BMW PBV = 1.37

Volkswagen
PBV = 0.51

Audi PBV = 1.63

Average PBV across all German stocks =19.69
Median PBV across all German stocks =1.85

(Y-axis: Number of firms, values 0 to 90)
(X-axis: P/BV, categories: 0-0.5, 0.5-1, 1-1.5, 1.5-2, 2-2.5, 2.5-3, 3-3.5, 3.5-4, 4-4.5, 4.5-5, 5-7.5, 7.5-10, >10)
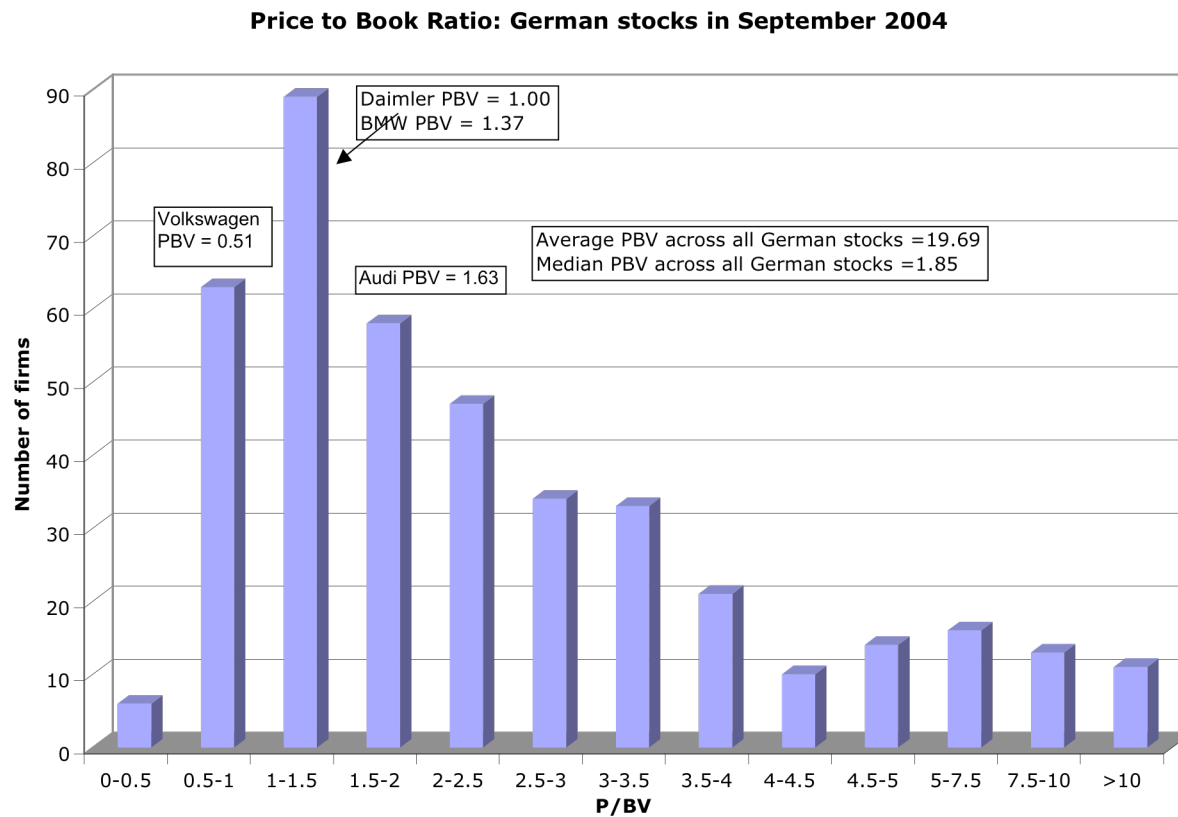
Price to Book Value: Europe, Japan and Emerging Markets

PBV Ratios: Different Markets
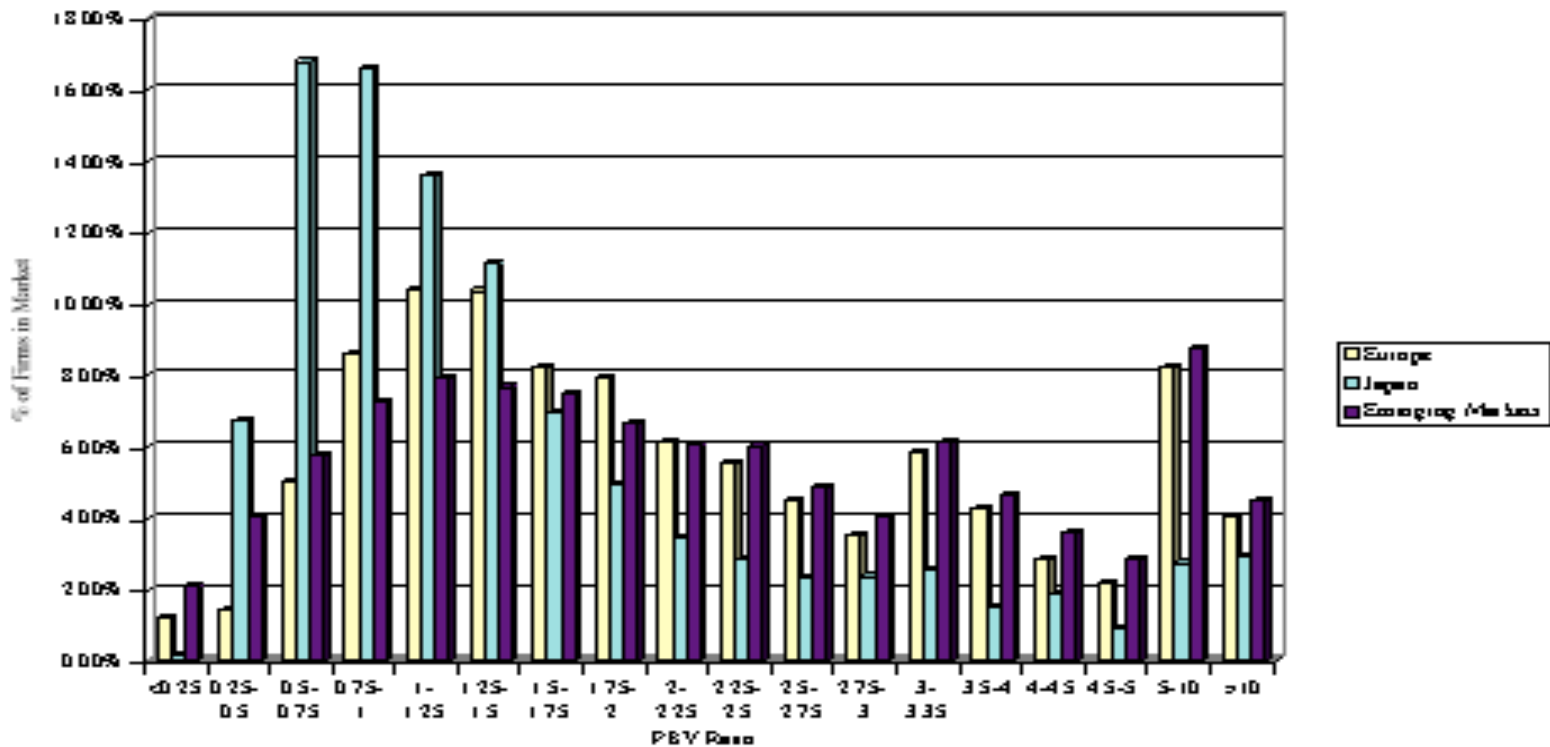
Price Book Value Ratio: Stable Growth Firm

■ Going back to a simple dividend discount model,

$$P_0 = \frac{DPS_1}{r - g_n}$$

■ Defining the return on equity (ROE) = EPS_0 / Book Value of Equity, the value of equity can be written as:

$$P_0 = \frac{BV_0 * ROE * \text{Payout Ratio} * (1 + g_n)}{r - g_n}$$

$$\frac{P_0}{BV_0} = PBV = \frac{ROE * \text{Payout Ratio} * (1 + g_n)}{r - g_n}$$

■ If the return on equity is based upon expected earnings in the next time period, this can be simplified to,

$$\frac{P_0}{BV_0} = PBV = \frac{ROE * \text{Payout Ratio}}{r - g_n}$$

PBV/ROE: European Banks

Bank	Symbol	PBV	ROE
Banca di Roma SpA	BAHQE	0.60	4.15%
Commerzbank AG	COHSO	0.74	5.49%
Bayerische Hypo und Vereinsbank AG	BAXWW	0.82	5.39%
Intesa Bci SpA	BAEWF	1.12	7.81%
Natexis Banques Populaires	NABQE	1.12	7.38%
Almanij NV Algemene Mij voor Nijver	ALPK	1.17	8.78%
Credit Industriel et Commercial	CIECM	1.20	9.46%
Credit Lyonnais SA	CREV	1.20	6.86%
BNL Banca Nazionale del Lavoro SpA	BAEXC	1.22	12.43%
Banca Monte dei Paschi di Siena SpA	MOGG	1.34	10.86%
Deutsche Bank AG	**DEMX**	**1.36**	**17.33%**
Skandinaviska Enskilda Banken	SKHS	1.39	16.33%
Nordea Bank AB	NORDEA	1.40	13.69%
DNB Holding ASA	**DNHLD**	**1.42**	**16.78%**
ForeningsSparbanken AB	FOLG	1.61	18.69%
Danske Bank AS	DANKAS	1.66	19.09%
Credit Suisse Group	***CRGAL***	***1.68***	***14.34%***
KBC Bankverzekeringsholding	KBCBA	1.69	30.85%
Societe Generale	SODI	1.73	17.55%
Santander Central Hispano SA	***BAZAB***	***1.83***	***11.01%***
National Bank of Greece SA	NAGT	1.87	26.19%
San Paolo IMI SpA	SAOEL	1.88	16.57%
BNP Paribas	BNPRB	2.00	18.68%
Svenska Handelsbanken AB	SVKE	2.12	21.82%
UBS AG	UBQH	2.15	16.64%
Banco Bilbao Vizcaya Argentaria SA	BBFUG	2.18	22.94%
ABN Amro Holding NV	ABTS	2.21	24.21%
UniCredito Italiano SpA	UNCZA	2.25	15.90%
Rolo Banca 1473 SpA	ROGMBA	2.37	16.67%
Dexia	DECCT	2.76	14.99%
Average		1.60	14.96%

PBV versus ROE regression

- Regressing PBV ratios against ROE for banks yields the following regression:

$$PBV = 0.81 + 5.32 \, (ROE) \qquad R^2 = 46\%$$

- For every 1% increase in ROE, the PBV ratio should increase by 0.0532.

Under and Over Valued Banks?

