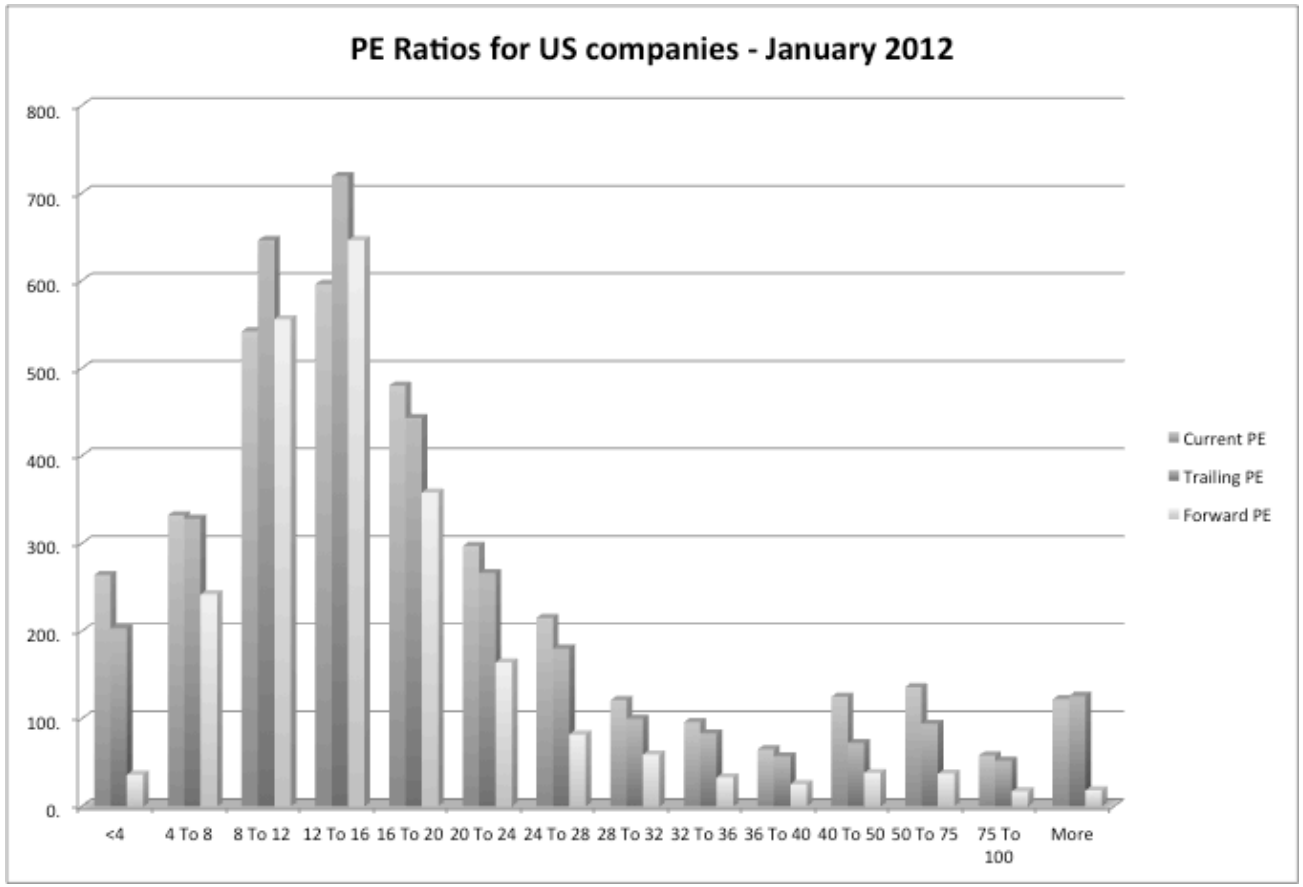
Price Earnings Ratio: Definition

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 (though some like to use average price over last 6 months or year)

  EPS:
  - Time variants: EPS in most recent financial year (current), EPS in most recent four quarters (trailing), EPS expected in next fiscal year or next four quartes (both called forward) or EPS in some future year
  - Primary, diluted or partially diluted
  - Before or after extraordinary items
  - Measured using different accounting rules (options expensed or not, pension fund income counted or not…)

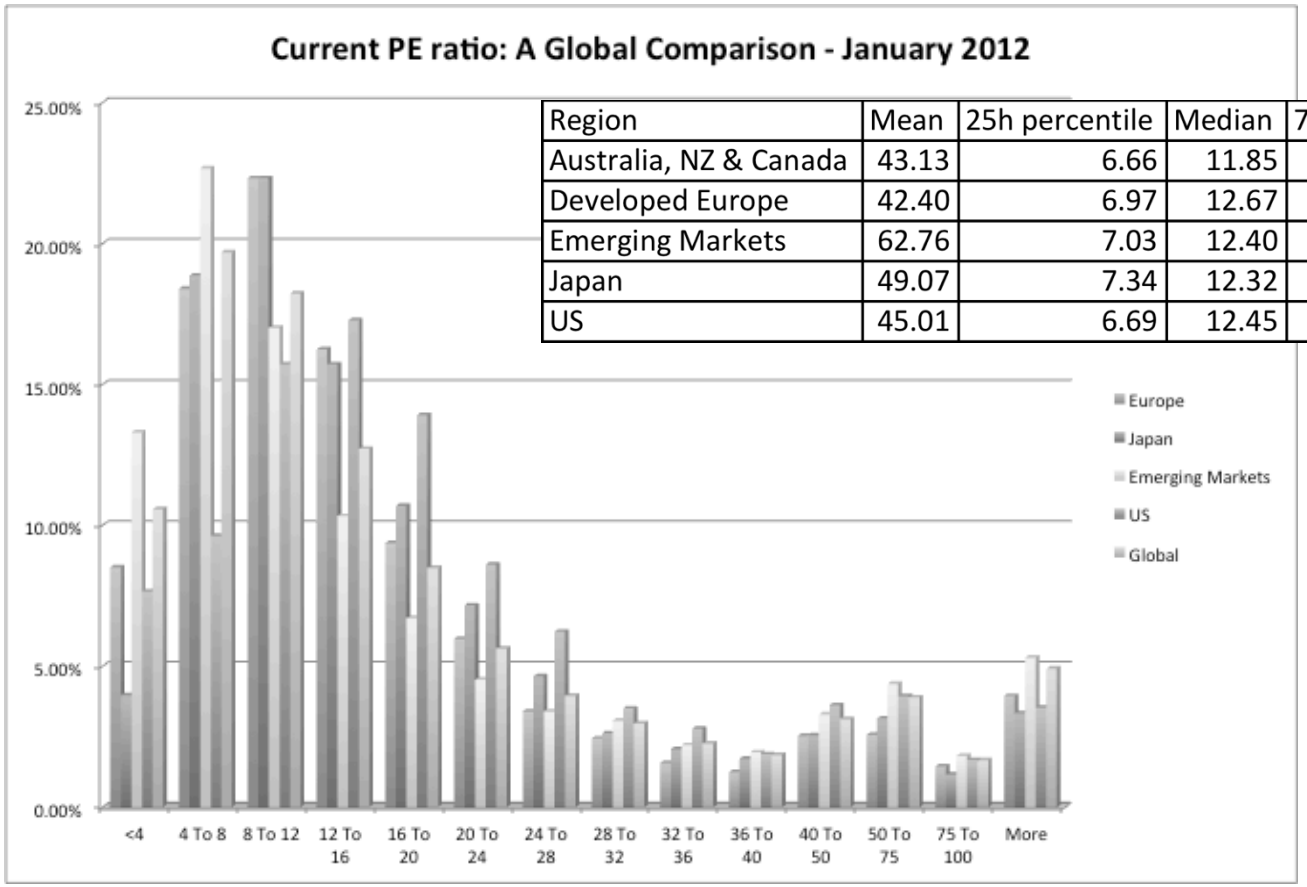
Characteristic 1: Skewed Distributions
PE ratios for US companies in January 2012



Characteristic 2: Biased Samples
PE ratios in January 2012

	Current PE	Trailing PE	Forward PE
Total firms	5891	5891	5891
Number of firms with PE	3456	3375	2311
Average	42.56	33.67	18.28
Median	15.94	14.56	13.74
Minimum	0.1	0.2	0.44
25th percentile	10.11	10	10.34
75th percentile	25.34	22.34	18.69
Maximum	18358	5083	780
Standard deviation	7.26	3.00	0.62
Skewness	33.40	21.86	15.98

Characteristic 3: Across Markets
PE Ratios: US, Europe, Japan and Emerging Markets – January 2012



Region	Mean	25h percentile	Median	75th percentile
Australia, NZ & Canada	43.13	6.66	11.85	22.64
Developed Europe	42.40	6.97	12.67	24.19
Emerging Markets	62.76	7.03	12.40	23.42
Japan	49.07	7.34	12.32	23.99
US	45.01	6.69	12.45	25.84

PE Ratio: Understanding the Fundamentals

- To understand the fundamentals, start with a basic <u>equity</u> discounted cash flow model. With a stable growth dividend discount model:

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

- Dividing both sides by the current earnings per share or forward EPS:

Current EPS

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

Forward EPS

$$\frac{P_0}{EPS_1} = PE = \frac{\text{Payout Ratio}}{r - g_n}$$

- If this had been a FCFE Model,

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

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

PE Ratio and Fundamentals

- **Proposition: Other things held equal, higher growth firms will have higher PE ratios than lower growth firms.**
- **Proposition: Other things held equal, higher risk firms will have lower PE ratios than lower risk firms**
- **Proposition: Other things held equal, firms with lower reinvestment needs 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

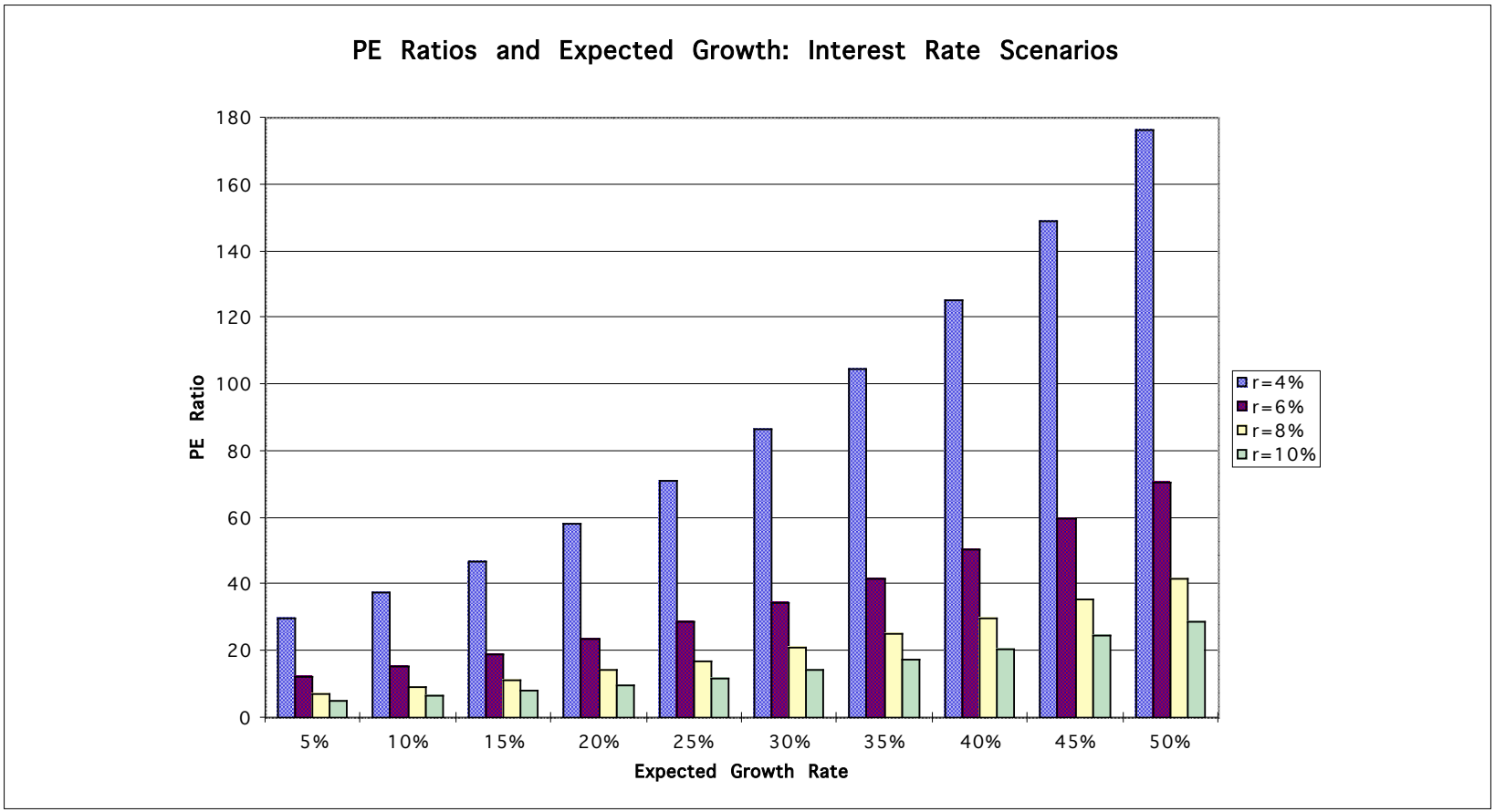
- Assume that you have been asked to estimate the PE ratio for a firm which has the following characteristics:

