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# Discount Rates: III

## Relative Risk Measures

# The CAPM Beta: The Most Used (and Misused) Risk Measure

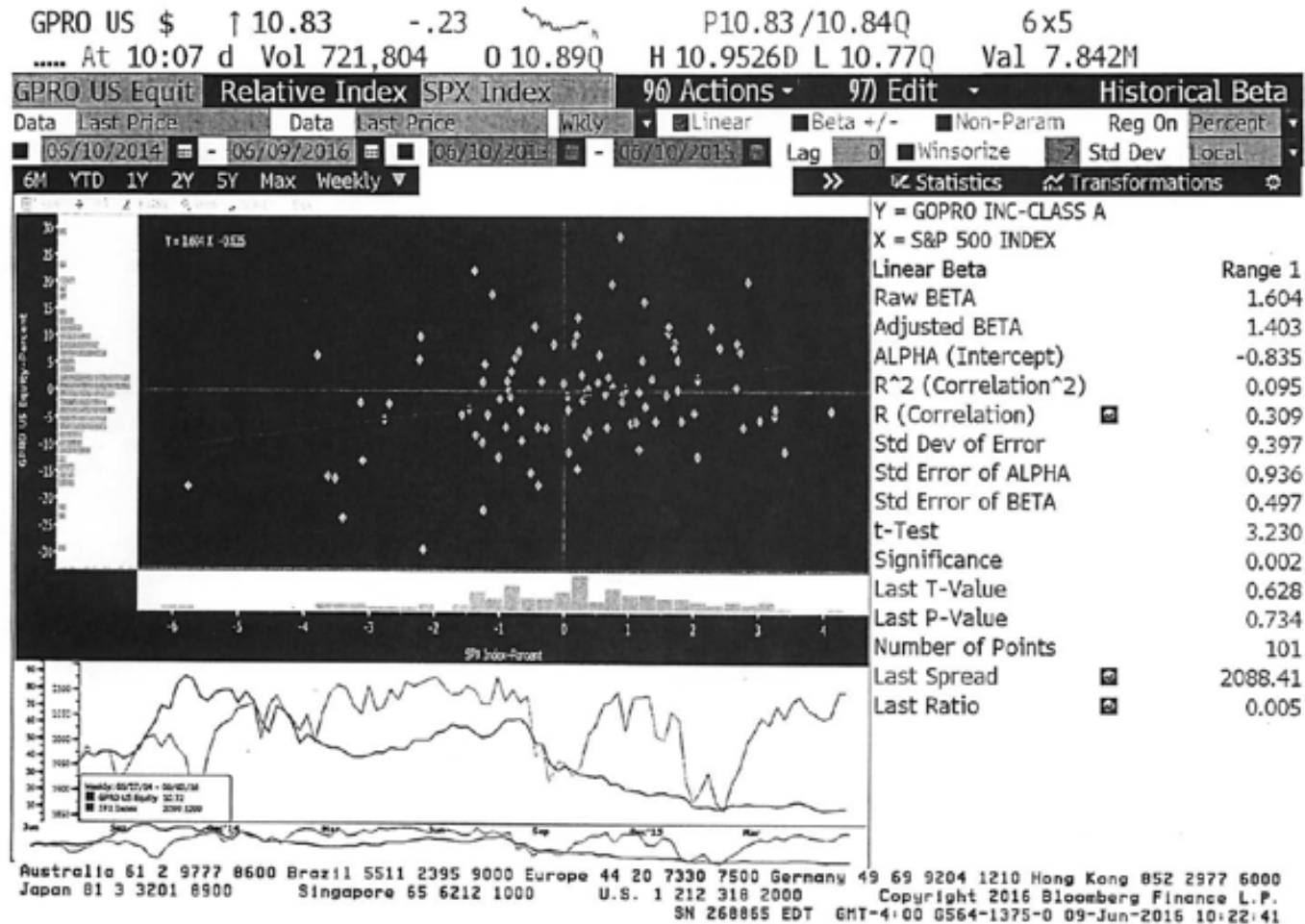
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- The standard procedure for estimating betas is to regress stock returns ( $R_j$ ) against market returns ( $R_m$ ) -  
$$R_j = a + b R_m$$

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.

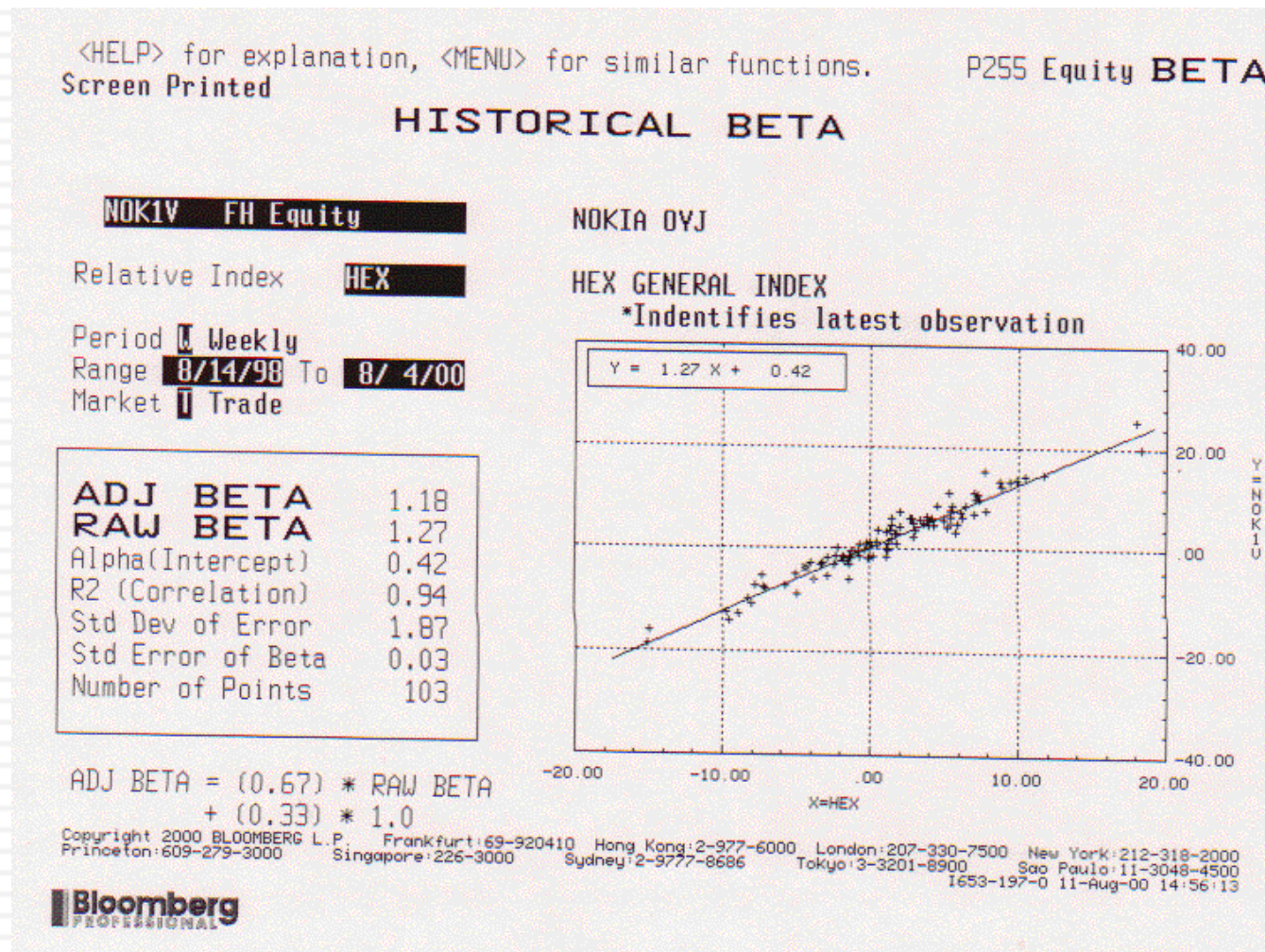
# Unreliable, when it looks bad..