Bank	Actual	Predicted	Under or Over
Banca di Roma SpA	0.60	1.03	-41.33%
Commerzbank AG	0.74	1.10	-32.86%
Bayerische Hypo und Vereinsbank AG	0.82	1.09	-24.92%
Intesa Bci SpA	1.12	1.22	-8.51%
Natexis Banques Populaires	1.12	1.20	-6.30%
Almanij NV Algemene Mij voor Nijver	1.17	1.27	-7.82%
Credit Industriel et Commercial	1.20	1.31	-8.30%
Credit Lyonnais SA	1.20	1.17	2.61%
BNL Banca Nazionale del Lavoro SpA	1.22	1.47	-16.71%
Banca Monte dei Paschi di Siena SpA	1.34	1.39	-3.38%
Deutsche Bank AG	1.36	1.73	-21.40%
Skandinaviska Enskilda Banken	1.39	1.68	-17.32%
Nordea Bank AB	1.40	1.54	-9.02%
DNB Holding ASA	1.42	1.70	-16.72%
ForeningsSparbanken AB	1.61	1.80	-10.66%
Danske Bank AS	1.66	1.82	-9.01%
Credit Suisse Group	1.68	1.57	7.20%
KBC Bankverzekeringsholding	1.69	2.45	-30.89%
Societe Generale	1.73	1.74	-0.42%
Santander Central Hispano SA	1.83	1.39	31.37%
National Bank of Greece SA	1.87	2.20	-15.06%
San Paolo IMI SpA	1.88	1.69	11.15%
BNP Paribas	2.00	1.80	11.07%
Svenska Handelsbanken AB	2.12	1.97	7.70%
UBS AG	2.15	1.69	27.17%
Banco Bilbao Vizcaya Argentaria SA	2.18	2.03	7.66%
ABN Amro Holding NV	2.21	2.10	5.23%
UniCredito Italiano SpA	2.25	1.65	36.23%
Rolo Banca 1473 SpA	2.37	1.69	39.74%
Dexia	2.76	1.61	72.04%

Looking for undervalued securities - PBV Ratios and ROE : The Valuation Matrix

MV/BV

Overvalued Low ROE High MV/BV	High ROE High MV/BV
Low ROE Low MV/BV	*Undervalued* High ROE Low MV/BV

ROE-r
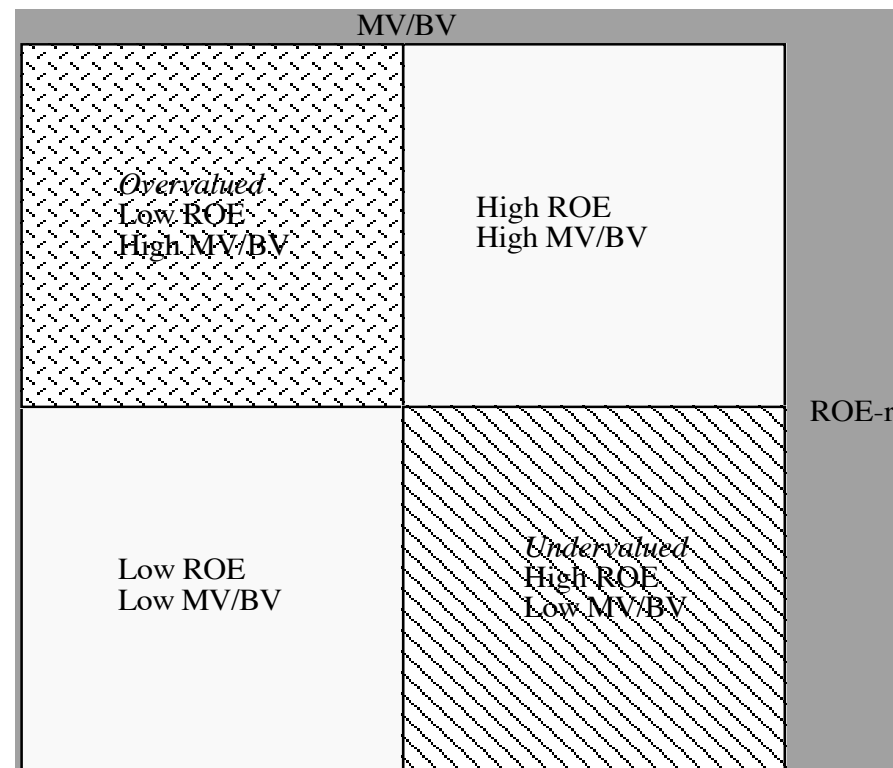
Price to Book vs ROE: German Stocks in September 2004
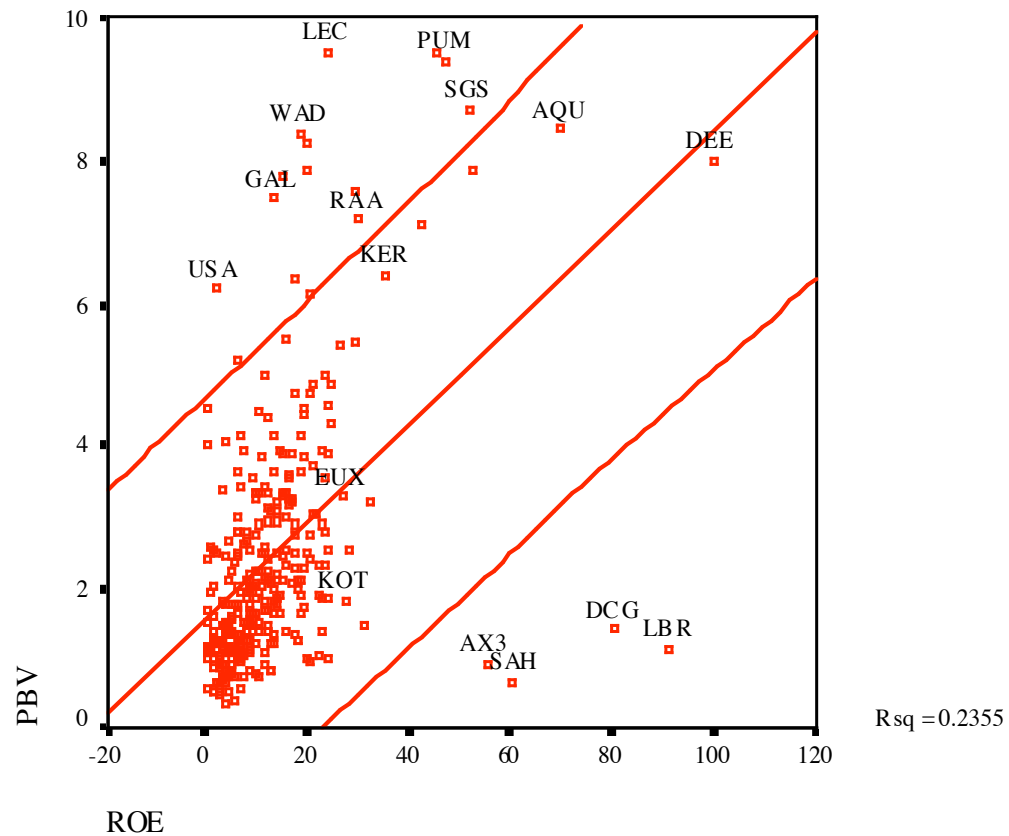
PBV Matrix: Telecom Companies
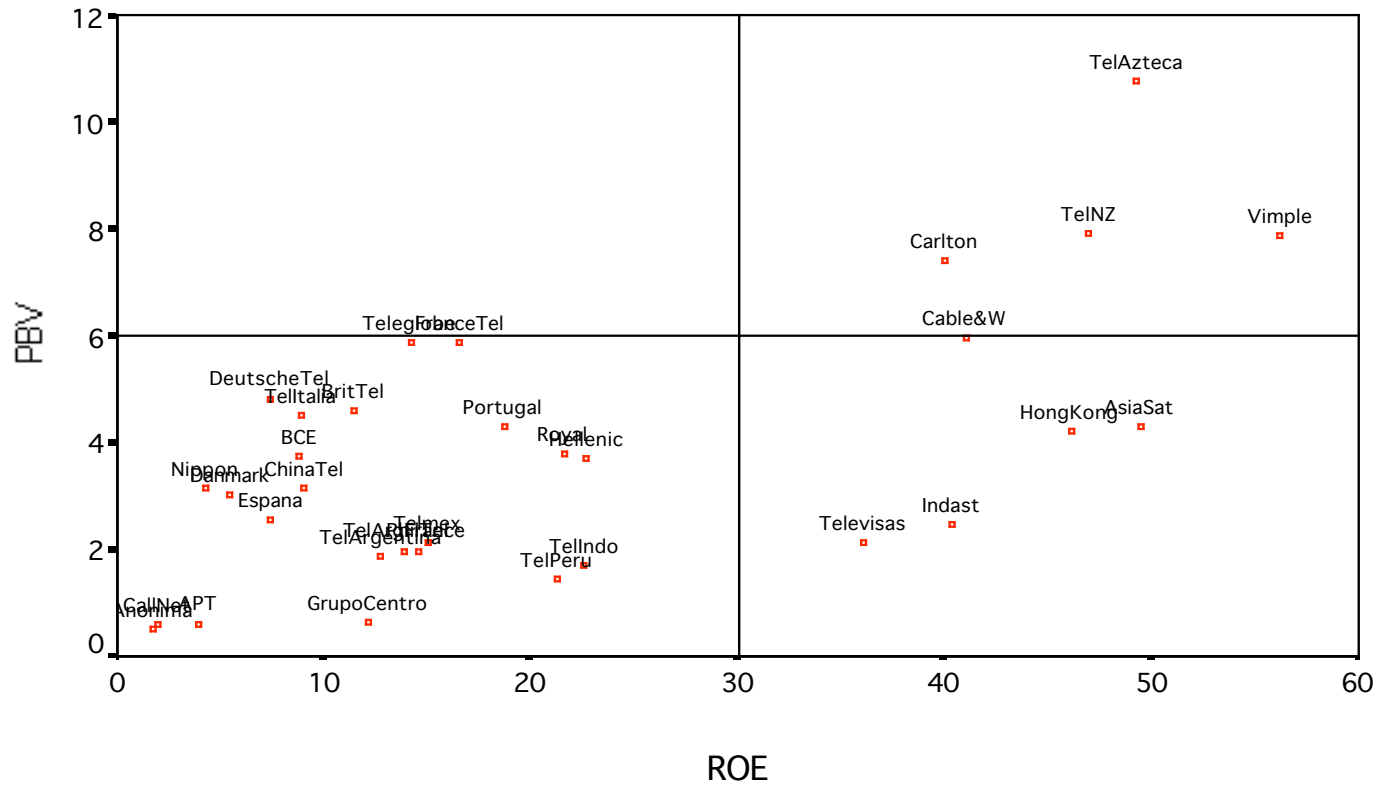
PBV, ROE and Risk: Large Cap US firms
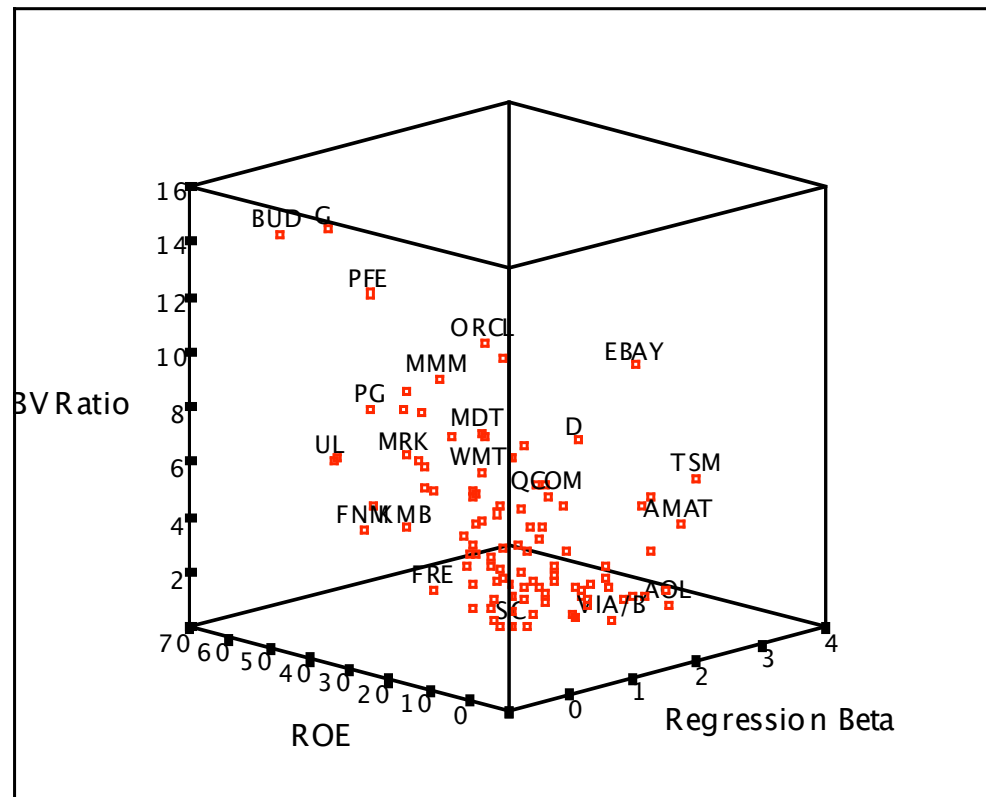
IBM: The Rise and Fall and Rise Again
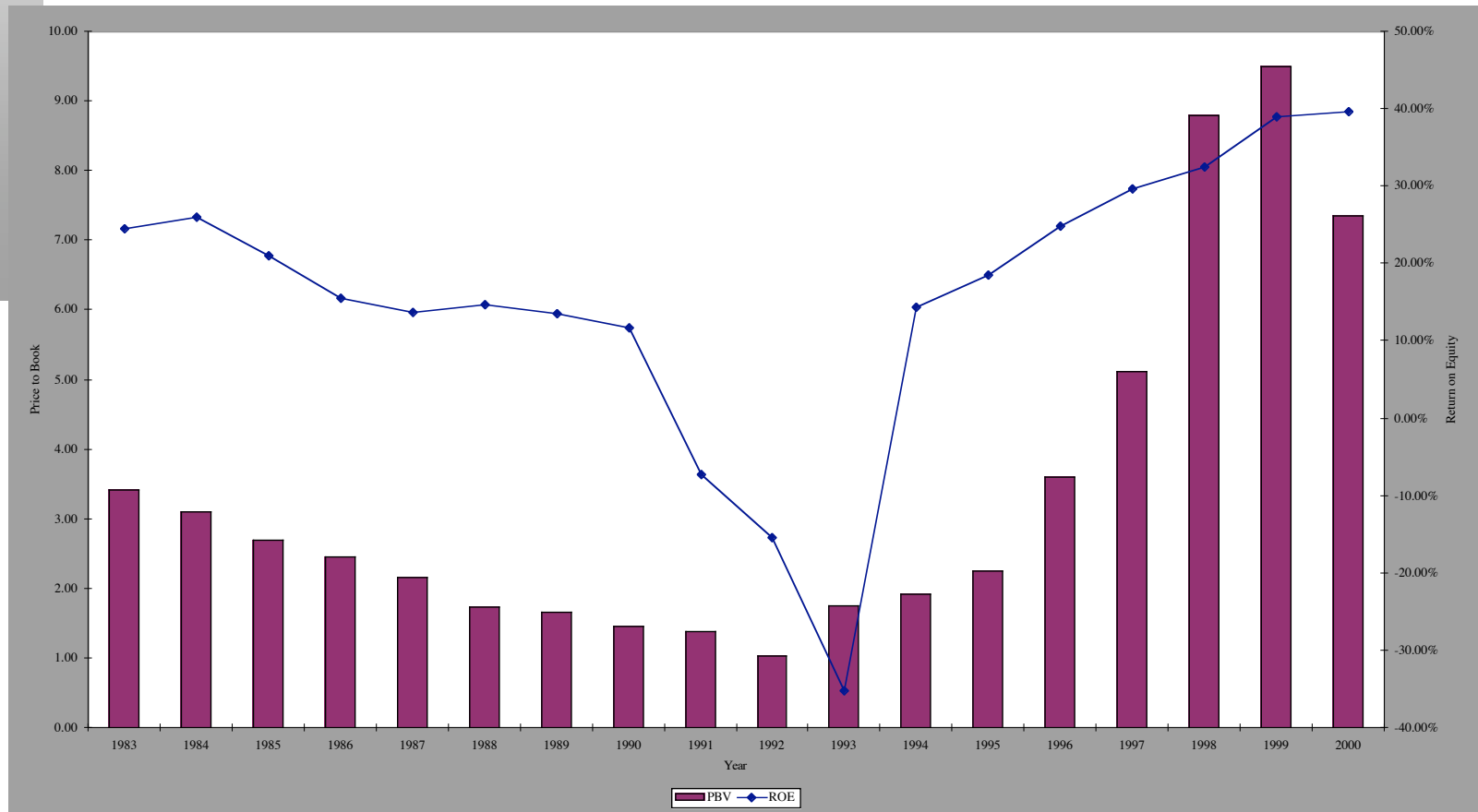
PBV Ratio Regression: US
January 2004