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

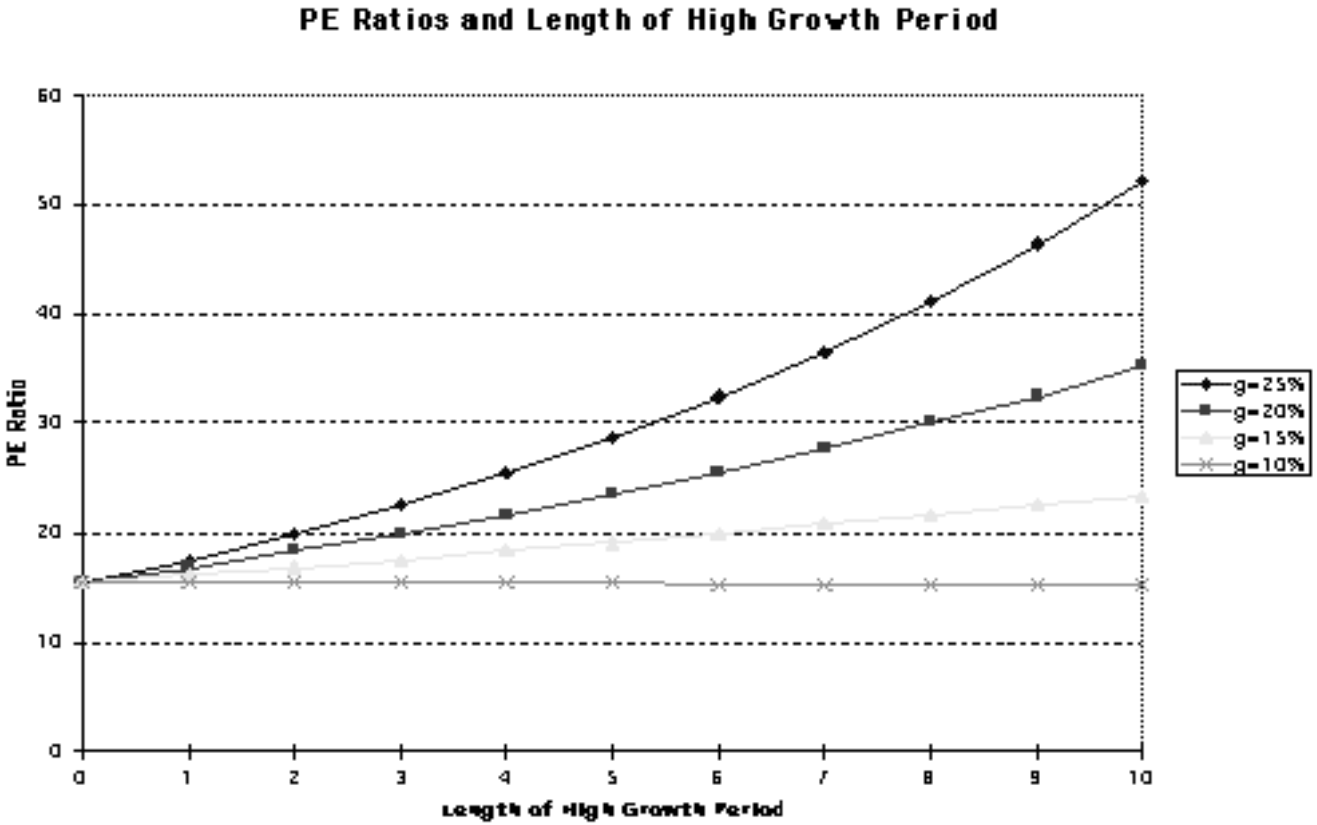
- Riskfree rate = T.Bond Rate = 6%
- Required rate of return = 6% + 1(5.5%)= 11.5%

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

PE and Growth: Firm grows at x% for 5 years, 8% thereafter

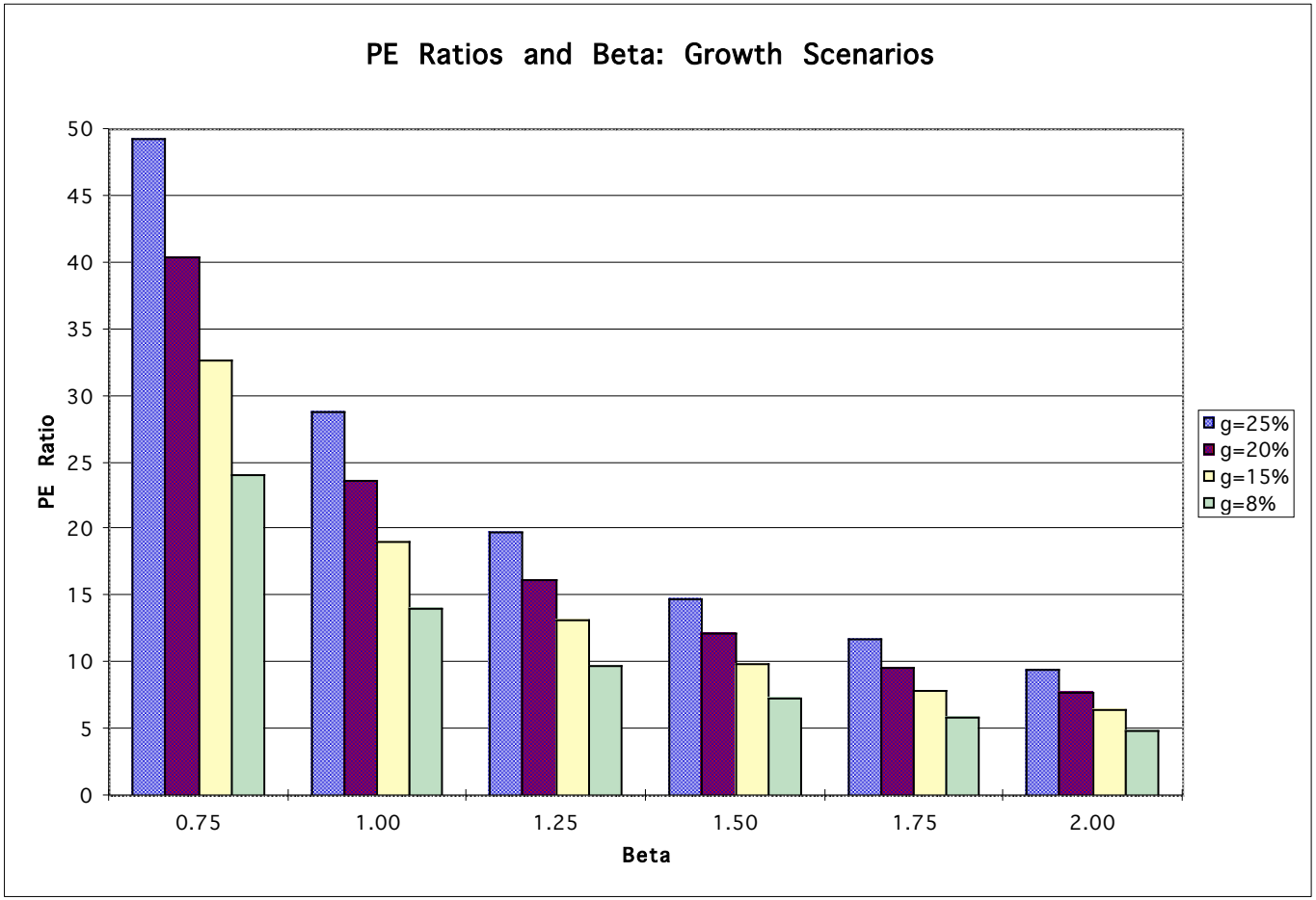


PE Ratios and Length of High Growth: 25% growth for n years; 8% thereafter

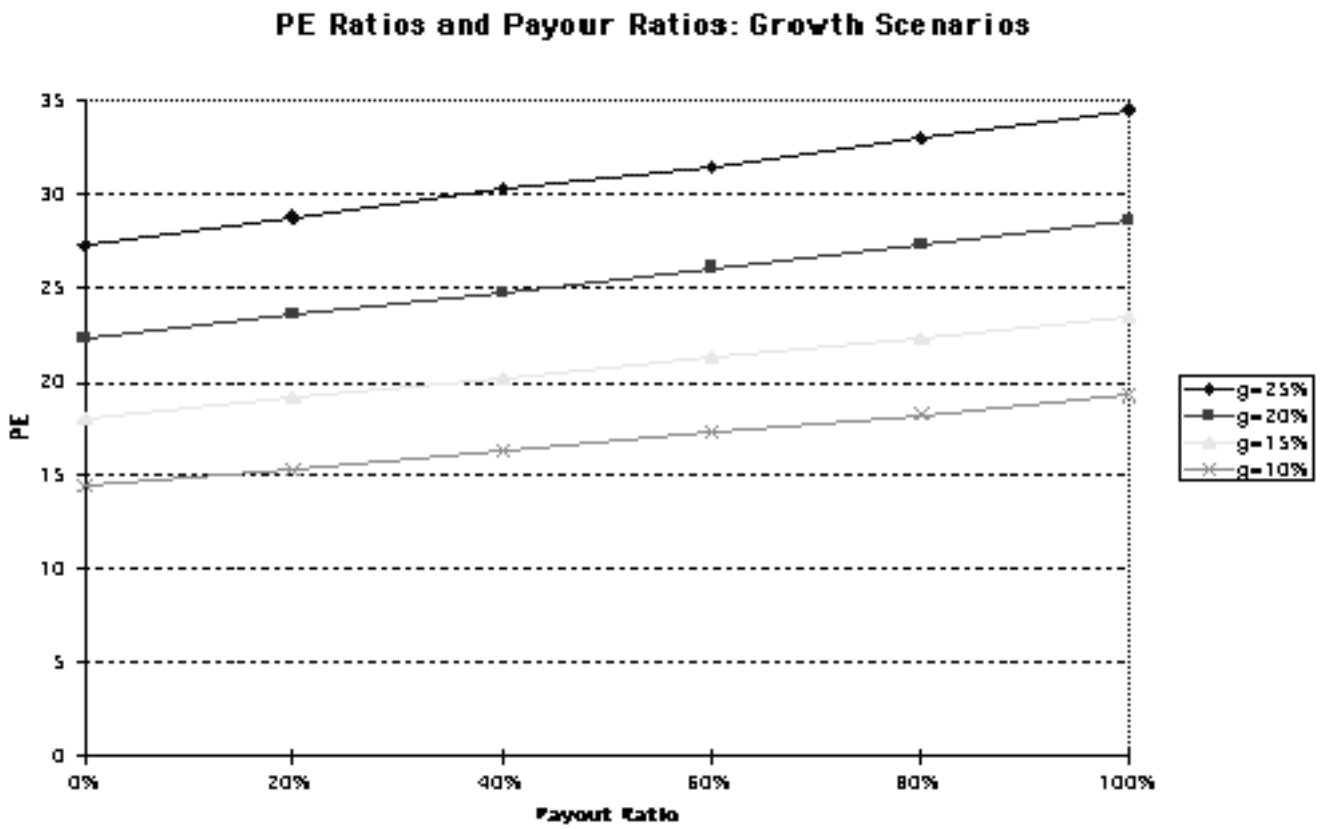


PE and Risk: Effects of Changing Betas on PE Ratio:

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



PE and Payout/ ROE

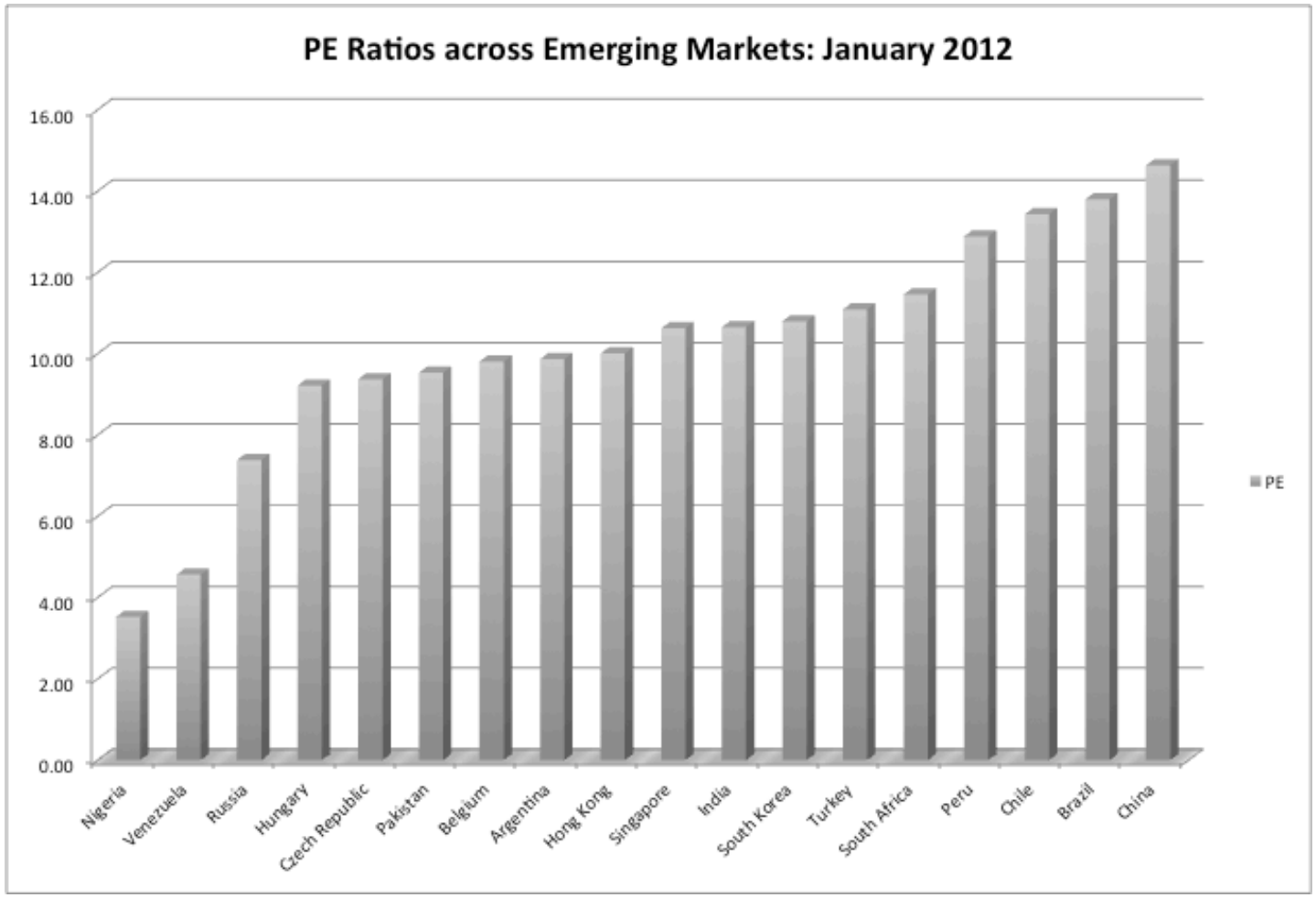


The perfect under valued company…

- If you were looking for the perfect undervalued asset, it would be one
  - With a low PE ratio (it is cheap)
  - With high expected growth in earnings
  - With low risk (and a low cost of equity)
  - And with high ROE

  In other words, it would be cheap with no good reason for being cheap.
- In the real world, most assets that look cheap on a multiple of earnings basis deserve to be cheap. In other words, one or more of these variables works against the company (It has low growth, high risk or a low ROE).
- When presented with a cheap stock (low PE), here are the key questions:
  - What is the expected growth in earnings?
  - What is the risk in the stock?
  - How efficiently does this company generate its growth?

I. Comparing PE ratios across Emerging Markets



II. An Old Example with Emerging Markets: June 2000

Country	*PE Ratio*	*Interest Rates*	*GDP Real Growth*	*Country Risk*
Argentina	14	18.00%	2.50%	45
Brazil	21	14.00%	4.80%	35
Chile	25	9.50%	5.50%	15
Hong Kong	20	8.00%	6.00%	15
India	17	11.48%	4.20%	25
Indonesia	15	21.00%	4.00%	50
Malaysia	14	5.67%	3.00%	40
Mexico	19	11.50%	5.50%	30
Pakistan	14	19.00%	3.00%	45
Peru	15	18.00%	4.90%	50
Phillipines	15	17.00%	3.80%	45
Singapore	24	6.50%	5.20%	5
South Korea	21	10.00%	4.80%	25
Thailand	21	12.75%	5.50%	25
Turkey	12	25.00%	2.00%	35
Venezuela	20	15.00%	3.50%	45

Regression Results

- The regression of PE ratios on these variables provides the following –

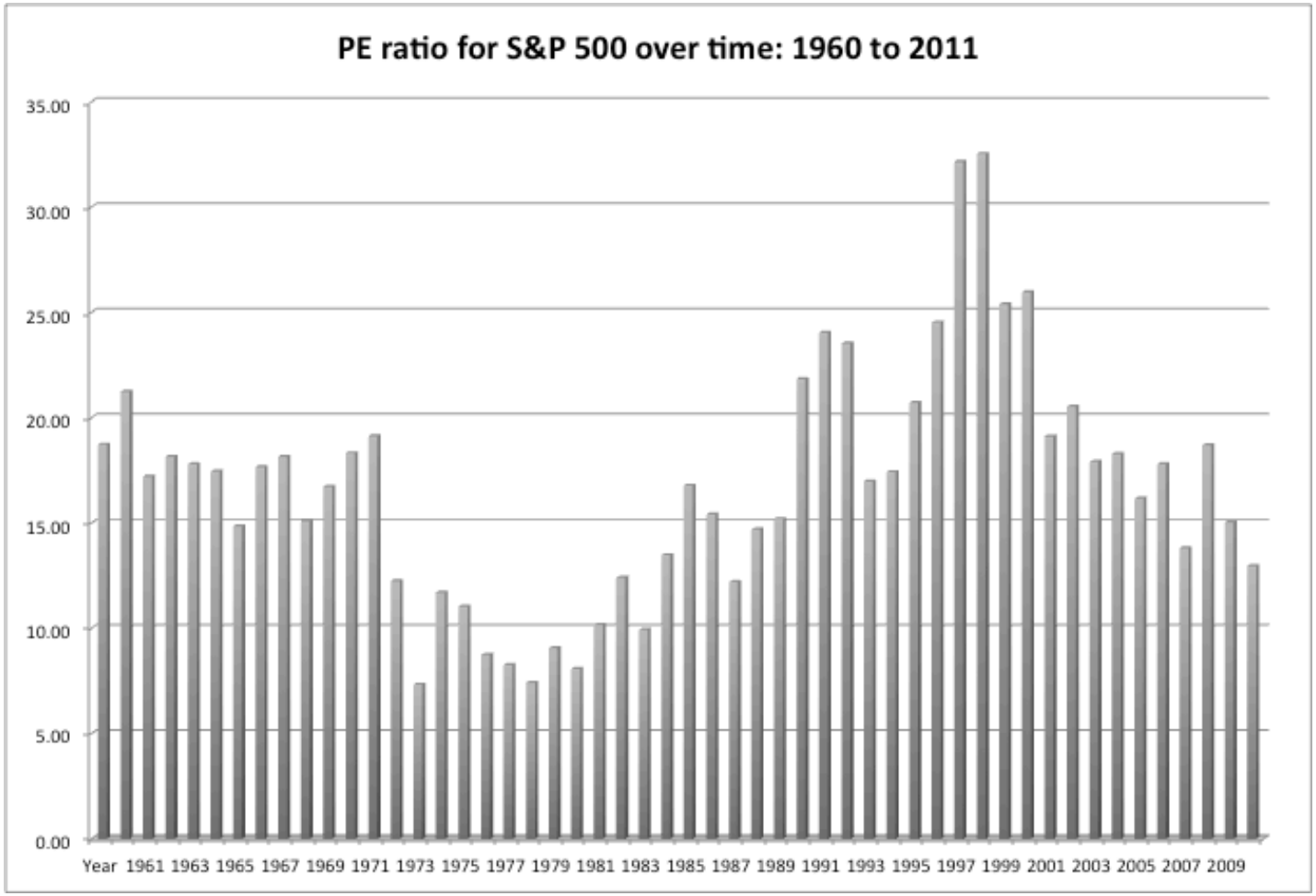
  PE = 16.16 - 7.94 Interest Rates
  + 154.40 Growth in GDP
  - 0.1116 Country Risk

  R Squared = 73%

Predicted PE Ratios

Country	*PE Ratio*	*Interest Rates*	*GDP Real Growth*	*Country Risk*	*Predicted PE*
Argentina	14	18.00%	2.50%	45	13.57
Brazil	21	14.00%	4.80%	35	18.55
Chile	25	9.50%	5.50%	15	22.22
Hong Kong	20	8.00%	6.00%	15	23.11
India	17	11.48%	4.20%	25	18.94
Indonesia	15	21.00%	4.00%	50	15.09
Malaysia	14	5.67%	3.00%	40	15.87
Mexico	19	11.50%	5.50%	30	20.39
Pakistan	14	19.00%	3.00%	45	14.26
Peru	15	18.00%	4.90%	50	16.71
Phillipines	15	17.00%	3.80%	45	15.65
Singapore	24	6.50%	5.20%	5	23.11
South Korea	21	10.00%	4.80%	25	19.98
Thailand	21	12.75%	5.50%	25	20.85
Turkey	12	25.00%	2.00%	35	13.35
Venezuela	20	15.00%	3.50%	45	15.35

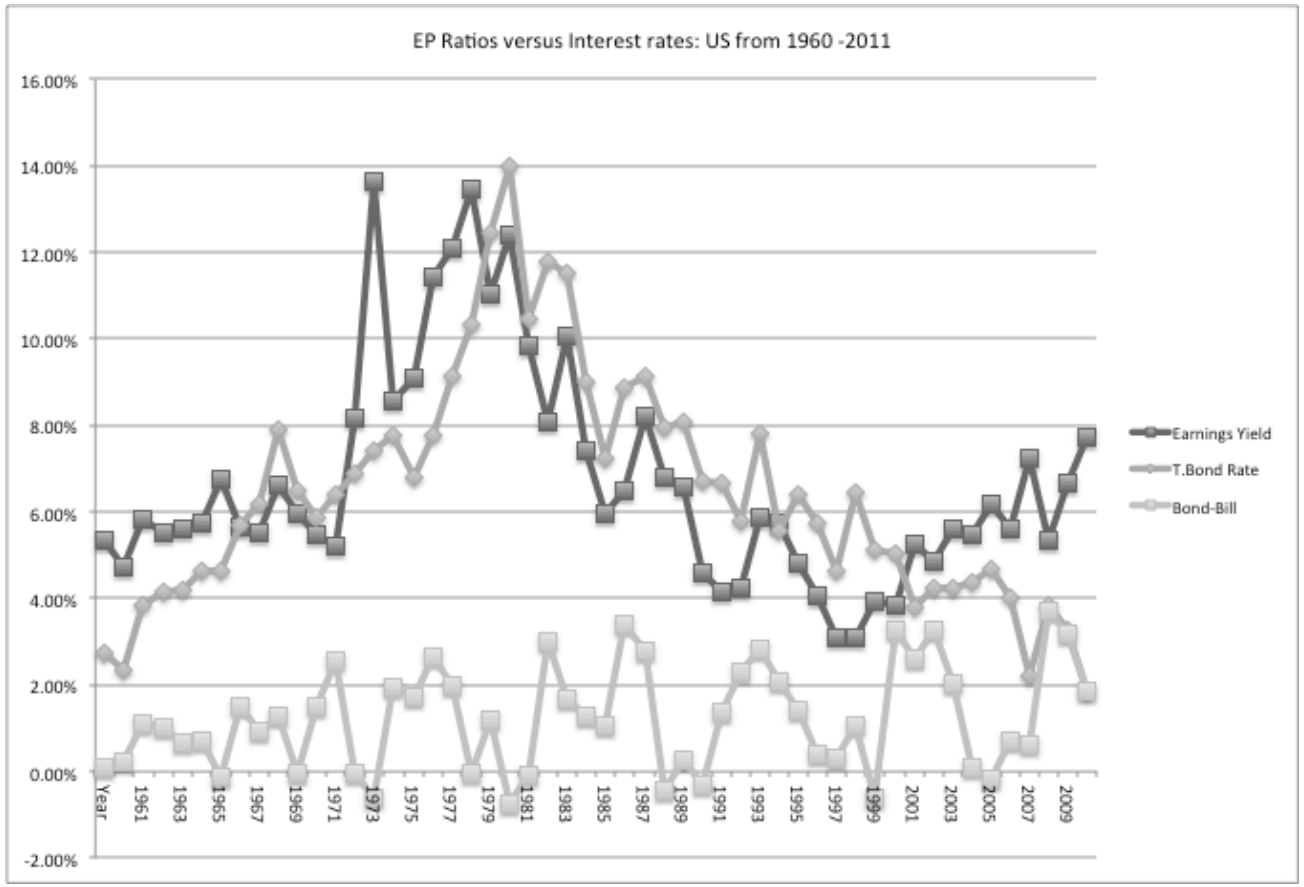
III. Comparisons of PE across time: PE Ratio for the S&P 500



Is low (high) PE cheap (expensive)?