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# Or when it looks good..

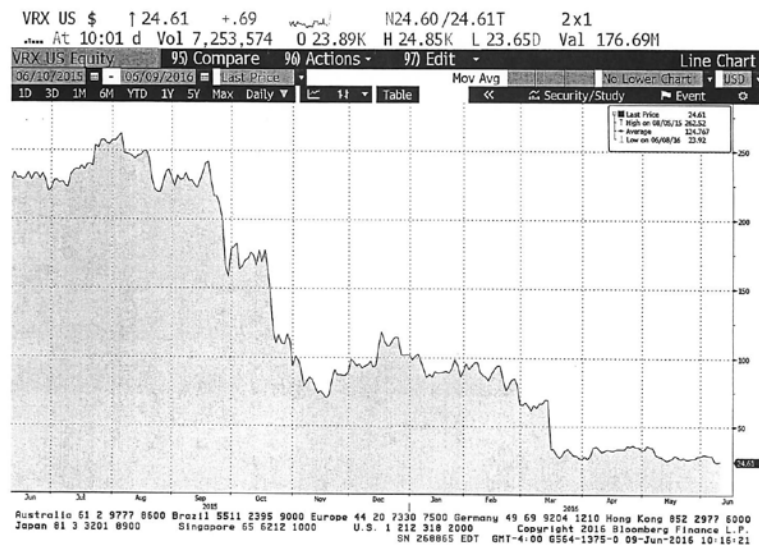
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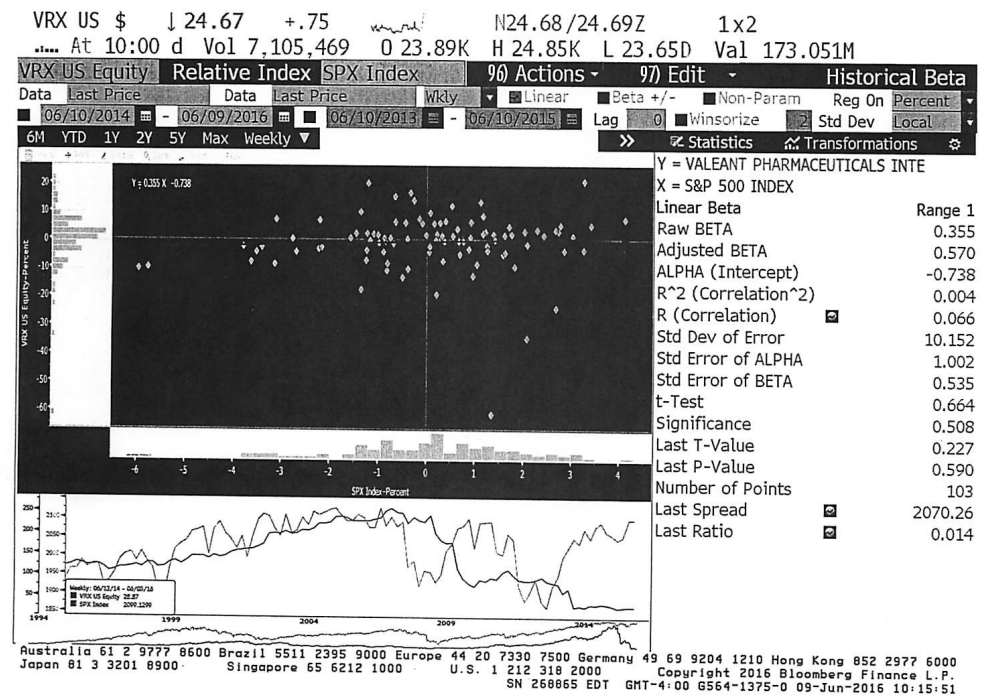