Model Summary

Model	R	R Square [a]	Adjusted R Square	Std. Error of the Estimate
1	.943[b]	.889	.889	117.0574933200291

a. For regression through the origin (the no–intercept model), R Square measures the proportion of the variability in the dependent variable about the origin explained by regression. This CANNOT be compared to R Square for models which include an intercept.

b. Predictors: ROE, Regression Beta, PAYOUT, Expected Growth in EPS: next 5 years

Coefficients[a,b,c]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	Expected Growth in EPS: next 5 years	8.E–02	.004	.256	21.935	.000
	PAYOUT	2.E–03	.001	.017	1.551	.121
	Regression Beta	.599	.042	.151	14.249	.000
	ROE	.140	.003	.628	50.731	.000

a. Dependent Variable: PBV Ratio

b. Linear Regression through the Origin

c. Weighted Least Squares Regression – Weighted by Market Cap

PBV Ratio Regression- Europe
January 2004

Model Summary

Model	R	R Square [a]	Adjusted R Square	Std. Error of the Estimate
1	.830[b]	.689	.689	154.4404 7748882220

a. For regression through the origin (the no–intercept model), R Square measures the proportion of the variability in the dependent variable about the origin explained by regression. This CANNOT be compared to R Square for models which include an intercept.

b. Predictors: ROE, Payout Ratio, BETA

Coefficients[a,b,c]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	Payout Ratio	8.E-03	.002	.074	3.667	.000
	BETA	1.399	.114	.291	12.279	.000
	ROE	.104	.004	.537	28.148	.000

a. Dependent Variable: PBV

b. Linear Regression through the Origin

c. Weighted Least Squares Regression – Weighted by Market Capitalization

Price Sales Ratio: Definition

■ The price/sales ratio is the ratio of the market value of equity to the sales.

■ Price/ Sales= $\dfrac{\text{Market Value of Equity}}{\text{Total Revenues}}$

■ Consistency Tests

  • The price/sales ratio is internally inconsistent, since the market value of equity is divided by the total revenues of the firm.

Price/Sales Ratio: German Stocks in January 2004

Price to Sales: German stocks in September 2004

Volkswagen PS = 0.14

Daimler PS = 0.25
Audi PS = 0.40

BMW PS =0.53

Average PS across all German stocks =14.55
Median PS across all German stocks =0.73

Number of firms

Price to Sales Ratio

0-0.25 | 0.25-0.5 | 0.5-0.75 | 0.75-1 | 1-1.25 | 1.25-1.5 | 1.5-1.75 | 1.75-2 | 2-2.25 | 2.25-2.5 | 2.5-2.75 | 2.75-3 | >3

Price to Sales: Europe, Japan and Emerging Markets

Price to Sales Ratios: Market Comparisons
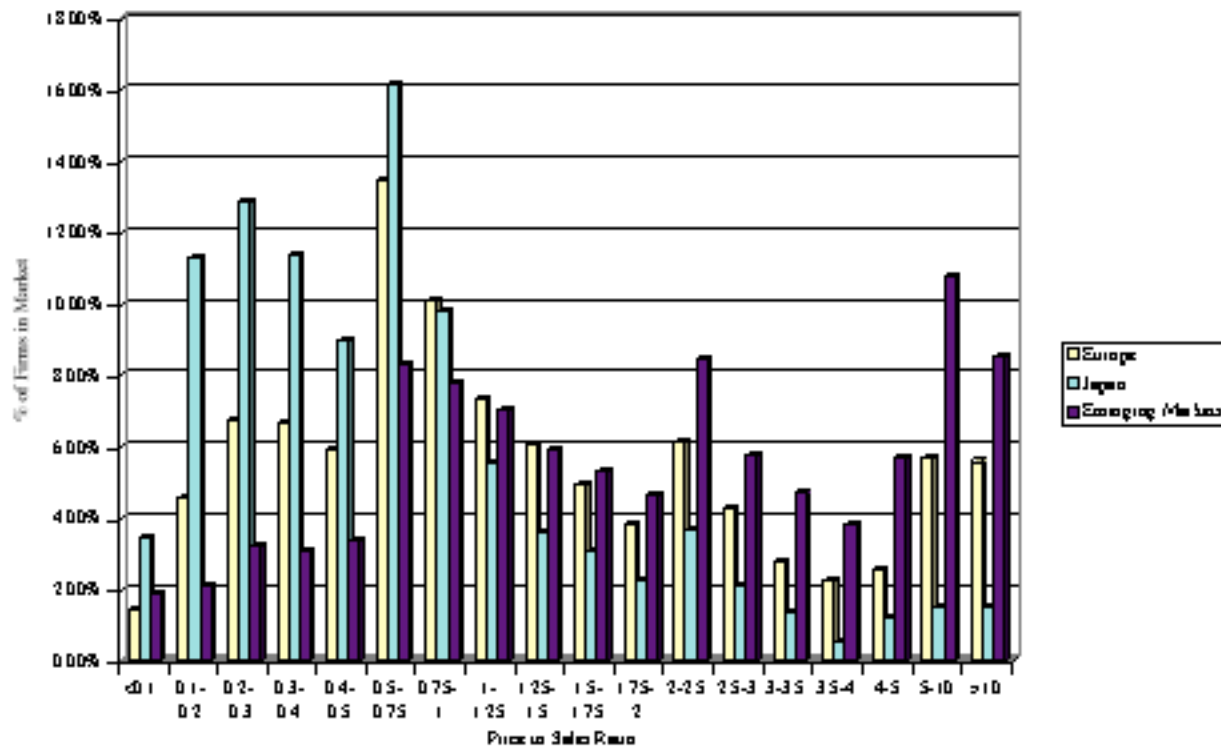
Price/Sales Ratio: Determinants

■ The price/sales ratio of a stable growth firm can be estimated beginning with a 2-stage equity valuation model:

$$P_0 = \frac{DPS_1}{r - g_n}$$

■ Dividing both sides by the sales per share:

$$\frac{P_0}{Sales_0} = PS = \frac{Net\ Profit\ Margin * Payout\ Ratio * (1 + g_n)}{r - g_n}$$

PS/Margins: European Retailers - September 2003
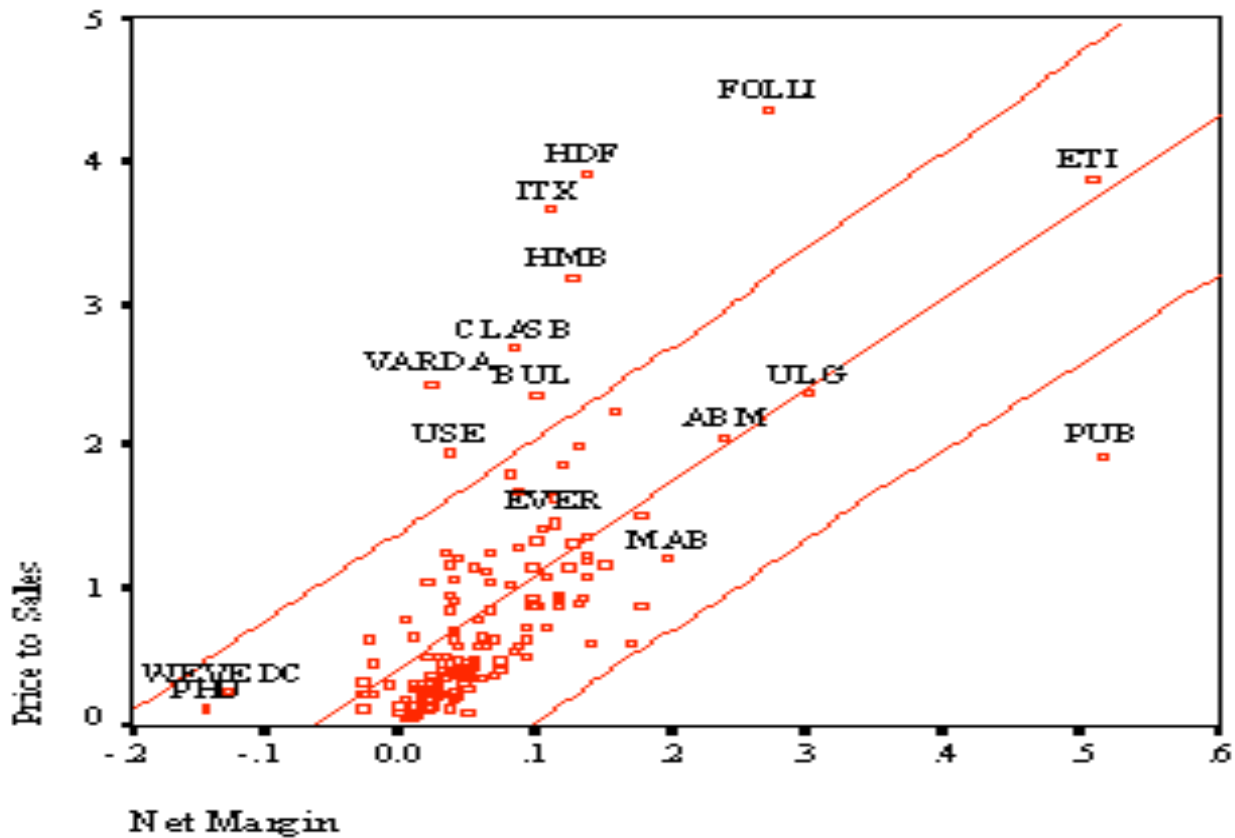
Regression Results: PS Ratios and Margins

- Regressing PS ratios against net margins,

    $$PS = -.39 + 0.6548 \text{ (Net Margin)} \qquad R^2 = 43.5\%$$

- Thus, a 1% increase in the margin results in an increase of 0.6548 in the price sales ratios.