- A market strategist argues that stocks are cheap because the PE ratio today is low relative to the average PE ratio across time. Do you agree?
  - Yes
  - No
- If you do not agree, what factors might explain the lower PE ratio today?

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



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 1960-2011 data, we regress E/P ratios against the level of T.Bond rates and a term structure variable (T.Bond - T.Bill rate)

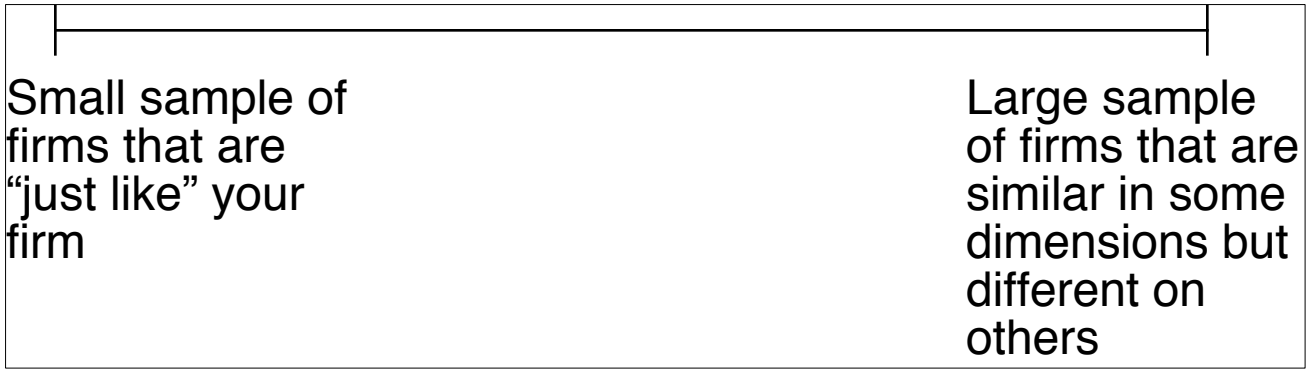
E/P = 3.16% + 0.597 T.Bond Rate – 0.213 (T.Bond Rate-T.Bill Rate)
(3.98) (5.71) (-0.92)

R squared = 40.92%

Given the treasury bond rate and treasury bill rate today, is the market under or over valued today?

IV. Valuing one company relative to others… Relative valuation with comparables

- Ideally, you would like to find lots of publicly traded firms that look just like your firm, in terms of fundamentals, and compare the pricing of your firm to the pricing of these other publicly traded firms. Since, they are all just like your firm, there will be no need to control for differences.
- In practice, it is very difficult (and perhaps impossible) to find firms that share the same risk, growth and cash flow characteristics of your firm. Even if you are able to find such firms, they will very few in number. The trade off then becomes:



Techniques for comparing across firms

- Direct comparisons: If the comparable firms are "just like" your firm, you can compare multiples directly across the firms and conclude that your firm is expensive (cheap) if it trades at a multiple higher (lower) than the other firms.
- Story telling: If there is a key dimension on which the firms vary, you can tell a story based upon your understanding of how value varies on that dimension.
  - An example: This company trades at 12 times earnings, whereas the rest of the sector trades at 10 times earnings, but I think it is cheap because it has a much higher growth rate than the rest of the sector.
- Modified multiple: You can modify the multiple to incorporate the dimension on which there are differences across firms.
- Statistical techniques: If your firms vary on more than one dimension, you can try using multiple regressions (or variants thereof) to arrive at a "controlled" estimate for your firm.

Example 1: Let's try some story telling
Comparing PE ratios across firms in a sector

Company Name	*Trailing PE*	*Expected Growth*	*Standard Dev*
Coca-Cola Bottling	29.18	9.50%	20.58%
Molson Inc. Ltd. 'A'	43.65	15.50%	21.88%
Anheuser-Busch	24.31	11.00%	22.92%
Corby Distilleries Ltd.	16.24	7.50%	23.66%
Chalone Wine Group Ltd.	21.76	14.00%	24.08%
Andres Wines Ltd. 'A'	8.96	3.50%	24.70%
Todhunter Int'l	8.94	3.00%	25.74%
Brown-Forman 'B'	10.07	11.50%	29.43%
Coors (Adolph) 'B'	23.02	10.00%	29.52%
PepsiCo, Inc.	33.00	10.50%	31.35%
Coca-Cola	44.33	19.00%	35.51%
Boston Beer 'A'	10.59	17.13%	39.58%
Whitman Corp.	25.19	11.50%	44.26%
Mondavi (Robert) 'A'	16.47	14.00%	45.84%
Coca-Cola Enterprises	37.14	27.00%	51.34%
Hansen Natural Corp	9.70	17.00%	62.45%

A Question

You are reading an equity research report on this sector, and the analyst claims that Andres Wine and Hansen Natural are under valued because they have low PE ratios. Would you agree?

- ❑ Yes
- ❑ No
- ■ Why or why not?

Example 2: The limits of story telling
Telecom ADRs in 1999

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	1.21223	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

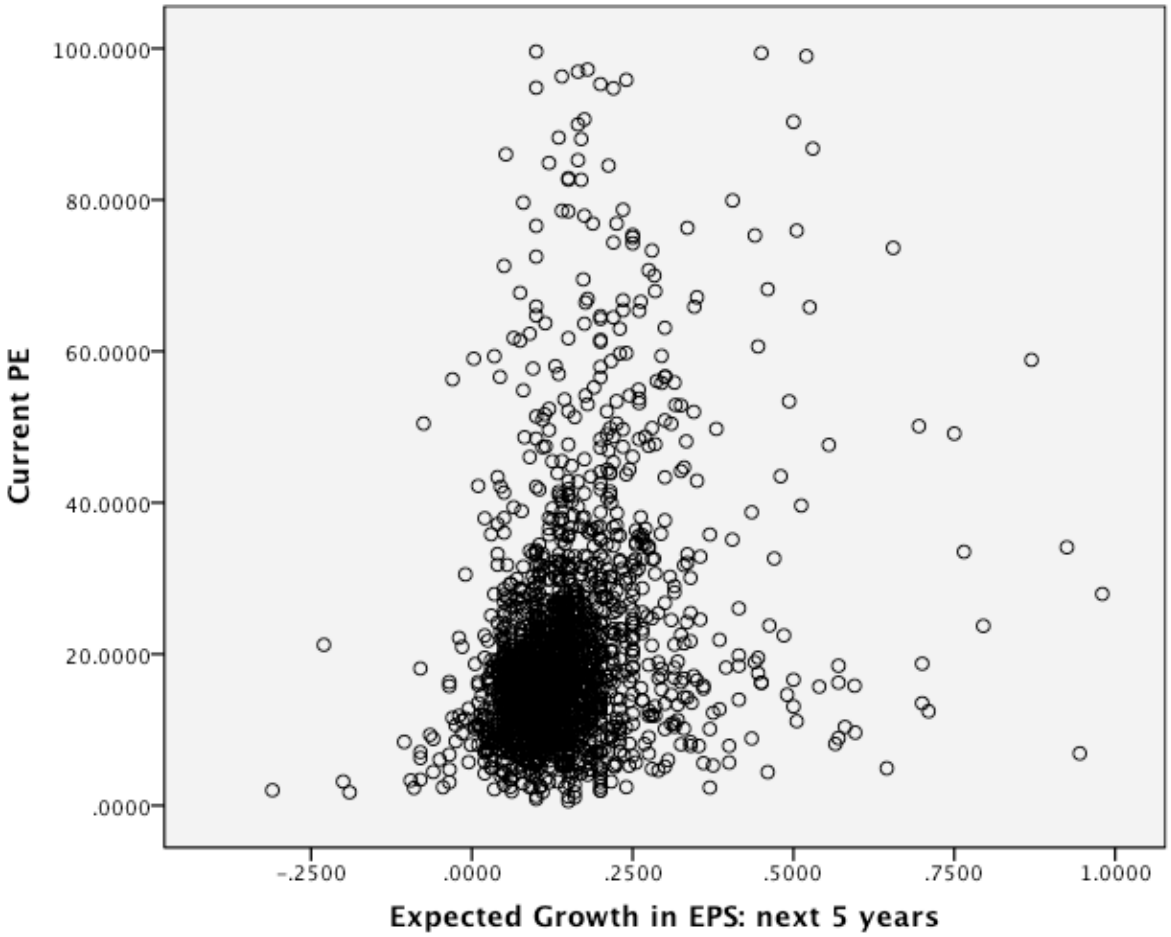
Is Telebras under valued?

- Predicted PE = 13.12 + 1.2122 (7.5) - 13.85 (1) = 8.35
- At an actual price to earnings ratio of 8.9, Telebras is slightly overvalued.

Relative to the entire market
Extending your sample

- If you can control for differences in risk, growth and cash flows, you can expand your list of comparable firms significantly. In fact, there is no reason why you cannot bring every firm in the market into your comparable firm list.
- The simplest way of controlling for differences is with a multiple regression, with the multiple (PE, EV/EBITDA etc) as the dependent variable, and proxies for risk, growth and payout forming the independent variables.
- When you make this comparison, you are estimating the value of your company relative to the entire market (rather than just a sector).

PE versus Expected EPS Growth: January 2012



PE Ratio: Standard Regression for US stocks - January 2012

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.340[a]	.116	.114	1068.79044

a. Predictors: (Constant), Payout Ratio, 3-yr Regression Beta, Expected Growth in EPS: next 5 years

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	13.477	.760		17.734	.000
	Expected Growth in EPS: next 5 years	40.841	2.627	.354	15.545	.000
	3-yr Regression Beta	-2.006	.499	-.092	-4.023	.000
	Payout Ratio	2.881	.992	.066	2.905	.004

a. Dependent Variable: Current PE
b. Weighted Least Squares Regression - Weighted by Market Cap

Problems with the regression methodology

- The basic regression assumes a linear relationship between PE ratios and the financial proxies, and that might not be appropriate.
- The basic relationship between PE ratios and financial variables itself might not be stable, and if it shifts from year to year, the predictions from the model may not be reliable.
- The independent variables are correlated with each other. 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

		Current PE	Expected Growth in EPS: next 5 years	3-yr Regression Beta	Payout Ratio
Current PE	Pearson Correlation	1	.279**	.004	.125**
	Sig. (2-tailed)		.000	.814	.000
	N	3334	1981	2935	3334
Expected Growth in EPS: next 5 years	Pearson Correlation	.279**	1	.222**	-.209**
	Sig. (2-tailed)	.000		.000	.000
	N	1981	2308	2109	2273
3-yr Regression Beta	Pearson Correlation	.004	.222**	1	-.033*
	Sig. (2-tailed)	.814	.000		.025
	N	2935	2109	4798	4716
Payout Ratio	Pearson Correlation	.125**	-.209**	-.033*	1
	Sig. (2-tailed)	.000	.000	.025	
	N	3334	2273	4716	5801

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 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 18 times earnings. What does the predicted PE tell you?