# One slice of history..

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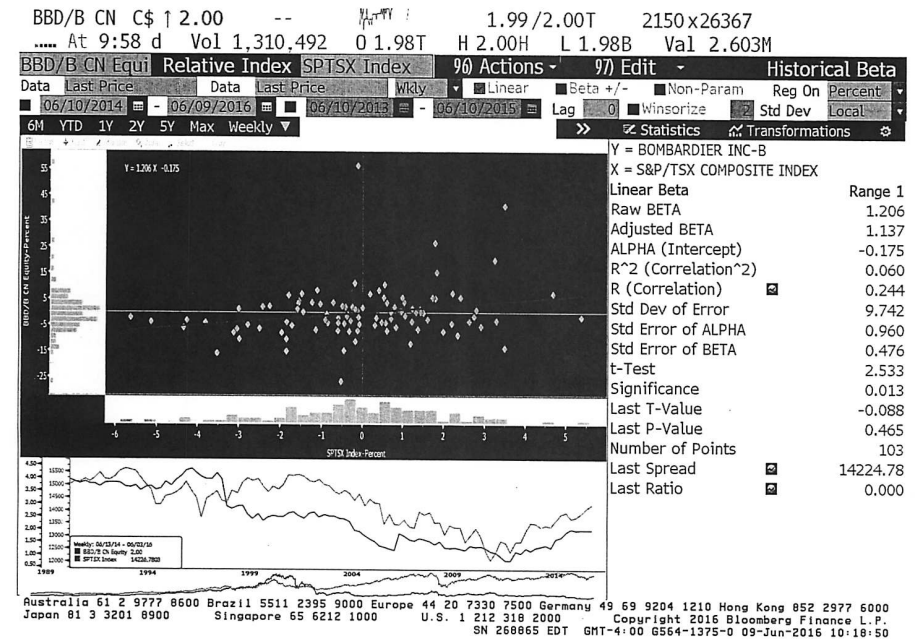
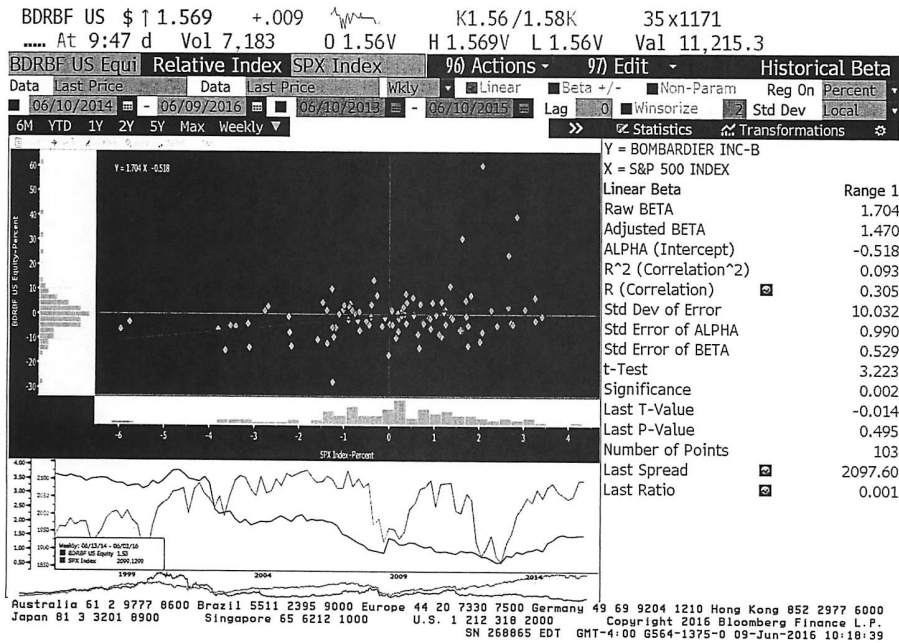


During this time period, Valeant was a stock under siege, without a CEO, under legal pressure & lacking financials.



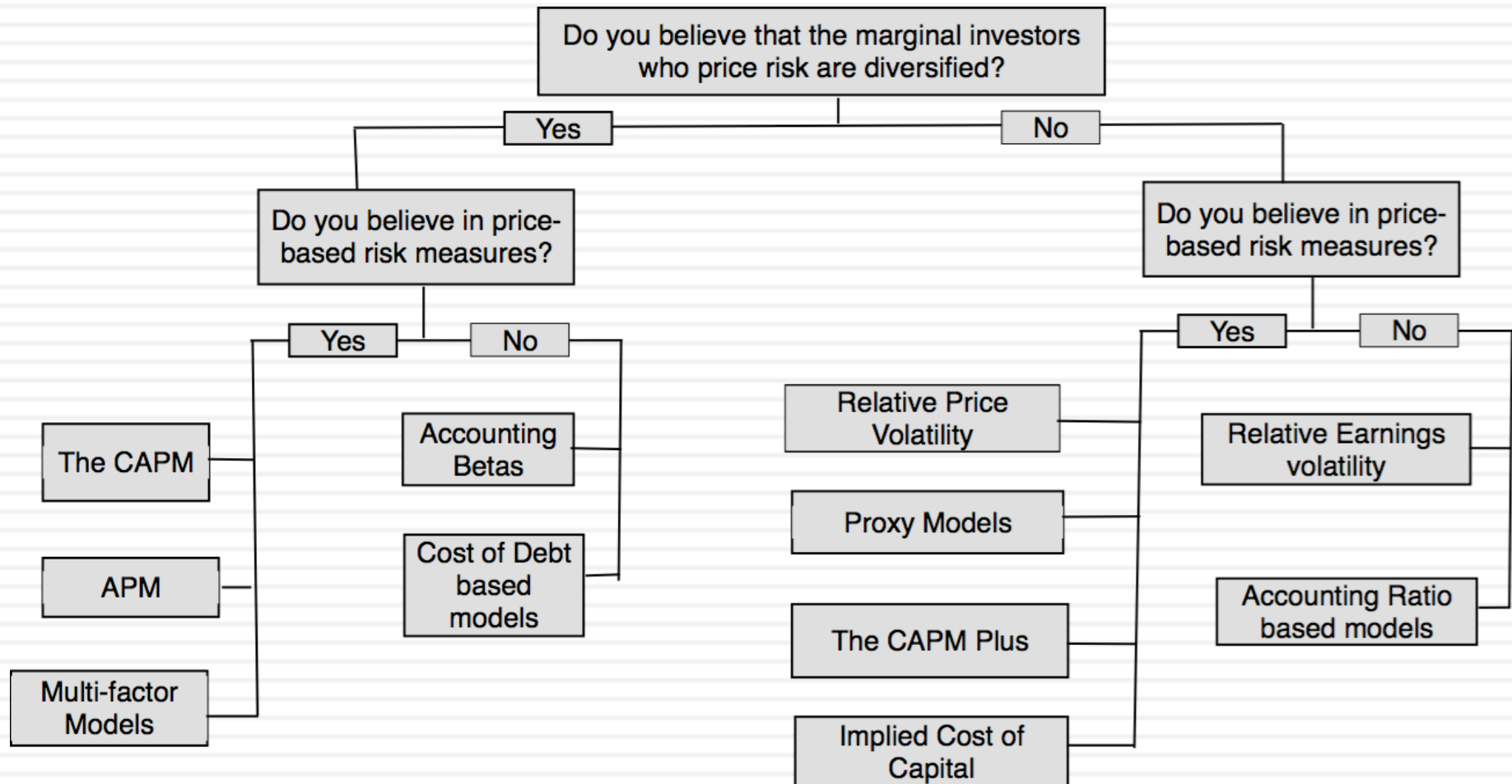
# And subject to game playing

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# Measuring Relative Risk: You don't like betas or modern portfolio theory? No problem.