- The regression also allows us to get predicted PS ratios for these firms

Current versus Predicted Margins

- One of the limitations of the analysis we did in these last few pages is the focus on current margins. Stocks are priced based upon expected margins rather than current margins.

- For most firms, current margins and predicted margins are highly correlated, making the analysis still relevant.

- For firms where current margins have little or no correlation with expected margins, regressions of price to sales ratios against current margins (or price to book against current return on equity) will not provide much explanatory power.

- In these cases, it makes more sense to run the regression using either predicted margins or some proxy for predicted margins.

A Case Study: The Internet Stocks
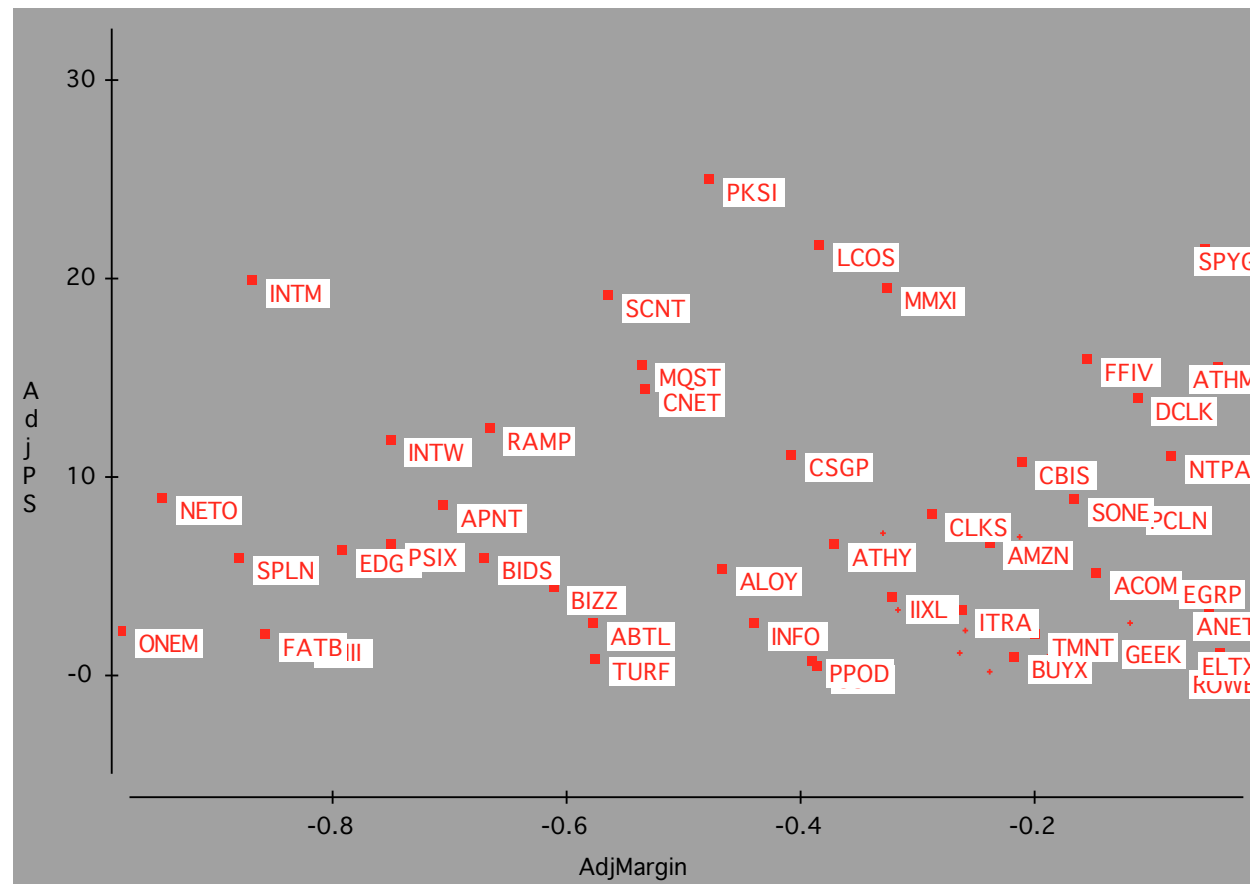
PS Ratios and Margins are not highly correlated

■ Regressing PS ratios against current margins yields the following

   PS = 81.36   - 7.54(Net Margin) $R^2 = 0.04$

                       (0.49)

■ This is not surprising. These firms are priced based upon expected margins, rather than current margins.

Solution 1: Use proxies for survival and growth: Amazon in early 2000

■ Hypothesizing that firms with higher revenue growth and higher cash balances should have a greater chance of surviving and becoming profitable, we ran the following regression: (The level of revenues was used to control for size)

PS = 30.61 - 2.77 ln(Rev) + 6.42 (Rev Growth) + 5.11 (Cash/Rev)

$\qquad$ (0.66) $\qquad$ (2.63) $\qquad$ (3.49)

R squared = 31.8%

Predicted PS = 30.61 - 2.77(7.1039) + 6.42(1.9946) + 5.11 (.3069) = 30.42

Actual PS = 25.63

Stock is undervalued, relative to other internet stocks.

Solution 2: Use forward multiples

■ Global Crossing lost $1.9 billion in 2001 and is expected to continue to lose money for the next 3 years. In a discounted cashflow valuation (see notes on DCF valuation) of Global Crossing, we estimated an expected EBITDA for Global Crossing in five years of $ 1,371 million.

■ The average enterprise value/ EBITDA multiple for healthy telecomm firms is 7.2 currently.

■ Applying this multiple to Global Crossing's EBITDA in year 5, yields a value in year 5 of

- Enterprise Value in year 5 = 1371 * 7.2 = $9,871 million
- Enterprise Value today = $ 9,871 million/ 1.138^5 = $5,172 million

(The cost of capital for Global Crossing is 13.80%)

- The probability that Global Crossing will not make it as a going concern is 77%.
- Expected Enterprise value today = 0.23 (5172) = $1,190 million

PS Regression: United States - January 2004

Model Summary

Model	R	R Square [a]	Adjusted R Square	Std. Error of the Estimate
1	.932[b]	.869	.868	114.30566982647230

a. For regression through the origin (the no-intercept model), R Square measures the proportion of the variability in the dependent variable about the origin explained by regression. This CANNOT be compared to R Square for models which include an intercept.

b. Predictors: Net Margin, Regression Beta, PAYOUT, Expected

Coefficients[a,b,c]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	Expected Growth in EPS: next 5 years	4.E-02	.004	.136	10.195	.000
	PAYOUT	-.011	.001	-.110	-9.425	.000
	Regression Beta	.549	.043	.156	12.658	.000
	Net Margin	.234	.004	.799	59.926	.000

a. Dependent Variable: PS_RATIO

b. Linear Regression through the Origin

c. Weighted Least Squares Regression – Weighted by Market Cap

PS Regression: Europe in January 2004

Model Summary

Model	R	R Square [a]	Adjusted R Square	Std. Error of the Estimate
1	.757[b]	.574	.573	134.938678072015

a. For regression through the origin (the no-intercept model), R Square measures the proportion of the variability in the dependent variable about the origin explained by regression. This CANNOT be compared to R Square for models which include an intercept.

b. Predictors: Net Margin, Payout Ratio, BETA

Coefficients[a,b,c]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	Payout Ratio	5.E-03	.002	.065	2.777	.006
	BETA	.937	.095	.261	9.909	.000
	Net Margin	.110	.004	.516	26.153	.000

a. Dependent Variable: PS

b. Linear Regression through the Origin

c. Weighted Least Squares Regression – Weighted by Market Capitalization

Choosing Between the Multiples

■ As presented in this section, there are dozens of multiples that can be potentially used to value an individual firm.

■ In addition, relative valuation can be relative to a sector (or comparable firms) or to the entire market (using the regressions, for instance)

■ Since there can be only one final estimate of value, there are three choices at this stage:

- Use a simple average of the valuations obtained using a number of different multiples

- Use a weighted average of the valuations obtained using a nmber of different multiples

- Choose one of the multiples and base your valuation on that multiple

Picking one Multiple

■ This is usually the best way to approach this issue. While a range of values can be obtained from a number of multiples, the "best estimate" value is obtained using one multiple.

■ The multiple that is used can be chosen in one of two ways:

- Use the multiple that <u>best fits your objective</u>. Thus, if you want the company to be undervalued, you pick the multiple that yields the highest value.

- Use the multiple that <u>has the highest R-squared</u> in the sector when regressed against fundamentals. Thus, if you have tried PE, PBV, PS, etc. and run regressions of these multiples against fundamentals, use the multiple that works best at explaining differences across firms in that sector.

- Use the multiple that seems to <u>make the most sense</u> for that sector, given how value is measured and created.

A More Intuitive Approach

■ Managers in every sector tend to focus on specific variables when analyzing strategy and performance. The multiple used will generally reflect this focus. Consider three examples.

- In retailing: The focus is usually on same store sales (turnover) and profit margins. Not surprisingly, the revenue multiple is most common in this sector.

- In financial services: The emphasis is usually on return on equity. Book Equity is often viewed as a scarce resource, since capital ratios are based upon it. Price to book ratios dominate.

- In technology: Growth is usually the dominant theme. PEG ratios were invented in this sector.

In Practice…

■ As a general rule of thumb, the following table provides a way of picking a multiple for a sector

Sector	Multiple Used	Rationale
Cyclical Manufacturing	PE, Relative PE	Often with normalized earnings
High Tech, High Growth	PEG	Big differences in growth across firms
High Growth/No Earnings	PS, VS	Assume future margins will be good
Heavy Infrastructure	VEBITDA	Firms in sector have losses in early years and reported earnings can vary depending on depreciation method
REITa	P/CF	Generally no cap ex investments from equity earnings
Financial Services	PBV	Book value often marked to market
Retailing	PS	If leverage is similar across firms
	VS	If leverage is different

Reviewing: The Four Steps to Understanding Multiples

- ■ Define the multiple
  - Check for consistency
  - Make sure that they are estimated uniformly
- ■ Describe the multiple
  - Multiples have skewed distributions: The averages are seldom good indicators of typical multiples
  - Check for bias, if the multiple cannot be estimated
- ■ Analyze the multiple
  - Identify the companion variable that drives the multiple
  - Examine the nature of the relationship
- ■ Apply the multiple

Real Options: Fact and Fantasy

Aswath Damodaran

Underlying Theme: Searching for an Elusive Premium

- Traditional discounted cashflow models under estimate the value of investments, where there are options embedded in the investments to
  - Delay or defer making the investment (delay)
  - Adjust or alter production schedules as price changes (flexibility)
  - Expand into new markets or products at later stages in the process, based upon observing favorable outcomes at the early stages (expansion)
  - Stop production or abandon investments if the outcomes are unfavorable at early stages (abandonment)
- Put another way, real option advocates believe that you should be paying a premium on discounted cashflow value estimates.

Three Basic Questions

- When is there a real option embedded in a decision or an asset?
- When does that real option have significant economic value?
- Can that value be estimated using an option pricing model?

When is there an option embedded in an action?