The value of growth

Time Period	*PE Value of extra 1% of growth*	*Equity Risk Premium*
January 2012	0.408	6.04%
January 2011	0.836	5.20%
January 2010	0.550	4.36%
January 2009	0.780	6.43%
January 2008	1.427	4.37%
January 2007	1.178	4.16%
January 2006	1.131	4.07%
January 2005	0.914	3.65%
January 2004	0.812	3.69%
January 2003	2.621	4.10%
January 2002	1.003	3.62%
January 2001	1.457	2.75%
January 2000	2.105	2.05%

Fundamentals in other markets: PE regressions across markets…

Region	Regression – January 2012	R squared
Europe	PE = 19.57 - 2.91 Payout - 3.67 Beta	6.9%
Japan	PE = 21.69 - 0.31 Expected Growth -4.12 Beta	5.3%
Emerging Markets	PE = 15.48+ 9.03 ROE - 2.77 Beta + 2.91 Payout	4.3%

Investment Strategies that compare PE to the expected growth rate

- If we assume that all firms within a sector have similar growth rates and risk, a strategy of picking the lowest PE ratio stock in each sector will yield undervalued stocks.
- Portfolio managers and analysts sometimes compare PE ratios to the expected growth rate to identify under and overvalued stocks.
  - In the simplest form of this approach, firms with PE ratios less than their expected growth rate are viewed as undervalued.
  - In its more general form, the ratio of PE ratio to growth is used as a measure of relative value.

Problems with comparing PE ratios to expected growth

- In its simple form, there is no basis for believing that a firm is undervalued just because it has a PE ratio less than expected growth.
- This relationship may be consistent with a fairly valued or even an overvalued firm, if interest rates are high, or if a firm is high risk.
- As interest rates decrease (increase), fewer (more) stocks will emerge as undervalued using this approach.

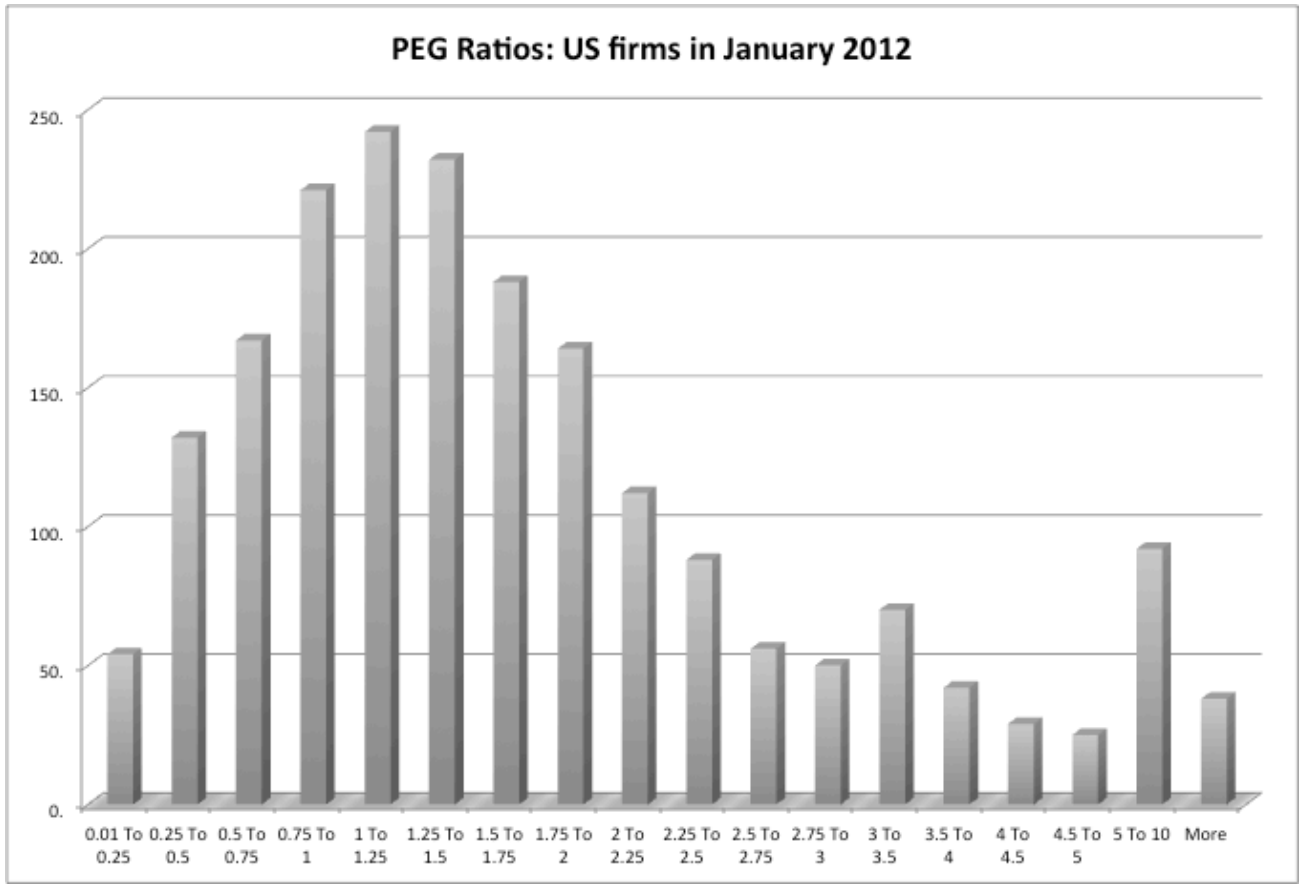
PEG Ratio: Definition

- The PEG ratio is the ratio of price earnings to expected growth in earnings per share.

$$\text{PEG} = \text{PE} / \text{Expected Growth Rate in Earnings}$$

- Definitional tests:
  - Is the growth rate used to compute the PEG ratio
    - on the same base? (base year EPS)
    - over the same period?(2 years, 5 years)
    - from the same source? (analyst projections, consensus estimates..)
  - Is the earnings used to compute the PE ratio consistent with the growth rate estimate?
    - No double counting: If the estimate of growth in earnings per share is from the current year, it would be a mistake to use forward EPS in computing PE
    - If looking at foreign stocks or ADRs, is the earnings used for the PE ratio consistent with the growth rate estimate? (US analysts use the ADR EPS)

PEG Ratio: Distribution – US stocks



PEG Ratios: The Beverage Sector

Company Name	*Trailing PE*	*Growth*	*Std Dev*	*PEG*
Coca-Cola Bottling	29.18	9.50%	20.58%	3.07
Molson Inc. Ltd. 'A'	43.65	15.50%	21.88%	2.82
Anheuser-Busch	24.31	11.00%	22.92%	2.21
Corby Distilleries Ltd.	16.24	7.50%	23.66%	2.16
Chalone Wine Group Ltd.	21.76	14.00%	24.08%	1.55
Andres Wines Ltd. 'A'	8.96	3.50%	24.70%	2.56
Todhunter Int'l	8.94	3.00%	25.74%	2.98
Brown-Forman 'B'	10.07	11.50%	29.43%	0.88
Coors (Adolph) 'B'	23.02	10.00%	29.52%	2.30
PepsiCo, Inc.	33.00	10.50%	31.35%	3.14
Coca-Cola	44.33	19.00%	35.51%	2.33
Boston Beer 'A'	10.59	17.13%	39.58%	0.62
Whitman Corp.	25.19	11.50%	44.26%	2.19
Mondavi (Robert) 'A'	16.47	14.00%	45.84%	1.18
Coca-Cola Enterprises	37.14	27.00%	51.34%	1.38
Hansen Natural Corp	9.70	17.00%	62.45%	0.57
Average	**22.66**	**13.00%**	**33.00%**	**2.00**

PEG Ratio: Reading the Numbers

- The average PEG ratio for the beverage sector is 2.00. The lowest PEG ratio in the group belongs to Hansen Natural, which has a PEG ratio of 0.57. Using this measure of value, Hansen Natural is
  - the most under valued stock in the group
  - the most over valued stock in the group
- What other explanation could there be for Hansen's low PEG ratio?

PEG Ratio: Analysis

- To understand the fundamentals that determine PEG ratios, let us return again to a 2-stage equity discounted cash flow model

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

- Dividing both sides of the equation by the earnings gives us the equation for the PE ratio. Dividing it again by the expected growth 'g'

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

PEG Ratios and Fundamentals

- Risk and payout, which affect PE ratios, continue to affect PEG ratios as well.
  - Implication: When comparing PEG ratios across companies, we are making implicit or explicit assumptions about these variables.
- Dividing PE by expected growth does not neutralize the effects of expected growth, since the relationship between growth and value is not linear and fairly complex (even in a 2-stage model)

A Simple Example

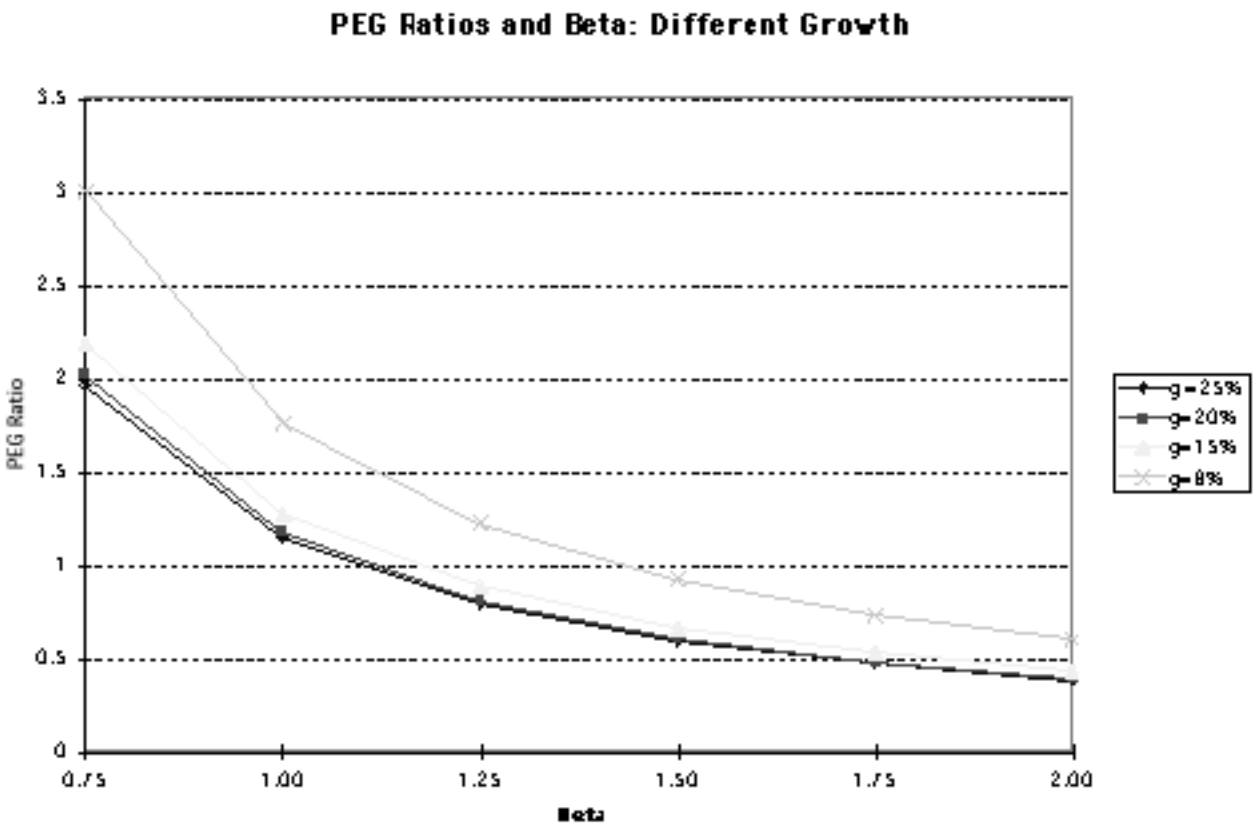
- Assume that you have been asked to estimate the PEG ratio for a firm which has the following characteristics:

Variable	High Growth Phase	Stable Growth Phase
Expected Growth Rate	25%	8%
Payout Ratio	20%	50%
Beta	1.00	1.00