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# Don't like the diversified investor focus, but okay with price-based measures

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## 1. Relative Standard Deviation

- Relative Volatility = Std dev of Stock/ Average Std dev across all stocks
- Captures all risk, rather than just market risk

## 2. Proxy Models

- Look at historical returns on all stocks and look for variables that explain differences in returns.
- You are, in effect, running multiple regressions with returns on individual stocks as the dependent variable and fundamentals about these stocks as independent variables.
- This approach started with market cap (the small cap effect) and over the last two decades has added other variables (momentum, liquidity etc.)

## 3. CAPM Plus Models

- Start with the traditional CAPM ( $R_f + \text{Beta} (\text{ERP})$ ) and then add other premiums for proxies.



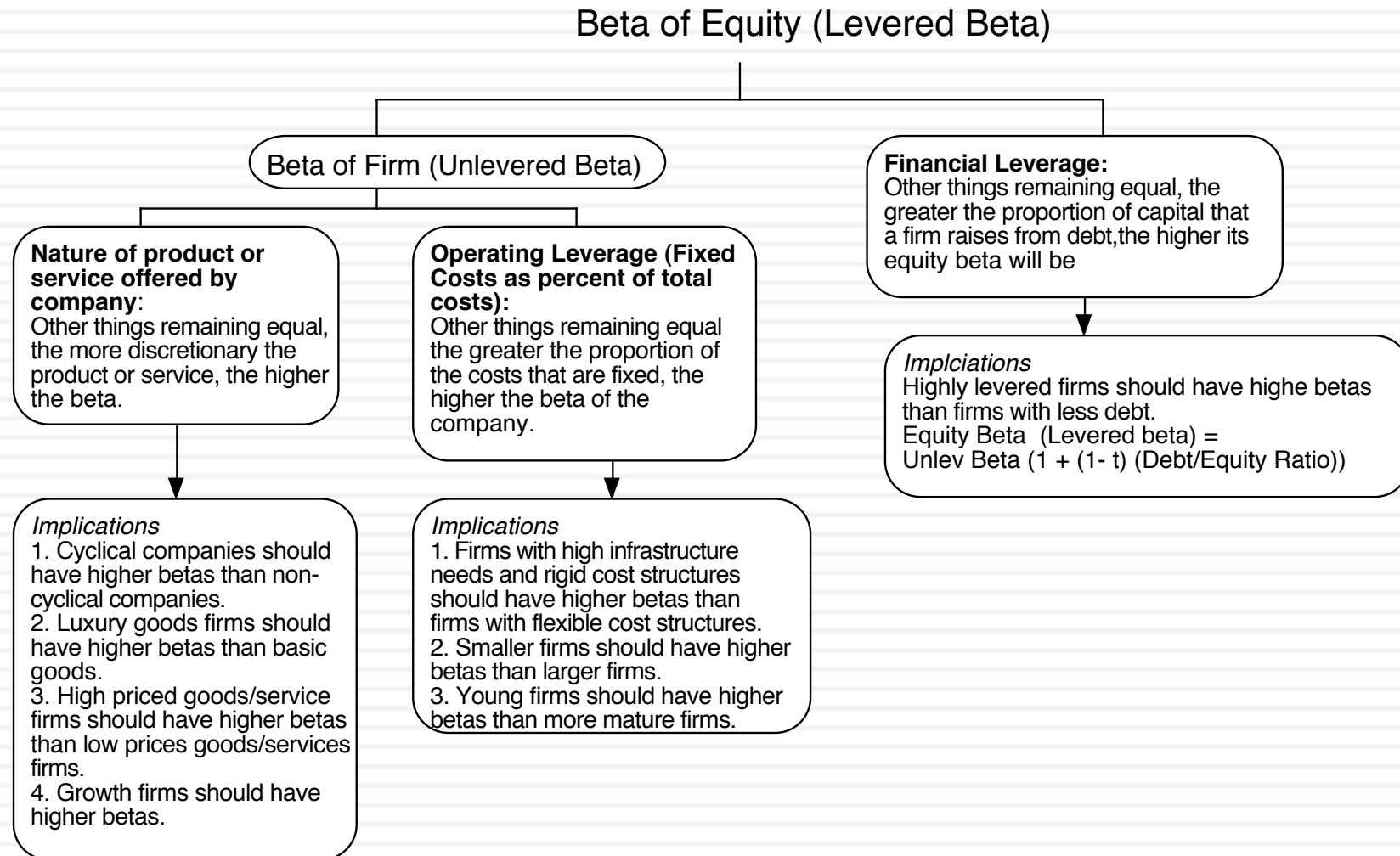
# Don't like the price-based approach..

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1. Accounting risk measures: To the extent that you don't trust market-priced based measures of risk, you could compute relative risk measures based on
  - Accounting earnings volatility: Compute an accounting beta or relative volatility
  - Balance sheet ratios: You could compute a risk score based upon accounting ratios like debt ratios or cash holdings (akin to default risk scores like the Z score)
2. Qualitative Risk Models: In these models, risk assessments are based at least partially on qualitative factors (quality of management).
3. Debt based measures: You can estimate a cost of equity, based upon an observable costs of debt for the company.
  - $\text{Cost of equity} = \text{Cost of debt} * \text{Scaling factor}$
  - The scaling factor can be computed from implied volatilities.