■ An option provides the holder with the **right** to buy or sell a specified quantity of an underlying asset at a fixed price (called a strike price or an exercise price) at or before the expiration date of the option.

■ There has to be a <u>clearly defined underlying asset</u> whose value changes over time in unpredictable ways.

■ The <u>payoffs on this asset</u> (real option) have to be <u>contingent on an specified event</u> occurring within a finite period.

Payoff Diagram on a Call

Net Payoff
on Call

Strike
Price

Price of underlying asset
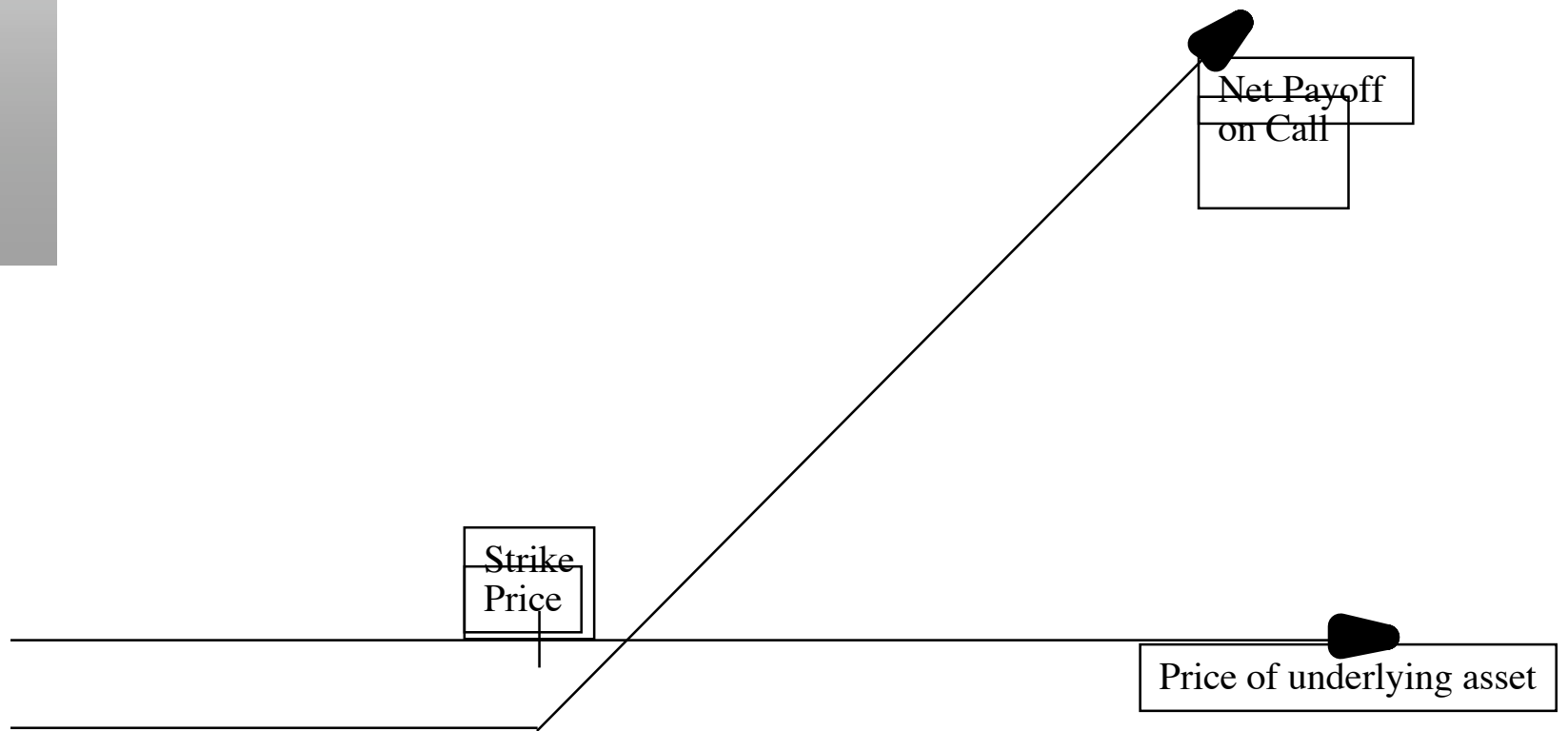
Example 1: Product Patent as an Option

PV of Cash Flows
from Project

Initial Investment in
Project

Present Value of Expected
Cash Flows on Product

Project has negative
NPV in this section

Project's NPV turns
positive in this section
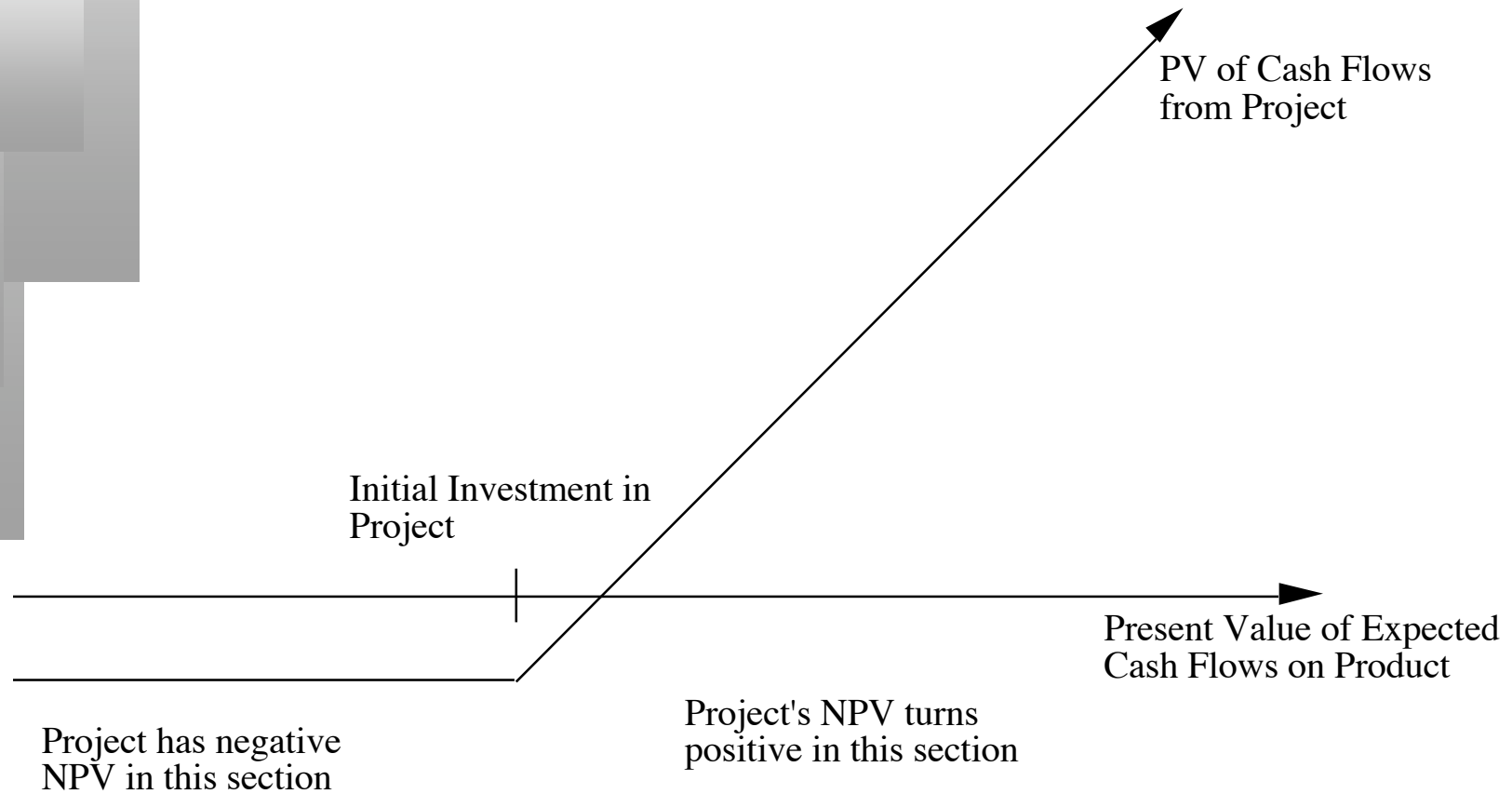
Example 2: Undeveloped Oil Reserve as an option

Net Payoff on Extraction

Cost of Developing Reserve

Value of estimated reserve of natural resource
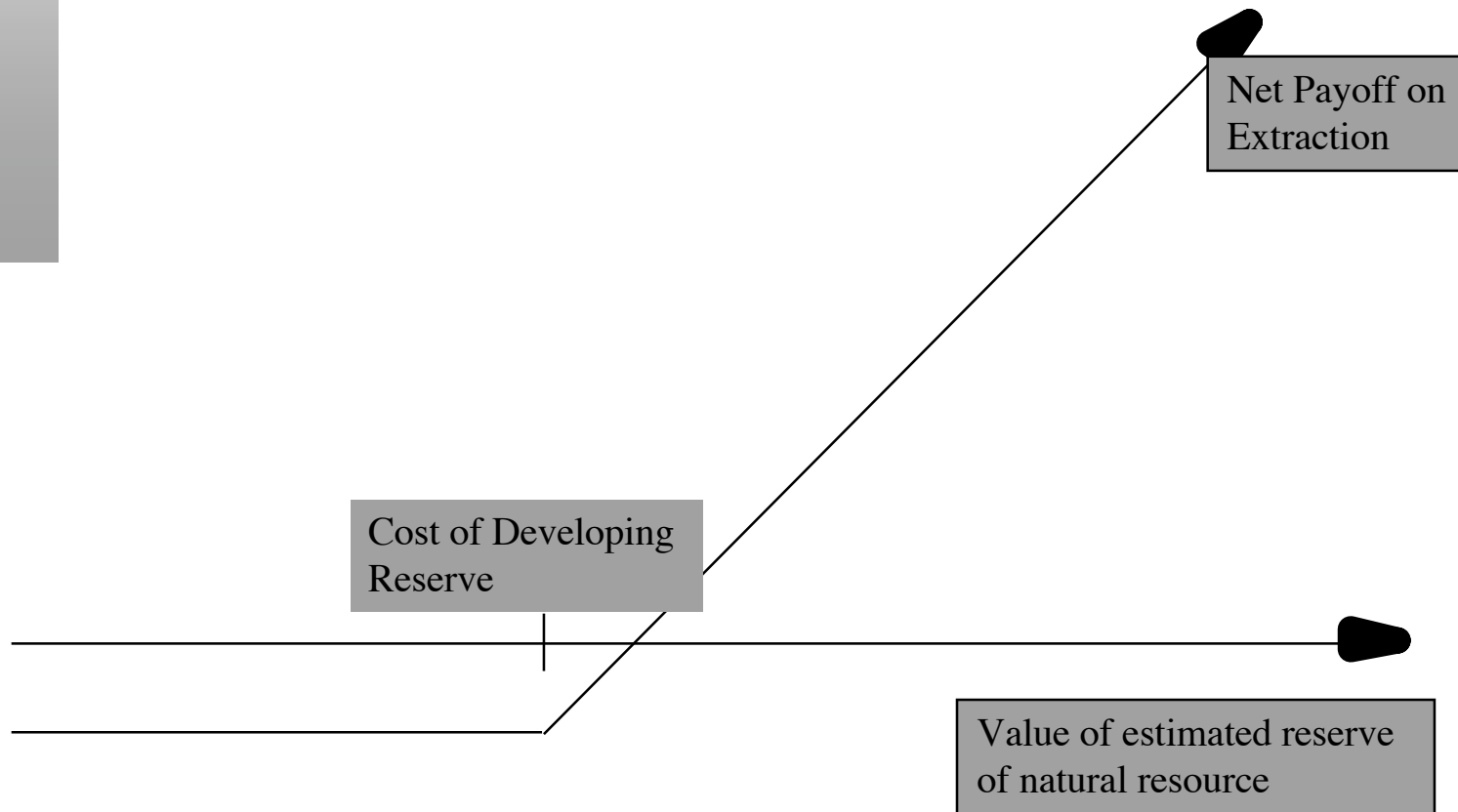
Example 3: Expansion of existing project as an option