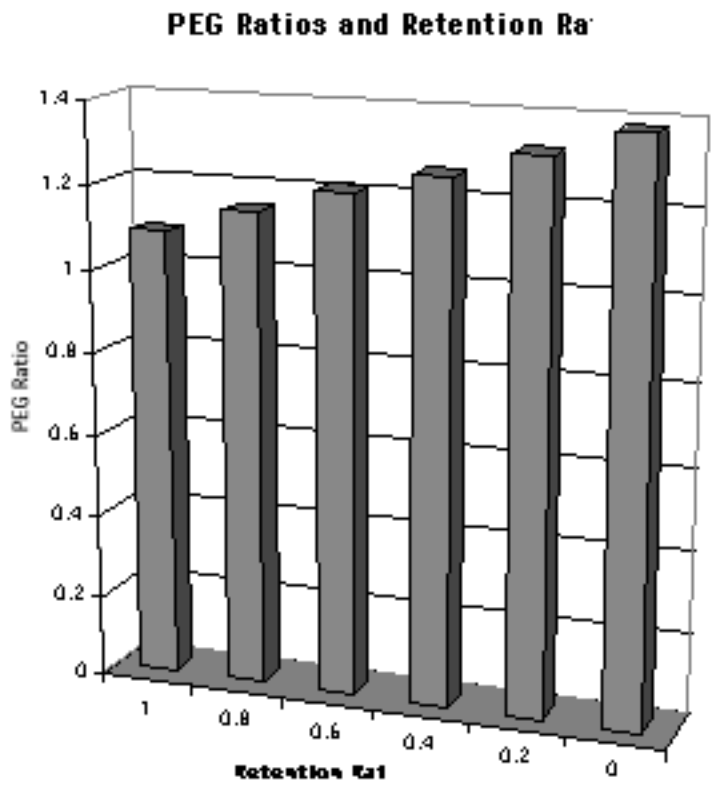
- Riskfree rate = T.Bond Rate = 6%
- Required rate of return = 6% + 1(5.5%)= 11.5%
- The PEG ratio for this firm can be estimated as follows:

$$PEG = \frac{0.2 * (1.25) * \left(1 - \frac{(1.25)^5}{(1.115)^5}\right)}{.25(.115 - .25)} + \frac{0.5 * (1.25)^5 * (1.08)}{.25(.115 - .08)(1.115)^5} = 115 \text{ or } 1.15$$

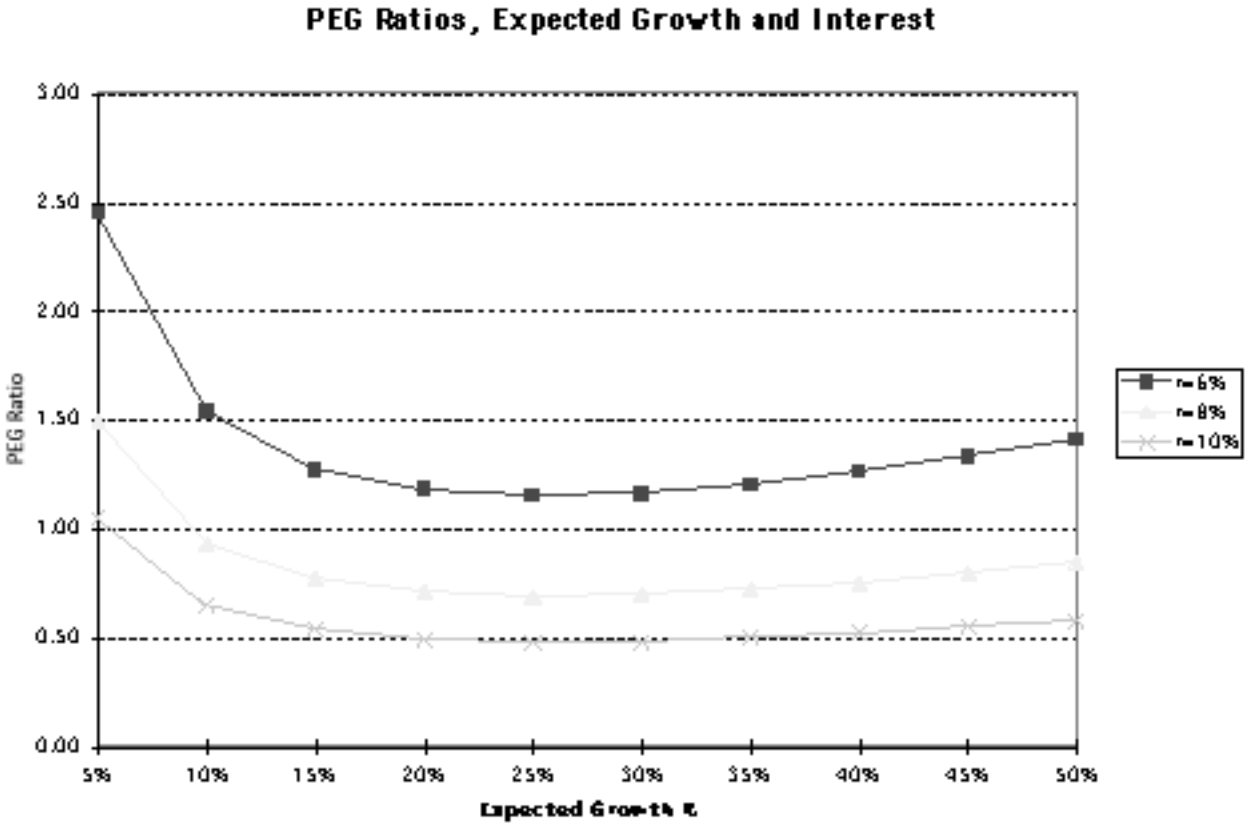
PEG Ratios and Risk



PEG Ratios and Quality of Growth



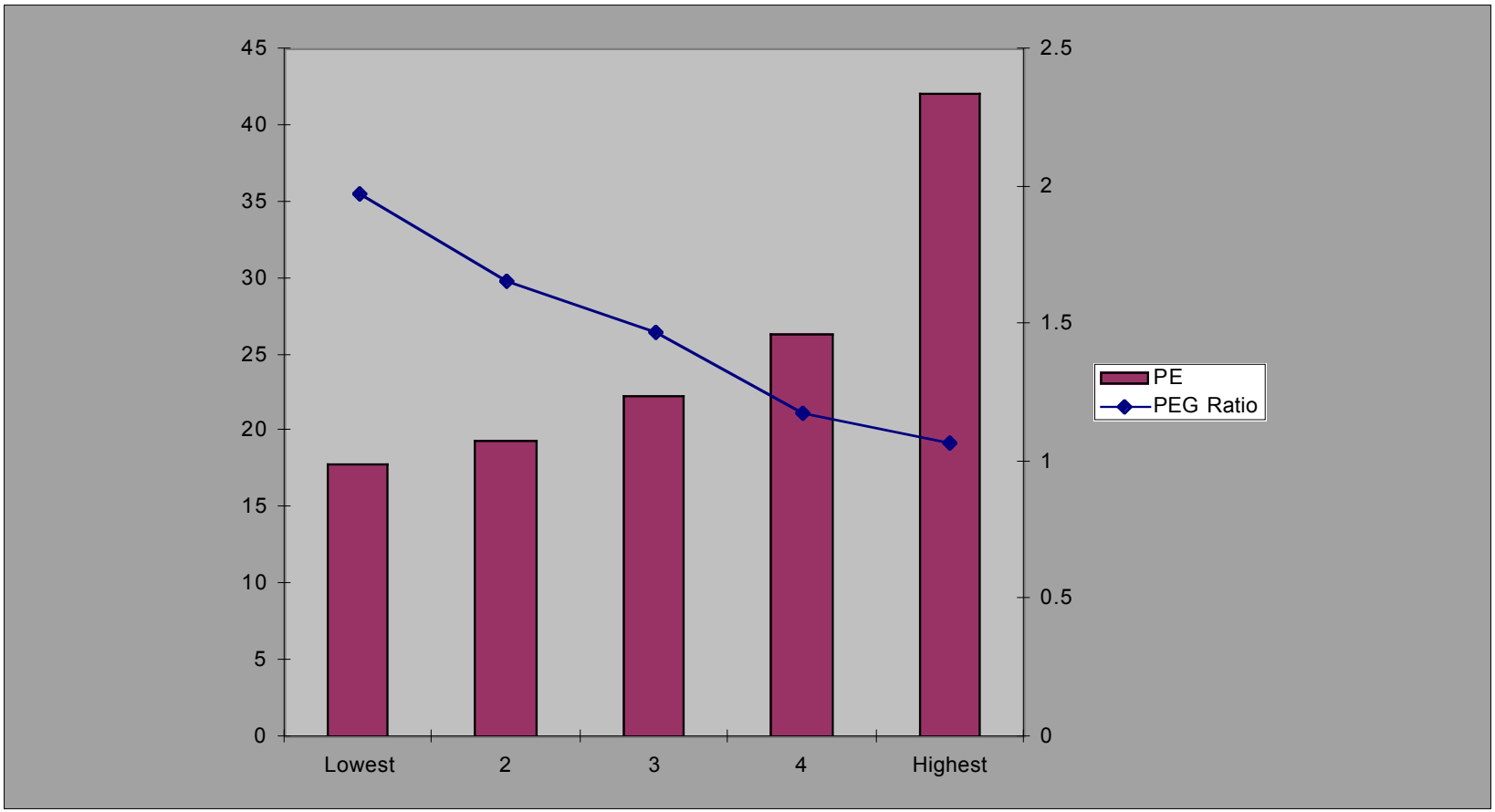
PE Ratios and Expected Growth



PEG Ratios and Fundamentals: Propositions

- Proposition 1: High risk companies will trade at much lower PEG ratios than low risk companies with the same expected growth rate.
  - Corollary 1: The company that looks most under valued on a PEG ratio basis in a sector may be the riskiest firm in the sector
- Proposition 2: Companies that can attain growth more efficiently by investing less in better return projects will have higher PEG ratios than companies that grow at the same rate less efficiently.
  - Corollary 2: Companies that look cheap on a PEG ratio basis may be companies with high reinvestment rates and poor project returns.
- Proposition 3: Companies with very low or very high growth rates will tend to have higher PEG ratios than firms with average growth rates. This bias is worse for low growth stocks.
  - Corollary 3: PEG ratios do not neutralize the growth effect.

PE, PEG Ratios and Risk



Risk classes

PEG Ratio: Returning to the Beverage Sector

Company Name	*Trailing PE*	*Growth*	*Std Dev*	*PEG*
Coca-Cola Bottling	29.18	9.50%	20.58%	3.07
Molson Inc. Ltd. 'A'	43.65	15.50%	21.88%	2.82
Anheuser-Busch	24.31	11.00%	22.92%	2.21
Corby Distilleries Ltd.	16.24	7.50%	23.66%	2.16
Chalone Wine Group Ltd.	21.76	14.00%	24.08%	1.55
Andres Wines Ltd. 'A'	8.96	3.50%	24.70%	2.56
Todhunter Int'l	8.94	3.00%	25.74%	2.98
Brown-Forman 'B'	10.07	11.50%	29.43%	0.88
Coors (Adolph) 'B'	23.02	10.00%	29.52%	2.30
PepsiCo, Inc.	33.00	10.50%	31.35%	3.14
Coca-Cola	44.33	19.00%	35.51%	2.33
Boston Beer 'A'	10.59	17.13%	39.58%	0.62
Whitman Corp.	25.19	11.50%	44.26%	2.19
Mondavi (Robert) 'A'	16.47	14.00%	45.84%	1.18
Coca-Cola Enterprises	37.14	27.00%	51.34%	1.38
Hansen Natural Corp	9.70	17.00%	62.45%	0.57
Average	**22.66**	**13.00%**	**33.00%**	**2.00**

Analyzing PE/Growth

- Given that the PEG ratio is still determined by the expected growth rates, risk and cash flow patterns, it is necessary that we control for differences in these variables.
- Regressing PEG against risk and a measure of the growth dispersion, we get:

PEG = 3.61 -.0286 (Expected Growth) - .0375 (Std Deviation in Prices)

R Squared = 44.75%

- In other words,
  - PEG ratios will be lower for high growth companies
  - PEG ratios will be lower for high risk companies
- We also ran the regression using the deviation of the actual growth rate from the industry-average growth rate as the independent variable, with mixed results.