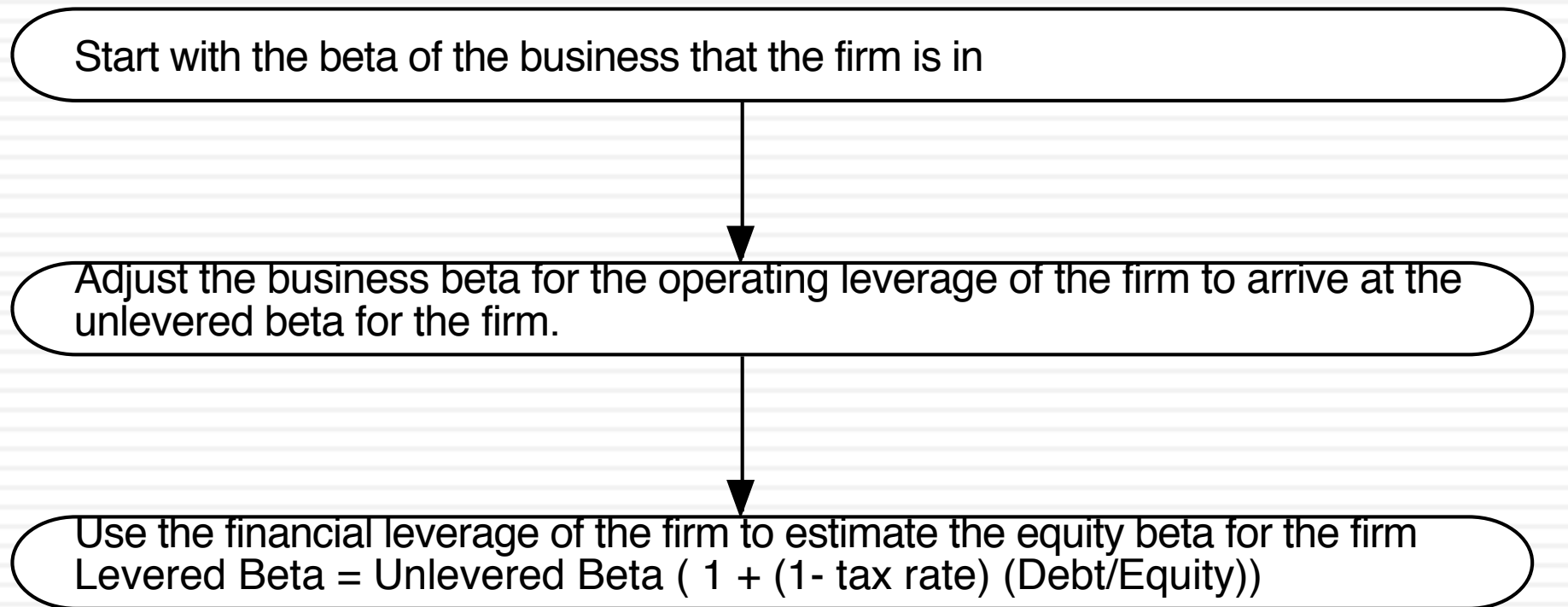
# Determinants of Betas & Relative Risk

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

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# Adjusting for operating leverage...

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- Within any business, firms with lower fixed costs (as a percentage of total costs) should have lower unlevered betas. If you can compute fixed and variable costs for each firm in a sector, you can break down the unlevered beta into business and operating leverage components.
  - ▣  $\text{Unlevered beta} = \text{Pure business beta} * (1 + (\text{Fixed costs} / \text{Variable costs}))$
- The biggest problem with doing this is informational. It is difficult to get information on fixed and variable costs for individual firms.
- In practice, we tend to assume that the operating leverage of firms within a business are similar and use the same unlevered beta for every firm.

# Adjusting for financial leverage...

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- Conventional approach: If we assume that debt carries no market risk (has a beta of zero), the beta of equity alone can be written as a function of the unlevered beta and the debt-equity ratio

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

In some versions, the tax effect is ignored and there is no  $(1-t)$  in the equation.

- Debt Adjusted Approach: If beta carries market risk and you can estimate the beta of debt, you can estimate the levered beta as follows:

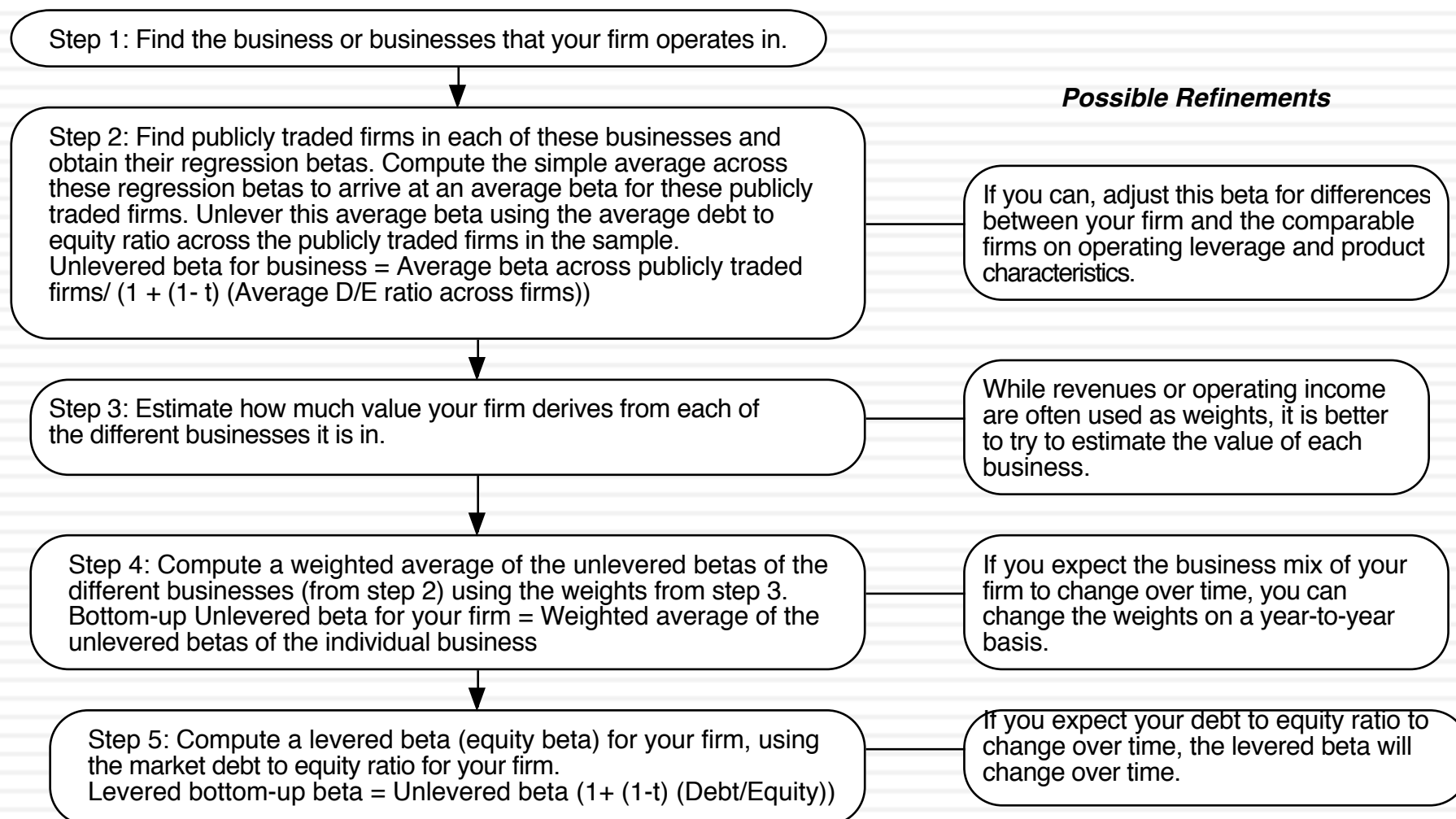
$$\beta_L = \beta_u (1 + ((1-t)D/E)) - \beta_{\text{debt}} (1-t) (D/E)$$