PV of Cash Flows
from Expansion

Additional Investment
to Expand

Present Value of Expected
Cash Flows on Expansion

Firm will not expand in
this section

Expansion becomes
attractive in this section
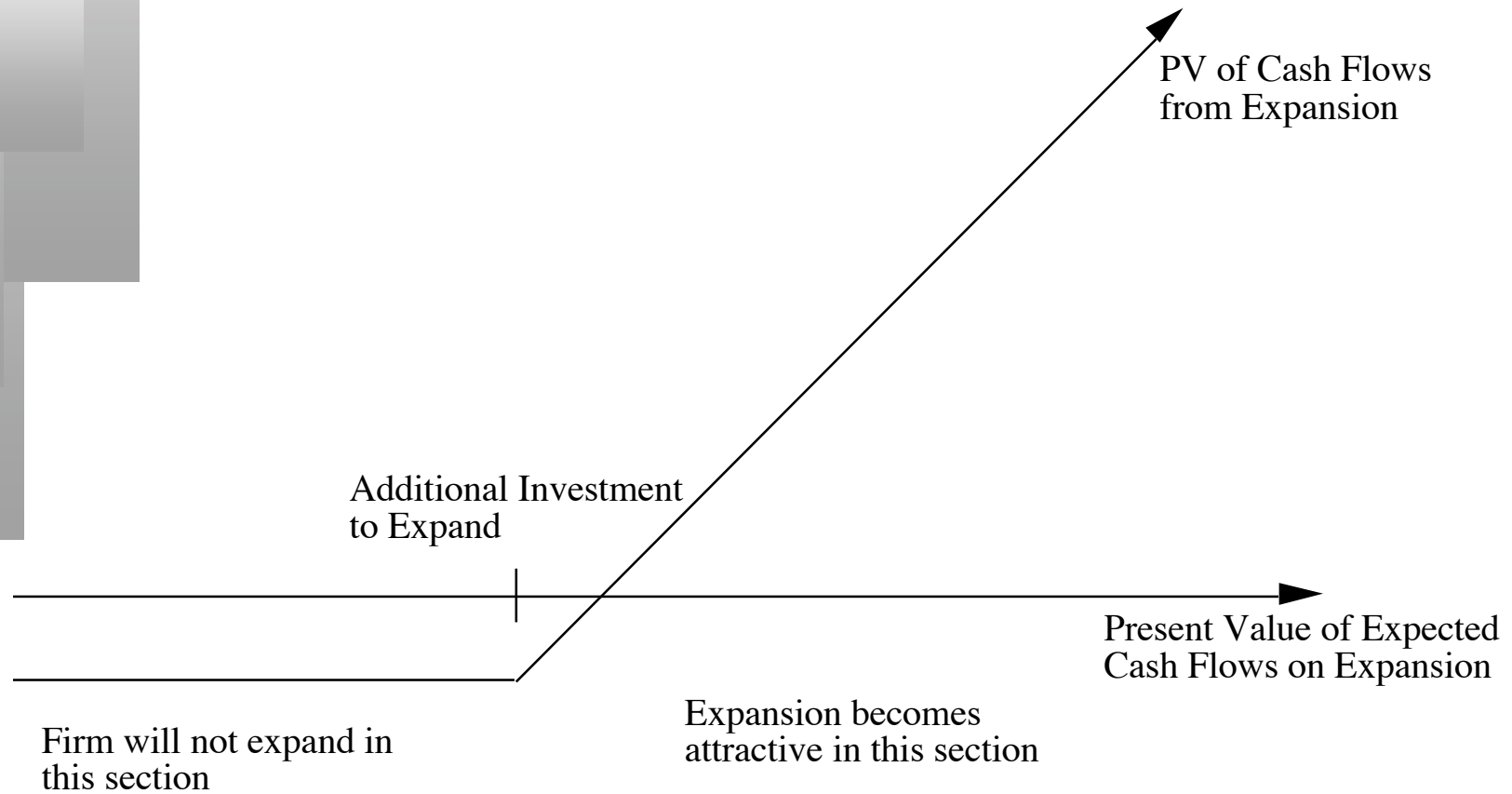
Example 4: Equity in a Deeply Troubled firm (losing money with substantial debt) as a Liquidation Optiion

Net Payoff
on Equity

Face Value
of Debt

Value of firm
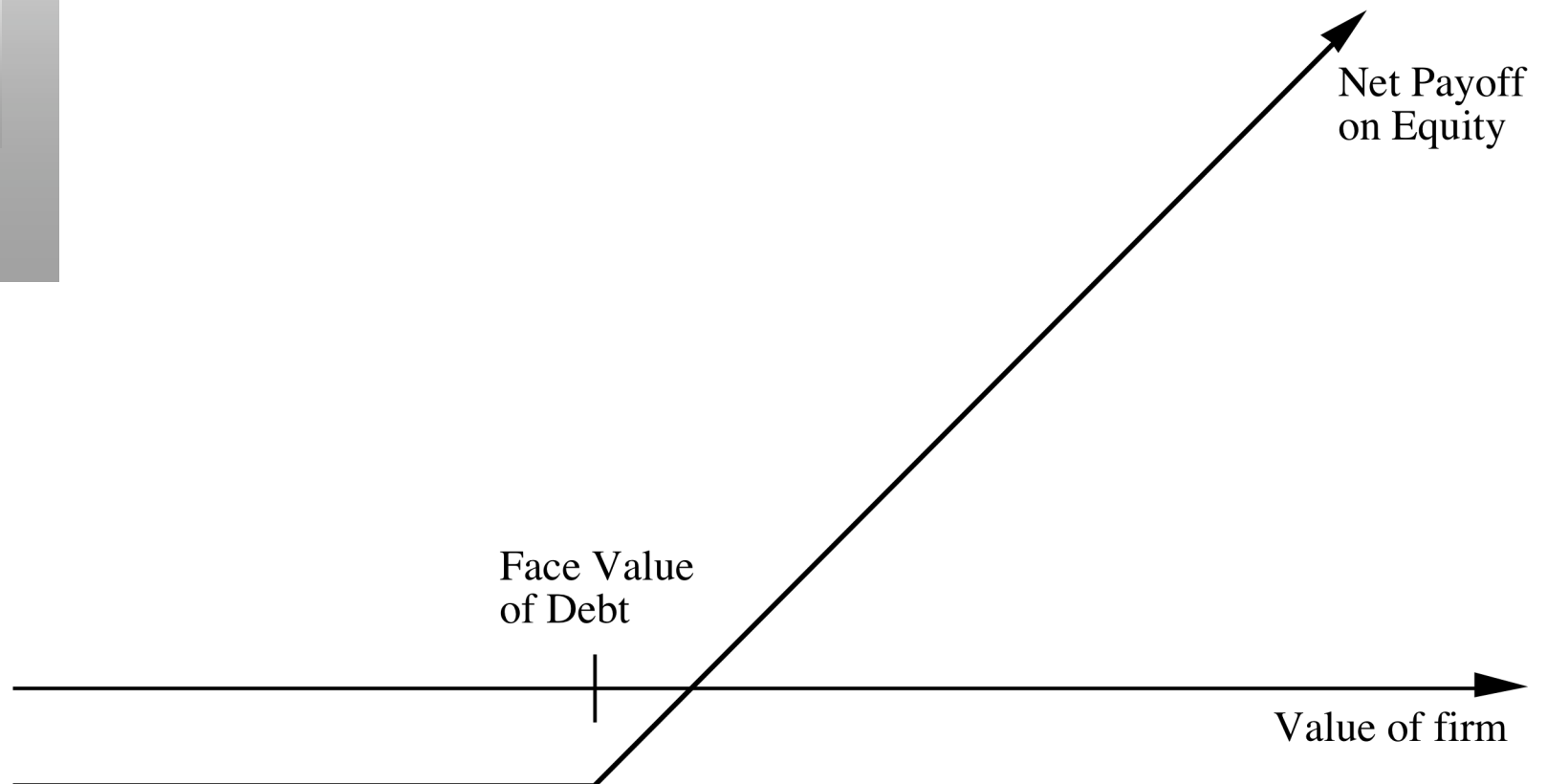
When does the option have significant economic value?

■ For an option to have significant economic value, there has to be a <u>restriction on competition in the event of the contingency</u>. In a perfectly competitive product market, no contingency, no matter how positive, will generate positive net present value.

■ At the limit, real options are <u>most valuable when you have exclusivity</u> - you and only you can take advantage of the contingency. They become less valuable as the barriers to competition become less steep.

Exclusivity: Putting Real Options to the Test

■ Product Options: Patent on a drug
- Patents restrict competitors from developing similar products
- Patents do not restrict competitors from developing other products to treat the same disease.

■ Natural Resource options: An undeveloped oil reserve or gold mine.
- Natural resource reserves are limited.
- It takes time and resources to develop new reserves

■ Growth Options: Expansion into a new product or market
- Barriers may range from strong (exclusive licenses granted by the government - as in telecom businesses) to weaker (brand name, knowledge of the market) to weakest (first mover).

■ Equity in a Deeply Troubled Firm as a Liquidation Option
- Option value greatest when equity investors have the exclusive power to decide on whether to liquidate or not
- Option value is reduced if lenders or the court get some or much of the power.

Determinants of option value

- **Variables Relating to Underlying Asset**
  - <u>Value of Underlying Asset</u>; as this value increases, the right to buy at a fixed price (calls) will become more valuable and the right to sell at a fixed price (puts) will become less valuable.
  - <u>Variance in that value</u>; as the variance increases, both calls and puts will become more valuable because all options have limited downside and depend upon price volatility for upside.
  - <u>Expected dividends on the asset</u>, which are likely to reduce the price appreciation component of the asset, reducing the value of calls and increasing the value of puts.
- **Variables Relating to Option**
  - <u>Strike Price of Options</u>; the right to buy (sell) at a fixed price becomes more (less) valuable at a lower price.
  - <u>Life of the Option</u>; both calls and puts benefit from a longer life.
- **Level of Interest Rates**; as rates increase, the right to buy (sell) at a fixed price in the future becomes more (less) valuable.

When can you use an option pricing model to value a real option?

■ All option pricing models are built on the premise of replication and arbitrage.

■ **Replication**: The objective in creating a replicating portfolio is to use a combination of riskfree borrowing/lending and the underlying asset to create the same cashflows as the option being valued.

  • Call = Borrowing + Buying D of the Underlying Stock
  • Put = Selling Short D on Underlying Asset + Lending
  • The number of shares bought or sold is called the **option delta**.

■ **Arbitrage**: If two assets have the same cashflows, they cannot sell at different prices. If they do, the principles of arbitrage then apply, and the value of the option has to be equal to the value of the replicating portfolio.