Estimating the PEG Ratio for Hansen

- Applying this regression to Hansen, the predicted PEG ratio for the firm can be estimated using Hansen's measures for the independent variables:
  - Expected Growth Rate = 17.00%
  - Standard Deviation in Stock Prices = 62.45%
- Plugging in,

Expected PEG Ratio for Hansen = 3.61 - .0286 (17) - .0375 (62.45)

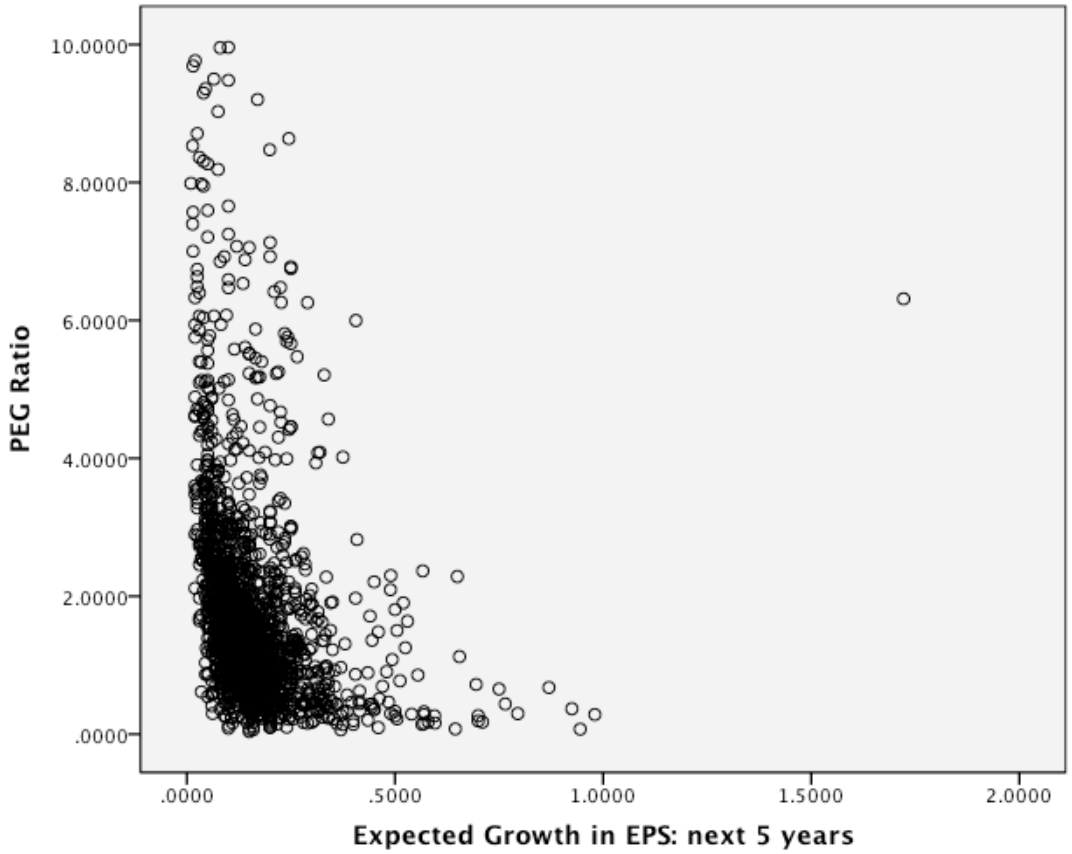
= 0.78

- With its actual PEG ratio of 0.57, Hansen looks undervalued, notwithstanding its high risk.

Extending the Comparables

- This analysis, which is restricted to firms in the software sector, can be expanded to include all firms in the firm, as long as we control for differences in risk, growth and payout.
- To look at the cross sectional relationship, we first plotted PEG ratios against expected growth rates.

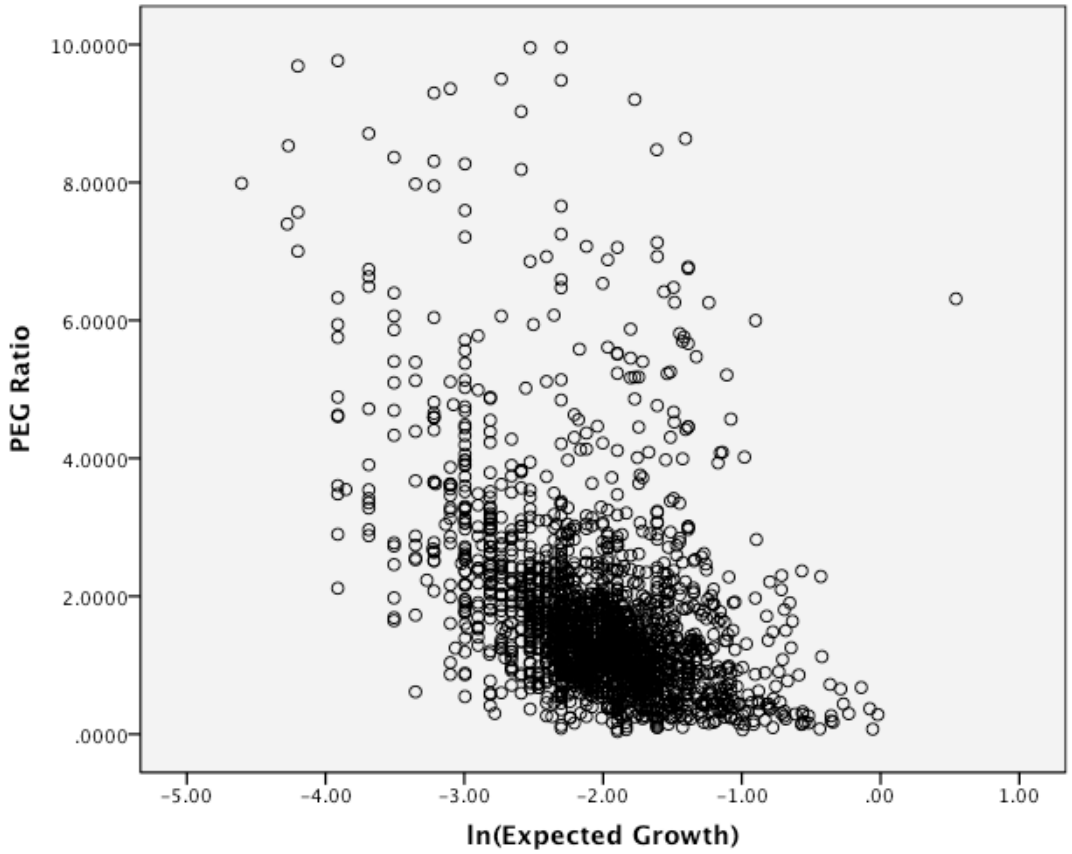
PEG versus Growth – January 2012



Analyzing the Relationship

- The relationship in not linear. In fact, the smallest firms seem to have the highest PEG ratios and PEG ratios become relatively stable at higher growth rates.
- To make the relationship more linear, we converted the expected growth rates in ln(expected growth rate). The relationship between PEG ratios and ln(expected growth rate) was then plotted.

PEG versus ln(Expected Growth) – January 2012



PEG Ratio Regression - US stocks
January 2012

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.624[a]	.390	.389	92.3626273

a. Predictors: (Constant), ln(Expected Growth), Payout Ratio, 3-yr Regression Beta

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.513	.115		-4.468	.000
	3-yr Regression Beta	-.326	.045	-.142	-7.273	.000
	Payout Ratio	.095	.088	.021	1.087	.277
	ln(Expected Growth)	-1.155	.041	-.555	-27.983	.000

a. Dependent Variable: PEG Ratio
b. Weighted Least Squares Regression - Weighted by Market Cap

Negative intercepts…and problem forecasts..

- When the intercept in a multiples regression is negative, there is the possibility that forecasted values can be negative as well. One way (albeit imperfect) is to re-run the regression without an intercept.

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	3-yr Regression Beta	-.185	.035	-.114	-5.309	.000
	ln(Expected Growth)	-.901	.027	-.836	-33.458	.000
	Payout Ratio	.788	.106	.127	7.443	.000

a. Dependent Variable: PEG Ratio
b. Linear Regression through the Origin

Applying the PEG ratio regression

- Consider Dell again. The stock has an expected growth rate of 10%, a beta of 1.20 and pays out no dividends. What should its PEG ratio be?

- If the stock's actual PE ratio is 18, what does this analysis tell you about the stock?

A Variant on PEG Ratio: The PEGY ratio

- The PEG ratio is biased against low growth firms because the relationship between value and growth is non-linear. One variant that has been devised to consolidate the growth rate and the expected dividend yield:

  PEGY = PE / (Expected Growth Rate + Dividend Yield)

- As an example, Con Ed has a PE ratio of 16, an expected growth rate of 5% in earnings and a dividend yield of 4.5%.
  - PEG = 16/ 5 = 3.2
  - PEGY = 16/(5+4.5) = 1.7

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 operating assets of the firm (Enterprise value or EV) relative to operating earnings or cash flows.

  EV = Market value of equity + Debt – Cash
- The form of value to cash flow ratios that has the closest parallels in DCF valuation is the ratio of Firm value to Free Cash Flow to the Firm.
  - FCFF = EBIT (1-t) - Net Cap Ex - Change in WC
- In practice, what we observe more commonly are firm values as multiples of operating income (EBIT), after-tax operating income (EBIT (1-t)) or EBITDA.

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

EV/FCFF: Determinants

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

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

  - $FCFF_0$ = 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)\

- Dividing both sides by the FCFF

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

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 can be computed even for firms that are reporting net losses, since earnings before interest, taxes and depreciation are usually positive.
2. For firms in certain industries, 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 leveraged buyouts, 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 if the capital expenditures are unwise or earn substandard returns.
5. By looking at the value of the firm and cashflows to the firm it allows for comparisons across firms with different financial leverage.