While the latter is more realistic, estimating betas for debt can be difficult to do.



# Bottom-up Betas

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# Why bottom-up betas?

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- The standard error in a bottom-up beta will be significantly lower than the standard error in a single regression beta. Roughly speaking, the standard error of a bottom-up beta estimate can be written as follows:

$$\text{Std error of bottom-up beta} = \frac{\text{Average Std Error across Betas}}{\sqrt{\text{Number of firms in sample}}}$$

- The bottom-up beta can be adjusted to reflect changes in the firm's business mix and financial leverage. Regression betas reflect the past.
- You can estimate bottom-up betas even when you do not have historical stock prices. This is the case with initial public offerings, private businesses or divisions of companies.

# Estimating Bottom Up Betas & Costs of Equity: Vale

| <i>Business</i>        | <i>Sample</i>   | <i>Sample size</i> | <i>Unlevered beta of business</i> | <i>Revenues</i> | <i>Peer Group EV/Sales</i> | <i>Value of Business</i> | <i>Proportion of Vale</i> |
|------------------------|---|--------------------|-----------------------------------|-----------------|----------------------------|--------------------------|---------------------------|
| Metals & Mining        | Global firms in metals & mining, Market cap>\$1 billion | 48                 | 0.86                              | \$9,013         | 1.97                       | \$17,739                 | 16.65%                    |
| Iron Ore               | Global firms in iron ore                                | 78                 | 0.83                              | \$32,717        | 2.48                       | \$81,188                 | 76.20%                    |
| Fertilizers            | Global specialty chemical firms                         | 693                | 0.99                              | \$3,777         | 1.52                       | \$5,741                  | 5.39%                     |
| Logistics              | Global transportation firms                             | 223                | 0.75                              | \$1,644         | 1.14                       | \$1,874                  | 1.76%                     |
| <i>Vale Operations</i> |   |                    | <i>0.8440</i>                     | <i>\$47,151</i> |                            | <i>\$106,543</i>         | <i>100.00%</i>            |

| Business        | Unlevered beta | D/E ratio | Levered beta | Risk free rate | ERP   | Cost of Equity |
|-----------------|----------------|-----------|--------------|----------------|-------|----------------|
| Metals & Mining | 0.86           | 54.99%    | 1.1657       | 2.75%          | 7.38% | 11.35%         |
| Iron Ore        | 0.83           | 54.99%    | 1.1358       | 2.75%          | 7.38% | 11.13%         |
| Fertilizers     | 0.99           | 54.99%    | 1.3493       | 2.75%          | 7.38% | 12.70%         |
| Logistics       | 0.75           | 54.99%    | 1.0222       | 2.75%          | 7.38% | 10.29%         |
| Vale Operations | 0.84           | 54.99%    | 1.1503       | 2.75%          | 7.38% | 11.23%         |

# Embraer's Bottom-up Beta

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| Business  | Unlevered Beta | D/E Ratio | Levered beta |
|-----------|----------------|-----------|--------------|
| Aerospace | 0.95           | 18.95%    | 1.07         |

- Levered Beta = Unlevered Beta ( 1 + (1- tax rate) (D/E Ratio) )  
= 0.95 ( 1 + (1-.34) (.1895)) = 1.07
  - Can an unlevered beta estimated using U.S. and European aerospace companies be used to estimate the beta for a Brazilian aerospace company?
    - a. Yes
    - b. No
- What concerns would you have in making this assumption?

# Gross Debt versus Net Debt Approaches

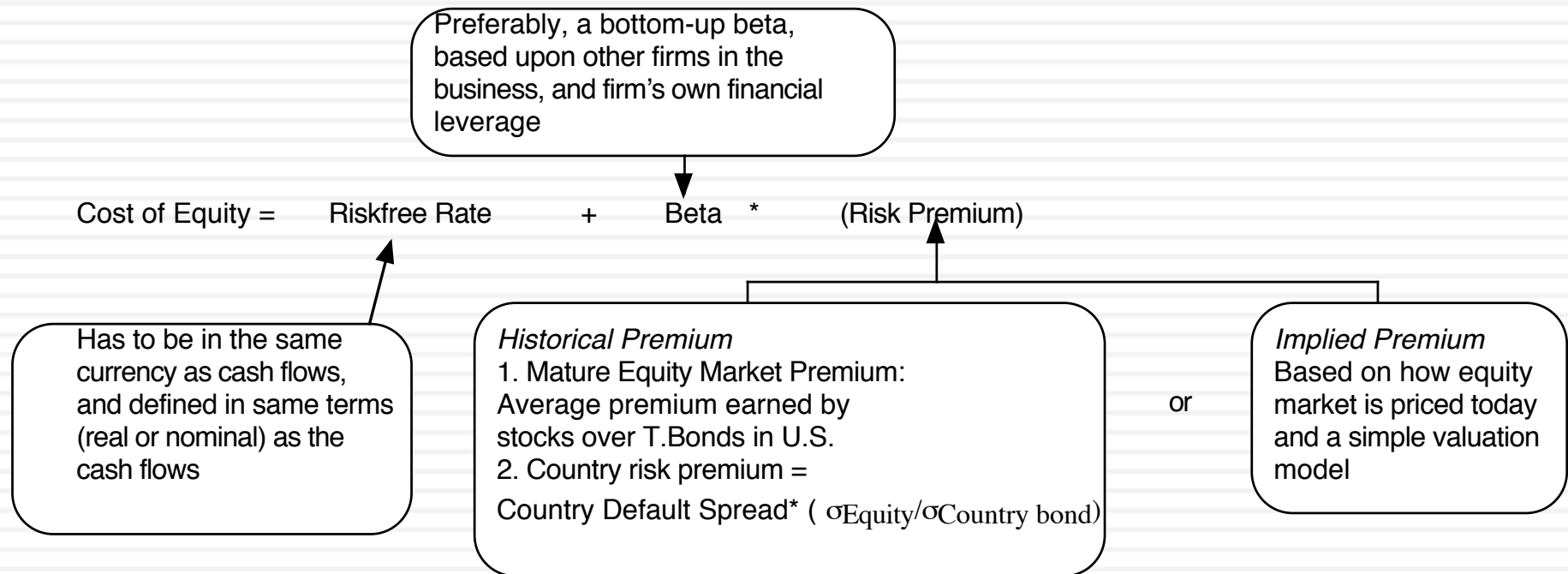
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- Analysts in Europe and Latin America often take the difference between debt and cash (net debt) when computing debt ratios and arrive at very different values.
- For Embraer, using the gross debt ratio
  - ▣ Gross D/E Ratio for Embraer =  $1953/11,042 = 18.95\%$
  - ▣ Levered Beta using Gross Debt ratio = 1.07
- Using the net debt ratio, we get
  - ▣ Net Debt Ratio for Embraer =  $(\text{Debt} - \text{Cash}) / \text{Market value of Equity}$   
 $= (1953 - 2320) / 11,042 = -3.32\%$
  - ▣ Levered Beta using Net Debt Ratio =  $0.95 (1 + (1 - .34) (-.0332)) = 0.93$
- The cost of Equity using net debt levered beta for Embraer will be much lower than with the gross debt approach. The cost of capital for Embraer will even out since the debt ratio used in the cost of capital equation will now be a net debt ratio rather than a gross debt ratio.