The Black Scholes Model

Value of call = $S\ N(d_1) - K\ e^{-rt}\ N(d_2)$
where,

$$d_1 = \frac{\ln\left(\frac{S}{K}\right) + (r + \frac{\sigma^2}{2})\,t}{\sigma \sqrt{t}}$$

- $d_2 = d_1 - \sigma \sqrt{t}$

■ The replicating portfolio is embedded in the Black-Scholes model. To replicate this call, you would need to

- Buy $N(d1)$ shares of stock; $N(d1)$ is called the option delta
- Borrow $K\ e^{-rt}\ N(d_2)$

The Normal Distribution
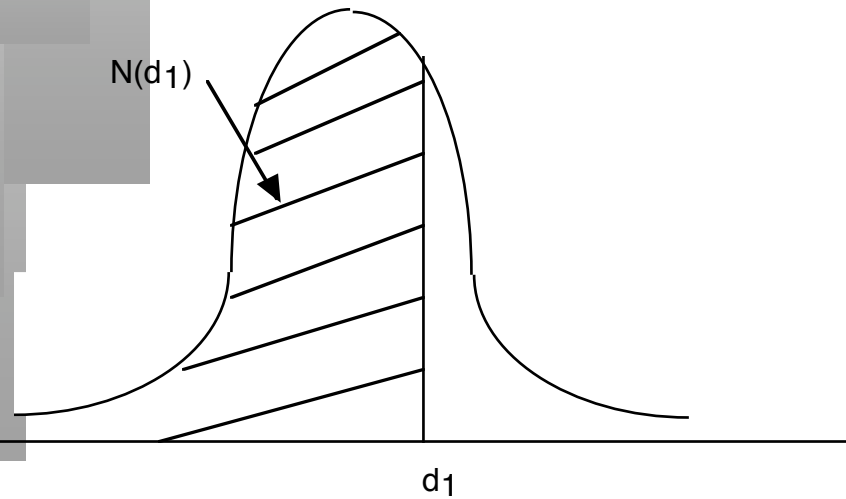
d	N(d)	d	N(d)	d	N(d)
-3.00	0.0013	-1.00	0.1587	1.05	0.8531
-2.95	0.0016	-0.95	0.1711	1.10	0.8643
-2.90	0.0019	-0.90	0.1841	1.15	0.8749
-2.85	0.0022	-0.85	0.1977	1.20	0.8849
-2.80	0.0026	-0.80	0.2119	1.25	0.8944
-2.75	0.0030	-0.75	0.2266	1.30	0.9032
-2.70	0.0035	-0.70	0.2420	1.35	0.9115
-2.65	0.0040	-0.65	0.2578	1.40	0.9192
-2.60	0.0047	-0.60	0.2743	1.45	0.9265
-2.55	0.0054	-0.55	0.2912	1.50	0.9332
-2.50	0.0062	-0.50	0.3085	1.55	0.9394
-2.45	0.0071	-0.45	0.3264	1.60	0.9452
-2.40	0.0082	-0.40	0.3446	1.65	0.9505
-2.35	0.0094	-0.35	0.3632	1.70	0.9554
-2.30	0.0107	-0.30	0.3821	1.75	0.9599
-2.25	0.0122	-0.25	0.4013	1.80	0.9641
-2.20	0.0139	-0.20	0.4207	1.85	0.9678
-2.15	0.0158	-0.15	0.4404	1.90	0.9713
-2.10	0.0179	-0.10	0.4602	1.95	0.9744
-2.05	0.0202	-0.05	0.4801	2.00	0.9772
-2.00	0.0228	0.00	0.5000	2.05	0.9798
-1.95	0.0256	0.05	0.5199	2.10	0.9821
-1.90	0.0287	0.10	0.5398	2.15	0.9842
-1.85	0.0322	0.15	0.5596	2.20	0.9861
-1.80	0.0359	0.20	0.5793	2.25	0.9878
-1.75	0.0401	0.25	0.5987	2.30	0.9893
-1.70	0.0446	0.30	0.6179	2.35	0.9906
-1.65	0.0495	0.35	0.6368	2.40	0.9918
-1.60	0.0548	0.40	0.6554	2.45	0.9929
-1.55	0.0606	0.45	0.6736	2.50	0.9938
-1.50	0.0668	0.50	0.6915	2.55	0.9946
-1.45	0.0735	0.55	0.7088	2.60	0.9953
-1.40	0.0808	0.60	0.7257	2.65	0.9960
-1.35	0.0885	0.65	0.7422	2.70	0.9965
-1.30	0.0968	0.70	0.7580	2.75	0.9970
-1.25	0.1056	0.75	0.7734	2.80	0.9974
-1.20	0.1151	0.80	0.7881	2.85	0.9978
-1.15	0.1251	0.85	0.8023	2.90	0.9981
-1.10	0.1357	0.90	0.8159	2.95	0.9984
-1.05	0.1469	0.95	0.8289	3.00	0.9987
-1.00	0.1587	1.00	0.8413		

Adjusting for Dividends

- If the dividend yield (y = dividends/ Current value of the asset) of the underlying asset is expected to remain unchanged during the life of the option, the Black-Scholes model can be modified to take dividends into account.

$$C = \qquad$$

where

$$d_1 = \frac{\ln\left(\dfrac{S}{K}\right) + (r - y + \dfrac{\sigma^2}{2}) t}{\sigma \sqrt{t}}$$

$$d_2 = d_1 - \sigma \sqrt{t}$$

- The value of a put can also be derived:

$$P = K\, e^{-rt}\, (1 - N(d_2)) - S\, e^{-yt}\, (1 - N(d_1))$$

Example 1: Valuing a Product Patent as an option: Avonex

■ Biogen, a bio-technology firm, has a patent on Avonex, a drug to treat multiple sclerosis, for the next 17 years, and it plans to produce and sell the drug by itself. The key inputs on the drug are as follows:

PV of Cash Flows from Introducing the Drug Now = S = $ 3.422 billion

PV of Cost of Developing Drug for Commercial Use = K = $ 2.875 billion

Patent Life = t = 17 years   Riskless Rate = r = 6.7% (17-year T.Bond rate)

Variance in Expected Present Values = s^2 = 0.224 (Industry average firm variance for bio-tech firms)

Expected Cost of Delay = y = 1/17 = 5.89%

d1 = 1.1362   N(d1) = 0.8720

d2 = -0.8512   N(d2) = 0.2076

Call Value= 3,422 exp$^{(-0.0589)(17)}$ (0.8720) - 2,875 (exp$^{(-0.067)(17)}$ (0.2076)= $ 907 million

Valuing a firm with patents

■ The value of a firm with a substantial number of patents can be derived using the option pricing model.

Value of Firm = Value of commercial products (using DCF value

+ Value of existing patents (using option pricing)

+ (Value of New patents that will be obtained in the future – Cost of obtaining these patents)

■ The last input measures the <u>efficiency of the firm in converting its R&D into commercial products</u>. If we assume that a firm earns its cost of capital from research, this term will become zero.

■ If we use this approach, we should <u>be careful not to double count</u> and allow for a high growth rate in cash flows (in the DCF valuation).

Value of Biogen's existing products

- Biogen had two commercial products (a drug to treat Hepatitis B and Intron) at the time of this valuation that it had licensed to other pharmaceutical firms.
- The license fees on these products were expected to generate $ 50 million in after-tax cash flows each year for the next 12 years. To value these cash flows, which were guaranteed contractually, the pre-tax cost of debt of the guarantors (6.7%) was used:

Present Value of License Fees = $ 50 million $(1 - (1.067)^{-12})/.067$

$$= \$ 403.56 \text{ million}$$

Value of Biogen's Future R&D

- Biogen continued to fund research into new products, spending about $ 100 million on R&D in the most recent year. These R&D expenses were expected to grow 20% a year for the next 10 years, and 5% thereafter.

- It was assumed that every dollar invested in research would create $ 1.25 in value in patents (valued using the option pricing model described above) for the next 10 years, and break even after that (i.e., generate $ 1 in patent value for every $ 1 invested in R&D).

- There was a significant amount of risk associated with this component and the cost of capital was estimated to be 15%.

Value of Future R&D

Yr	Value of Patents	R&D Cost	Excess Value	Present Value (at 15%)
1	$ 150.00	$ 120.00	$ 30.00	$ 26.09
2	$ 180.00	$ 144.00	$ 36.00	$ 27.22
3	$ 216.00	$ 172.80	$ 43.20	$ 28.40
4	$ 259.20	$ 207.36	$ 51.84	$ 29.64
5	$ 311.04	$ 248.83	$ 62.21	$ 30.93
6	$ 373.25	$ 298.60	$ 74.65	$ 32.27
7	$ 447.90	$ 358.32	$ 89.58	$ 33.68
8	$ 537.48	$ 429.98	$ 107.50	$ 35.14
9	$ 644.97	$ 515.98	$ 128.99	$ 36.67
10	$ 773.97	$ 619.17	$ 154.79	$ 38.26
				$ 318.30

Value of Biogen

■ The value of Biogen as a firm is the sum of all three components – the present value of cash flows from existing products, the value of Avonex (as an option) and the value created by new research:

Value = Existing products + Existing Patents + Value: Future R&D

= $ 403.56 million + $ 907 million + $ 318.30 million

= $1628.86 million

■ Since Biogen had no debt outstanding, this value was divided by the number of shares outstanding (35.50 million) to arrive at a value per share:

Value per share = $ 1,628.86 million / 35.5 = $ 45.88

Example 2: Valuing an Oil Reserve

■ Consider an offshore oil property with an estimated oil reserve of 50 million barrels of oil, where the present value of the development cost is $12 per barrel and the development lag is two years.

■ The firm has the rights to exploit this reserve for the next twenty years and the marginal value per barrel of oil is $12 per barrel currently (Price per barrel - marginal cost per barrel).

■ Once developed, the net production revenue each year will be 5% of the value of the reserves.

■ The riskless rate is 8% and the variance in ln(oil prices) is 0.03.

Valuing an oil reserve as a real option

- Current Value of the asset = S = Value of the developed reserve discounted back the length of the development lag at the dividend yield = $12 * 50 /(1.05)^2 = $ 544.22

- (If development is started today, the oil will not be available for sale until two years from now. The estimated opportunity cost of this delay is the lost production revenue over the delay period. Hence, the discounting of the reserve back at the dividend yield)

- Exercise Price = Present Value of development cost = $12 * 50 = $600 million

- Time to expiration on the option = 20 years

- Variance in the value of the underlying asset = 0.03

- Riskless rate =8%

- Dividend Yield = Net production revenue / Value of reserve = 5%

Valuing one oil reserve to valuing an oil company: Valuing Gulf Oil in 1984

■ Gulf Oil was the target of a takeover in early 1984 at $70 per share (It had 165.30 million shares outstanding, and total debt of $9.9 billion).

- It had estimated reserves of 3038 million barrels of oil and the average cost of developing these reserves was estimated to be $10 a barrel in present value dollars (The development lag is approximately two years).

- The average relinquishment life of the reserves is 12 years.

- The price of oil was $22.38 per barrel, and the production cost, taxes and royalties were estimated at $7 per barrel.

- The bond rate at the time of the analysis was 9.00%.

- Gulf was expected to have net production revenues each year of approximately 5% of the value of the developed reserves. The variance in oil prices is 0.03.

Valuing Undeveloped Reserves

- ■ Inputs for valuing undeveloped reserves
  - Value of underlying asset = Value of estimated reserves discounted back for period of development lag= 3038 * ($ 22.38 - $7) / 1.05^2 = **$42,380.44**
  - Exercise price = Estimated development cost of reserves = 3038 * $10 = **$30,380 million**
  - Time to expiration = Average length of relinquishment option = **12 years**
  - Variance in value of asset = Variance in oil prices = **0.03**
  - Riskless interest rate = **9%**
  - Dividend yield = Net production revenue/ Value of developed reserves = **5%**
- ■ Based upon these inputs, the Black-Scholes model provides the following value for the call:

  d1 = 1.6548   N(d1) = 0.9510

  d2 = 1.0548   N(d2) = 0.8542
- ■ Call Value= 42,380.44 $\exp^{(-0.05)(12)}$ (0.9510) -30,380 ($\exp^{(-0.09)(12)}$ (0.8542)= **$ 13,306 million**

Valuing Gulf Oil

- In addition, Gulf Oil had free cashflows to the firm from its oil and gas production of $915 million from already developed reserves and these cashflows are likely to continue for ten years (the remaining lifetime of developed reserves).

- The present value of these developed reserves, discounted at the weighted average cost of capital of 12.5%, yields:
  - Value of already developed reserves = 915 $(1 - 1.125^{-10})/.125 = \$5065.83$

- Adding the value of the developed and undeveloped reserves

Value of undeveloped reserves	= $ 13,306 million
Value of production in place	= $ 5,066 million
Total value of firm	= $ 18,372 million
Less Outstanding Debt	= $ 9,900 million
Value of Equity	= $ 8,472 million
Value per share	= $ 8,472/165.3 = $51.25

Example 3: Valuing an Expansion Option

- Ambev is considering introducing a soft drink to the U.S. market. The drink will initially be introduced only in the metropolitan areas of the U.S. and the cost of this "limited introduction" is $ 500 million.

- A financial analysis of the cash flows from this investment suggests that the present value of the cash flows from this investment to Ambev will be only $ 400 million. Thus, by itself, the new investment has a **negative NPV of $ 100 million**.

- If the initial introduction works out well, Ambev **could go ahead with a full-scale introduction to the entire market** with **an additional investment of $ 1 billion** any time over the next 5 years. While the current expectation is that the cash flows from having this investment is only $ 750 million, there is considerable uncertainty about both the potential for the drink, leading to significant variance in this estimate.