Enterprise Value/EBITDA Multiple

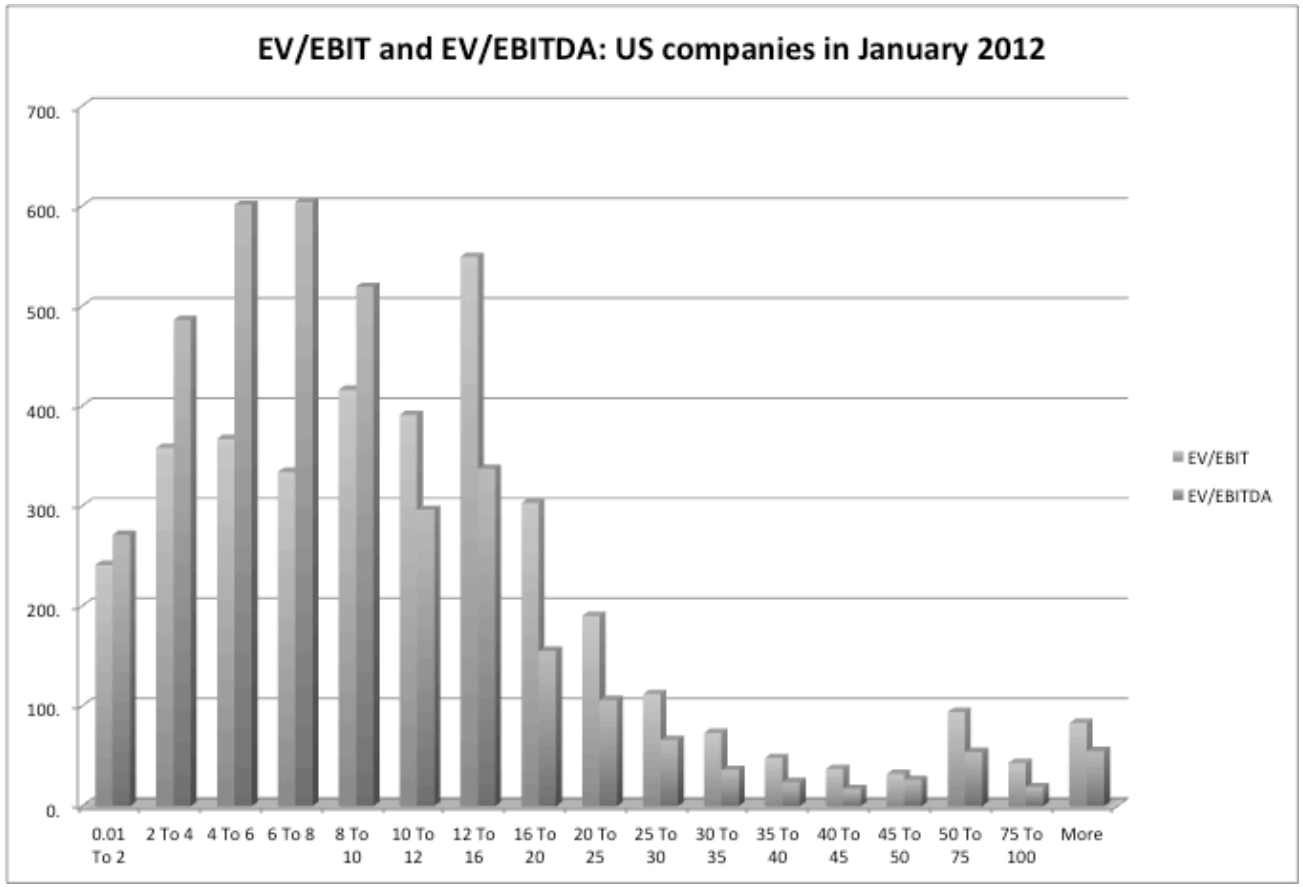
- The Classic Definition

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

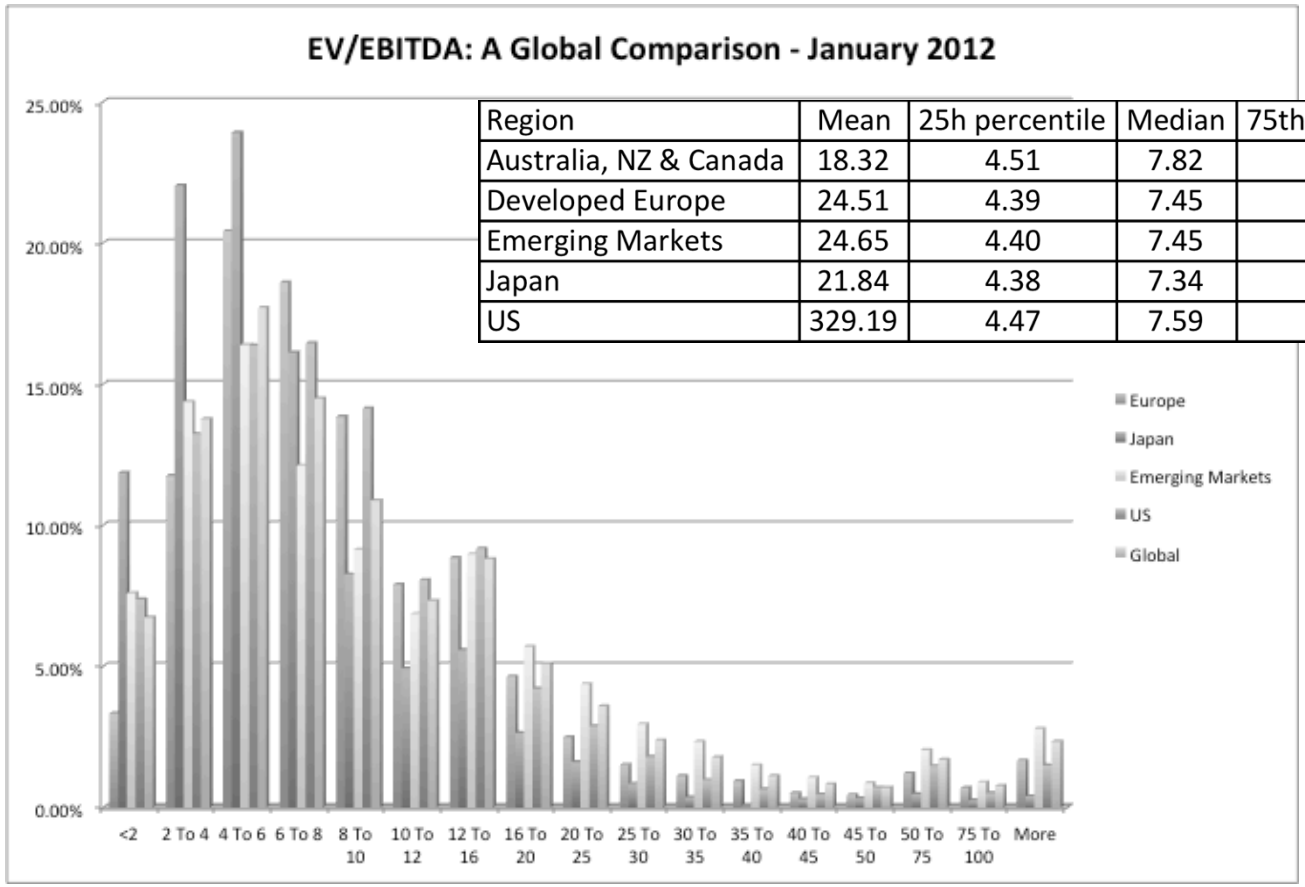
- The No-Cash Version

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

Enterprise Value/EBITDA Distribution – US

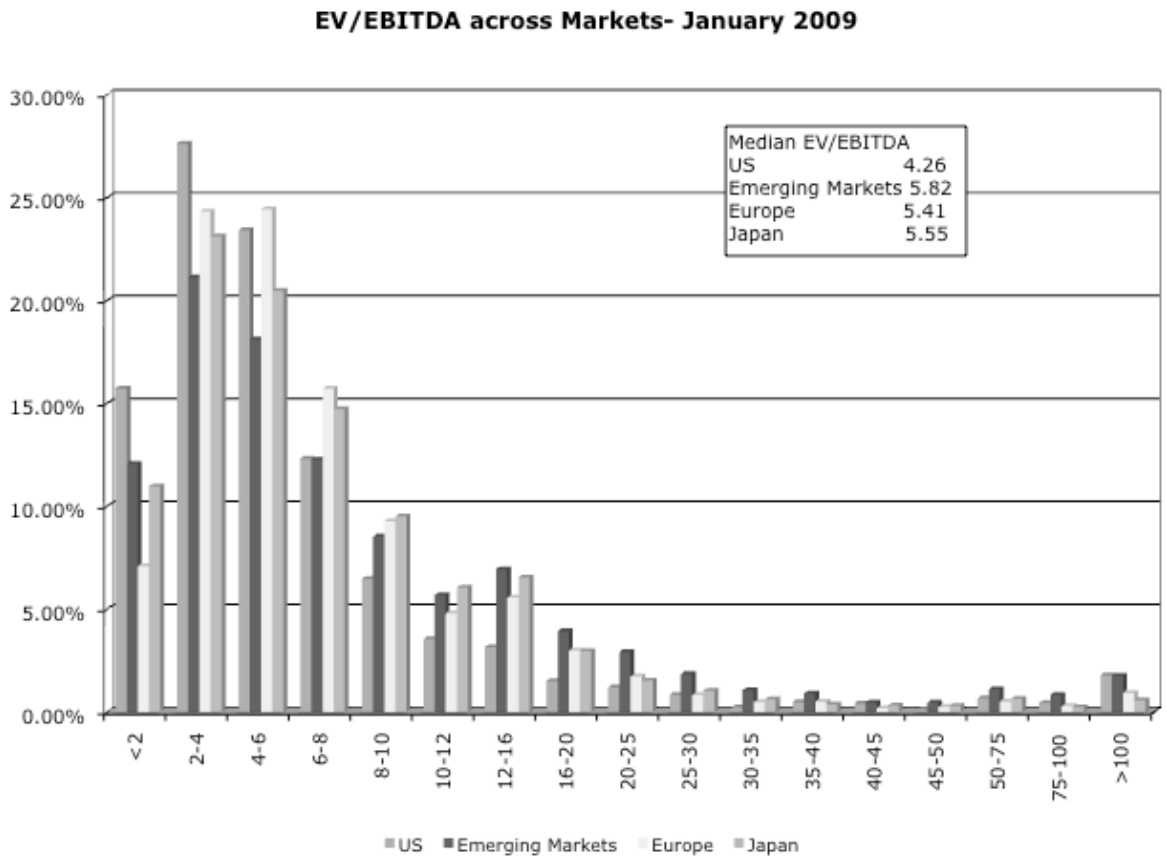


Enterprise Value/EBITDA : Global Data
6 times EBITDA may seem like a good rule of thumb..



Region	Mean	25h percentile	Median	75th percentile
Australia, NZ & Canada	18.32	4.51	7.82	14.09
Developed Europe	24.51	4.39	7.45	13.21
Emerging Markets	24.65	4.40	7.45	13.53
Japan	21.84	4.38	7.34	12.77
US	329.19	4.47	7.59	13.83

But not in early 2009…



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

- The value of the operating assets of a firm can be written as:

$$EV_0 = \frac{FCFF_1}{WACC - g}$$

- 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,

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

- Dividing both sides of the equation by EBITDA,

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

- Since Reinvestment = (CEx – Depreciation + Δ Working Capital), the determinants of EV/EBITDA are:
  - The cost of capital
  - Expected growth rate
  - Tax rate
  - Reinvestment rate (or ROC)

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.

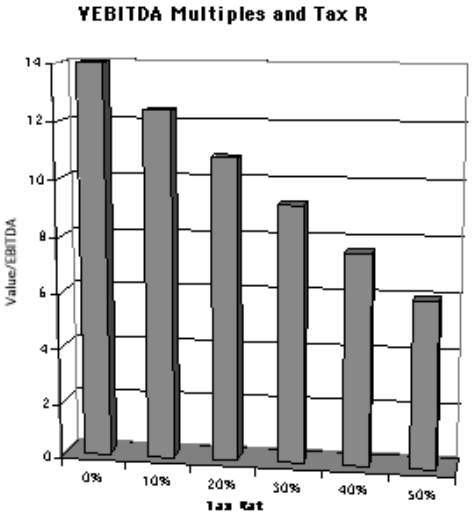
Calculating Value/EBITDA Multiple

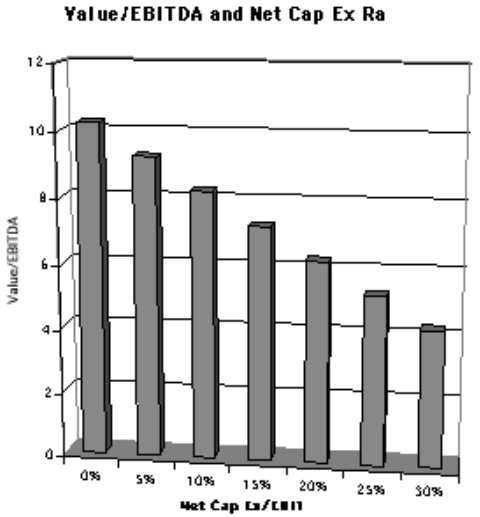
- In this case, the Value/EBITDA multiple for this firm can be estimated as follows:

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

The Determinants of EV/EBITDA

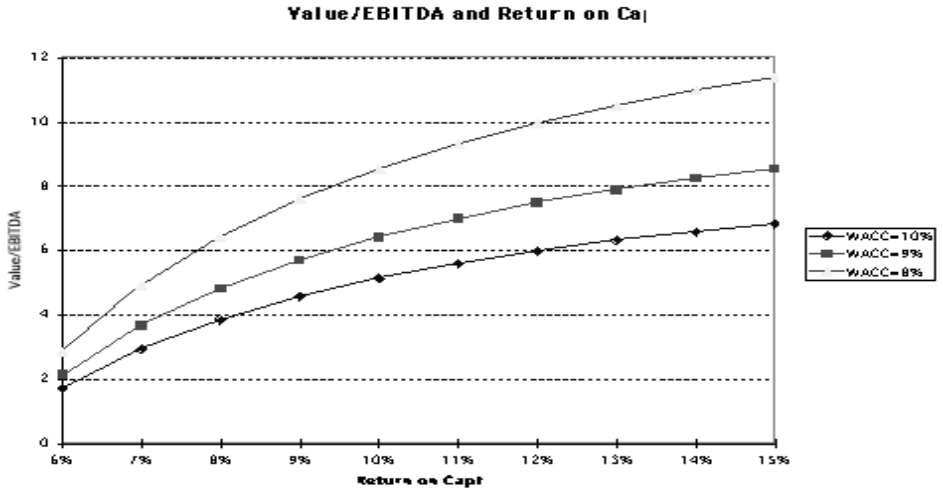
Tax Rates





Reinvestment Needs

Excess Returns



Is this stock cheap?

- Assume that I am trying to convince you to buy a company, because it trades at 5 times EBITDA. What are some of the questions you would ask me as a potential buyer?

- Following through, what combination of fundamentals would make for a cheap company on an EV/EBITDA basis:
  - Tax rate
  - Growth
  - Return on capital
  - Cost of capital/Risk

Value/EBITDA Multiple: Trucking Companies: Is Ryder cheap?

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**

Extending to the market
US Market: January 2012

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.477[a]	.228	.226	543.163118

a. Predictors: (Constant), Market Debt to Capital, Eff Tax Rate, Expected Growth in Revenues: next 5 years

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8.080	.532		15.196	.000
	Expected Growth in Revenues: next 5 years	42.675	2.876	.394	14.838	.000
	Eff Tax Rate	-11.410	1.211	-.221	-9.422	.000
	Market Debt to Capital	-1.711	.951	-.048	-1.799	.072

a. Dependent Variable: EV/EBITDA
b. Weighted Least Squares Regression - Weighted by Market Cap

EBITDA regressions across markets… January 2012

Region	Regression – January 2011	R squared
Europe	EV/EBITDA= 12.47 +0.02 Interest Coverage Ratio - 11.50 Tax Rate -3.31 Reinvestment Rate	8.9%
Japan	EV/EBITDA= 3.70 -0.01 Interest Coverage Ratio + 8.00 Tax Rate + 3.05 Reinvestment Rate	6.6%
Emerging Markets	EV/EBITDA= 15.01 - 10.70 Tax Rate -3.04 Reinvestment Rate	2.2%