# The Cost of Equity: A Recap

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# Discount Rates: IV

Mopping up

# Estimating the Cost of Debt

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- The cost of debt is the rate at which you can borrow at currently, It will reflect not only your default risk but also the level of interest rates in the market.
- The two most widely used approaches to estimating cost of debt are:
  - Looking up the yield to maturity on a straight bond outstanding from the firm. The limitation of this approach is that very few firms have long term straight bonds that are liquid and widely traded
  - Looking up the rating for the firm and estimating a default spread based upon the rating. While this approach is more robust, different bonds from the same firm can have different ratings. You have to use a median rating for the firm
- When in trouble (either because you have no ratings or multiple ratings for a firm), estimate a synthetic rating for your firm and the cost of debt based upon that rating.

# Estimating Synthetic Ratings

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- 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 Embraer's interest coverage ratio, we used the interest expenses from 2003 and the average EBIT from 2001 to 2003. (The aircraft business was badly affected by 9/11 and its aftermath. In 2002 and 2003, Embraer reported significant drops in operating income)

$$\text{Interest Coverage Ratio} = 462.1 / 129.70 = 3.56$$

# Interest Coverage Ratios, Ratings and Default Spreads: 2004

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| If Interest Coverage Ratio is |            | Estimated Bond Rating | Default Spread(2004) |
|-------------------------------|------------|-----------------------|----------------------|
| > 8.50                        | (>12.50)   | AAA                   | 0.35%                |
| 6.50 - 8.50                   | (9.5-12.5) | AA                    | 0.50%                |
| 5.50 - 6.50                   | (7.5-9.5)  | A+                    | 0.70%                |
| 4.25 - 5.50                   | (6-7.5)    | A                     | 0.85%                |
| 3.00 - 4.25                   | (4.5-6)    | A-                    | 1.00%                |
| 2.50 - 3.00                   | (4-4.5)    | BBB                   | 1.50%                |
| 2.25 - 2.50                   | (3.5-4)    | BB+                   | 2.00%                |
| 2.00 - 2.25                   | ((3-3.5)   | BB                    | 2.50%                |
| 1.75 - 2.00                   | (2.5-3)    | B+                    | 3.25%                |
| 1.50 - 1.75                   | (2-2.5)    | B                     | 4.00%                |
| 1.25 - 1.50                   | (1.5-2)    | B -                   | 6.00%                |
| 0.80 - 1.25                   | (1.25-1.5) | CCC                   | 8.00%                |
| 0.65 - 0.80                   | (0.8-1.25) | CC                    | 10.00%               |
| 0.20 - 0.65                   | (0.5-0.8)  | C                     | 12.00%               |
| < 0.20 (<0.5)                 | D          |                       | 20.00%               |



# Cost of Debt computations

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- Based on the interest coverage ratio of 3.56, the synthetic rating for Embraer is A-, giving it a default spread of 1.00%
- Companies in countries with low bond ratings and high default risk might bear the burden of country default risk, especially if they are smaller or have all of their revenues within the country.
  - If I assume that Embraer bears all of the country risk burden, I would add on the country default spread for Brazil in 2004 of 6.01%.
  - Larger companies that derive a significant portion of their revenues in global markets may be less exposed to country default risk. I am going to add only two thirds of the Brazilian country risk (based upon traded bond spreads of other large Brazilian companies in 2004)

Cost of debt

= Riskfree rate + 2/3(Brazil country default spread) + Company default spread = 4.29% + 2/3 (6.01%) + 1.00% = 9.29%

# Synthetic Ratings: Some Caveats

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- The relationship between interest coverage ratios and ratings, developed using US companies, tends to travel well, as long as we are analyzing large manufacturing firms in markets with interest rates close to the US interest rate
- They are more problematic when looking at smaller companies in markets with higher interest rates than the US. One way to adjust for this difference is modify the interest coverage ratio table to reflect interest rate differences (For instances, if interest rates in an emerging market are twice as high as rates in the US, halve the interest coverage ratio).