Valuing the Expansion Option

- Value of the Underlying Asset (S) = PV of Cash Flows from Expansion to entire U.S. market, if done now =$ 750 Million

- Strike Price (K) = Cost of Expansion into entire U.S market = $ 1000 Million

- We estimate the standard deviation in the estimate of the project value by using the annualized standard deviation in firm value of publicly traded firms in the beverage markets, which is approximately 34.25%.
  - Standard Deviation in Underlying Asset's Value = 34.25%

- Time to expiration = Period for which expansion option applies = 5 years

Call Value= $ 234 Million

Example 4: Valuing Equity in a Deeply Troubled Firm

■ Assume that you have a firm whose assets are currently valued at $100 million and that the standard deviation in this asset value is 40%.

■ Further, assume that the face value of debt is $80 million (It is zero coupon debt with 10 years left to maturity).

■ If the ten-year treasury bond rate is 10%,

- how much is the equity worth?
- What should the interest rate on debt be?

Model Parameters

- Value of the underlying asset = S = Value of the firm = $ 100 million
- Exercise price = K = Face Value of outstanding debt = $ 80 million
- Life of the option = t = Life of zero-coupon debt = 10 years
- Variance in the value of the underlying asset = σ^2 = Variance in firm value = 0.16
- Riskless rate = r = Treasury bond rate corresponding to option life = 10%

Valuing Equity as a Call Option

■ Based upon these inputs, the Black-Scholes model provides the following value for the call:

- d1 = 1.5994   N(d1) = 0.9451
- d2 = 0.3345   N(d2) = 0.6310

■ Value of the call = 100 (0.9451) - 80 exp$^{(-0.10)(10)}$ (0.6310) = $75.94 million

■ Value of the outstanding debt = $100 - $75.94 = $24.06 million

■ Interest rate on debt = ($ 80 / $24.06)$^{1/10}$ -1 = 12.77%

The Effect of Catastrophic Drops in Value

■ Assume now that a catastrophe wipes out half the value of this firm (the value drops to $ 50 million), while the face value of the debt remains at $ 80 million. What will happen to the equity value of this firm?

❏ It will drop in value to $ 25.94 million [$ 50 million - market value of debt from previous page]

❏ It will be worth nothing since debt outstanding > Firm Value

❏ It will be worth more than $ 25.94 million

Valuing Equity in the Troubled Firm

- Value of the underlying asset = S = Value of the firm = $ 50 million
- Exercise price = K = Face Value of outstanding debt = $ 80 million
- Life of the option = t = Life of zero-coupon debt = 10 years
- Variance in the value of the underlying asset = σ^2 = Variance in firm value = 0.16
- Riskless rate = r = Treasury bond rate corresponding to option life = 10%

The Value of Equity as an Option

- Based upon these inputs, the Black-Scholes model provides the following value for the call:
  - d1 = 1.0515   N(d1) = 0.8534
  - d2 = -0.2135   N(d2) = 0.4155
- Value of the call = 50 (0.8534) - 80 $\exp^{(-0.10)(10)}$ (0.4155) = $30.44 million
- Value of the bond= $50 - $30.44 = $19.56 million
- The equity in this firm drops by, because of the option characteristics of equity.
- This might explain why stock in firms, which are in Chapter 11 and essentially bankrupt, still has value.

Equity value persists ..

Value of Equity as Firm Value Changes
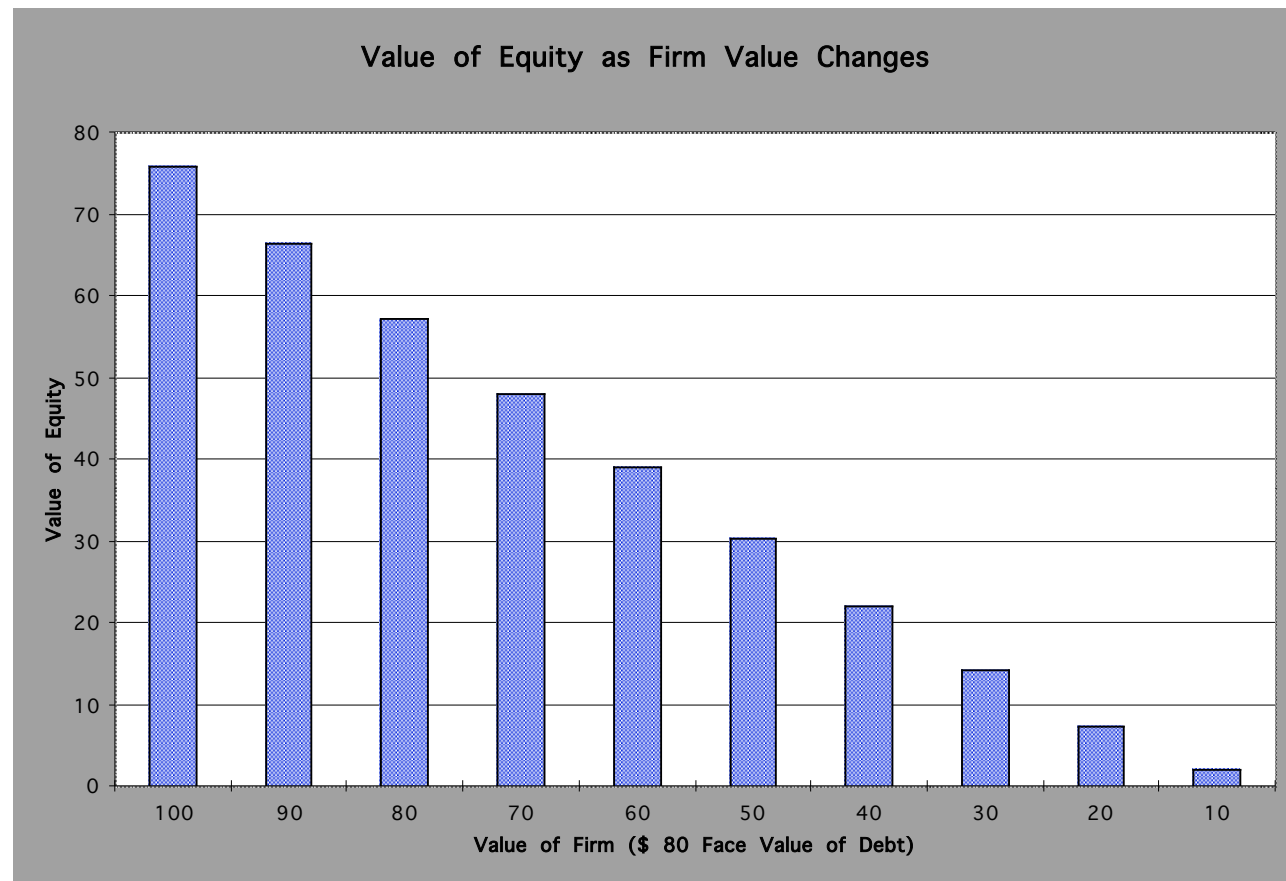
Obtaining option pricing inputs - Some real world problems

■ The examples that have been used to illustrate the use of option pricing theory to value equity have made some simplifying assumptions. Among them are the following:

(1) There were only two claim holders in the firm - debt and equity.

(2) There is only one issue of debt outstanding and it can be retired at face value.

(3) The debt has a zero coupon and no special features (convertibility, put clauses etc.)

(4) The value of the firm and the variance in that value can be estimated.

Real World Approaches to Getting inputs

Input	Estimation Process
Value of the Firm	• Cumulate market values of equity and debt (or) • Value the <u>assets in place</u> using FCFF and WACC (or) • Use cumulated market value of assets, if traded.
Variance in Firm Value	• If stocks and bonds are traded, $\sigma^2_{firm} = w_e^2\, \sigma_e^2 + w_d^2\, \sigma_d^2 + 2\, w_e\, w_d\, \rho_{ed}\; \sigma_e\, \sigma_d$ where σ_e^2 = variance in the stock price w_e = MV weight of Equity σ_d^2 = the variance in the bond price $\quad$ w_d = MV weight of debt • If not traded, use variances of similarly rated bonds. • Use average firm value variance from the industry in which company operates.
Value of the Debt	• If the debt is short term, you can use only the face or book value of the debt. • If the debt is long term and coupon bearing, add the cumulated nominal value of these coupons to the face value of the debt.
Maturity of the Debt	• Face value weighted duration of bonds outstanding (or) • If not available, use weighted maturity

Valuing Equity as an option - Eurotunnel in early 1998

- ■ Eurotunnel has been a financial disaster since its opening
  - In 1997, Eurotunnel had earnings before interest and taxes of -£56 million and net income of -£685 million
  - At the end of 1997, its book value of equity was -£117 million
- ■ It had £8,865 million in face value of debt outstanding
  - The weighted average duration of this debt was 10.93 years

Debt Type	Face Value	Duration
Short term	935	0.50
10 year	2435	6.7
20 year	3555	12.6
Longer	1940	18.2
Total	*£8,865 mil 10.93 years*	

The Basic DCF Valuation

- The value of the firm estimated using projected cashflows to the firm, discounted at the weighted average cost of capital was £2,312 million.

- This was based upon the following assumptions –
  - Revenues will grow 5% a year in perpetuity.
  - The COGS which is currently 85% of revenues will drop to 65% of revenues in yr 5 and stay at that level.
  - Capital spending and depreciation will grow 5% a year in perpetuity.
  - There are no working capital requirements.
  - The debt ratio, which is currently 95.35%, will drop to 70% after year 5. The cost of debt is 10% in high growth period and 8% after that.
  - The beta for the stock will be 1.10 for the next five years, and drop to 0.8 after the next 5 years.
  - The long term bond rate is 6%.

Other Inputs

■ The stock has been traded on the London Exchange, and the annualized std deviation based upon ln (prices) is 41%.

■ There are Eurotunnel bonds, that have been traded; the annualized std deviation in ln(price) for the bonds is 17%.

  • The correlation between stock price and bond price changes has been 0.5. The proportion of debt in the capital structure during the period (1992-1996) was 85%.

  • Annualized variance in firm value

  $= (0.15)^2 (0.41)^2 + (0.85)^2 (0.17)^2 + 2 (0.15) (0.85)(0.5)(0.41)(0.17) = 0.0335$

■ The 15-year bond rate is 6%. (I used a bond with a duration of roughly 11 years to match the life of my option)

Valuing Eurotunnel Equity and Debt

■ Inputs to Model
- Value of the underlying asset = S = Value of the firm = £2,312 million
- Exercise price = K = Face Value of outstanding debt = £8,865 million
- Life of the option = t = Weighted average duration of debt = 10.93 years
- Variance in the value of the underlying asset = σ^2 = Variance in firm value = 0.0335
- Riskless rate = r = Treasury bond rate corresponding to option life = 6%

■ Based upon these inputs, the Black-Scholes model provides the following value for the call:

d1 = -0.8337   N(d1) = 0.2023
d2 = -1.4392   N(d2) = 0.0751

■ Value of the call = 2312 (0.2023) - 8,865 exp$^{(-0.06)(10.93)}$ (0.0751) = £122 million

■ Appropriate interest rate on debt = (8865/2190)$^{(1/10.93)}$-1= 13.65%

Key Tests for Real Options

- Is there an option embedded in this asset/ decision?
    - Can you identify the underlying asset?
    - Can you specify the contigency under which you will get payoff?
- Is there exclusivity?
    - If yes, there is option value.
    - If no, there is none.
    - If in between, you have to scale value.
- Can you use an option pricing model to value the real option?
    - Is the underlying asset traded?
    - Can the option be bought and sold?
    - Is the cost of exercising the option known and clear?

In Closing…

- There are real options everywhere.
- Most of them have no significant economic value because there is no exclusivity associated with using them.
- When options have significant economic value, the inputs needed to value them in a binomial model can be used in more traditional approaches (decision trees) to yield equivalent value.
- The real value from real options lies in
  - Recognizing that building in flexibility and escape hatches into large decisions has value
  - Insights we get on understanding how and why companies behave the way they do in investment analysis and capital structure choices.

Back to Lemmings...

WHAT LEMMINGS BELIEVE