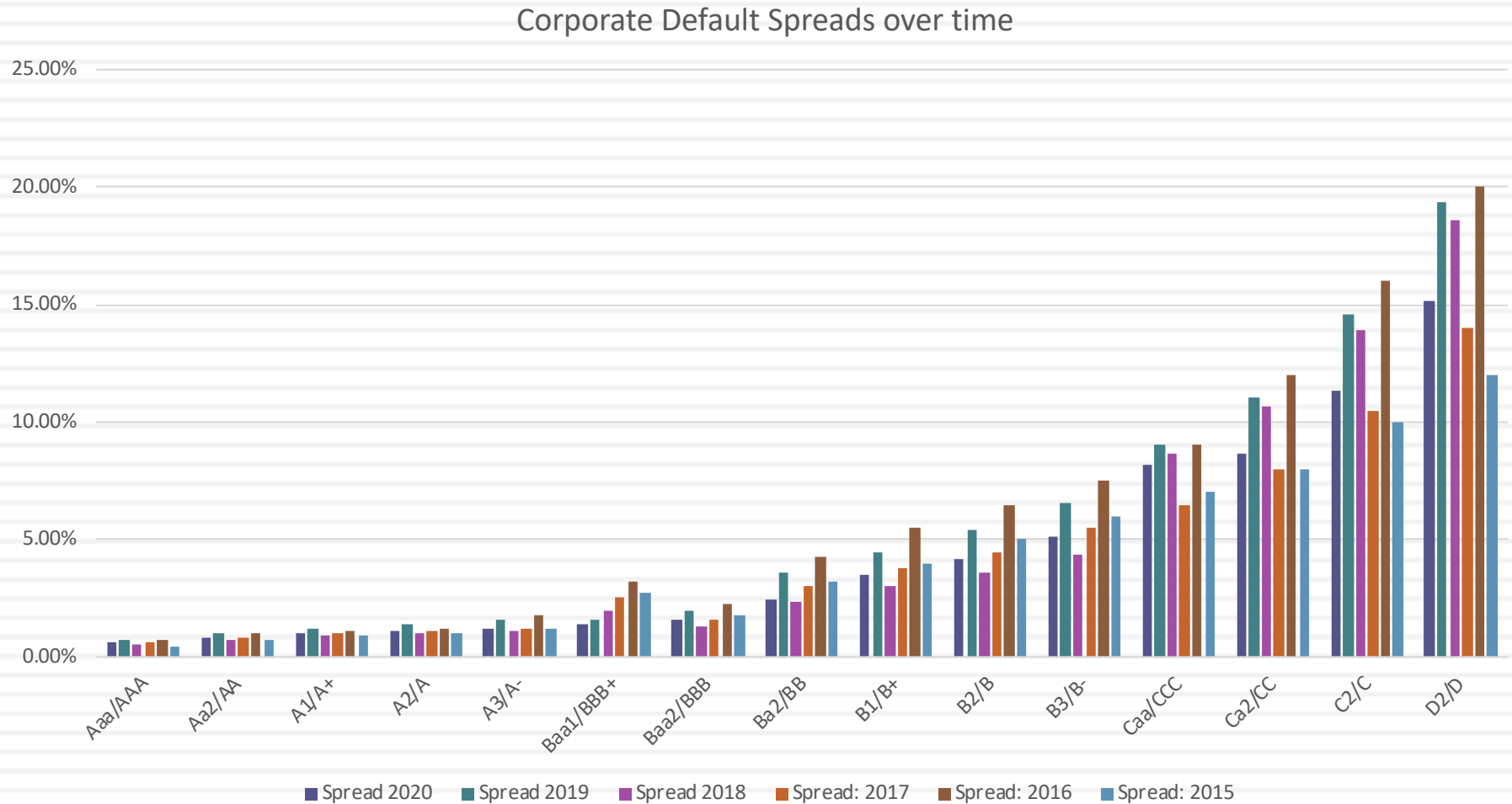
# Default Spreads: The effect of the crisis of 2008.. And the aftermath

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|           | <i>Default spread over treasury</i> |           |           |          |          |          |
|-----------|-------------------------------------|-----------|-----------|----------|----------|----------|
| Rating    | 1-Jan-08                            | 12-Sep-08 | 12-Nov-08 | 1-Jan-09 | 1-Jan-10 | 1-Jan-11 |
| Aaa/AAA   | 0.99%                               | 1.40%     | 2.15%     | 2.00%    | 0.50%    | 0.55%    |
| Aa1/AA+   | 1.15%                               | 1.45%     | 2.30%     | 2.25%    | 0.55%    | 0.60%    |
| Aa2/AA    | 1.25%                               | 1.50%     | 2.55%     | 2.50%    | 0.65%    | 0.65%    |
| Aa3/AA-   | 1.30%                               | 1.65%     | 2.80%     | 2.75%    | 0.70%    | 0.75%    |
| A1/A+     | 1.35%                               | 1.85%     | 3.25%     | 3.25%    | 0.85%    | 0.85%    |
| A2/A      | 1.42%                               | 1.95%     | 3.50%     | 3.50%    | 0.90%    | 0.90%    |
| A3/A-     | 1.48%                               | 2.15%     | 3.75%     | 3.75%    | 1.05%    | 1.00%    |
| Baa1/BBB+ | 1.73%                               | 2.65%     | 4.50%     | 5.25%    | 1.65%    | 1.40%    |
| Baa2/BBB  | 2.02%                               | 2.90%     | 5.00%     | 5.75%    | 1.80%    | 1.60%    |
| Baa3/BBB- | 2.60%                               | 3.20%     | 5.75%     | 7.25%    | 2.25%    | 2.05%    |
| Ba1/BB+   | 3.20%                               | 4.45%     | 7.00%     | 9.50%    | 3.50%    | 2.90%    |
| Ba2/BB    | 3.65%                               | 5.15%     | 8.00%     | 10.50%   | 3.85%    | 3.25%    |
| Ba3/BB-   | 4.00%                               | 5.30%     | 9.00%     | 11.00%   | 4.00%    | 3.50%    |
| B1/B+     | 4.55%                               | 5.85%     | 9.50%     | 11.50%   | 4.25%    | 3.75%    |
| B2/B      | 5.65%                               | 6.10%     | 10.50%    | 12.50%   | 5.25%    | 5.00%    |
| B3/B-     | 6.45%                               | 9.40%     | 13.50%    | 15.50%   | 5.50%    | 6.00%    |
| Caa/CCC+  | 7.15%                               | 9.80%     | 14.00%    | 16.50%   | 7.75%    | 7.75%    |
| ERP       | 4.37%                               | 4.52%     | 6.30%     | 6.43%    | 4.36%    | 5.20%    |

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# Default Spreads – January 2020



# Subsidized Debt: What should we do?

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- Assume that the Brazilian government lends money to Embraer at a subsidized interest rate (say 6% in dollar terms). In computing the cost of capital to value Embraer, should we use the cost of debt based upon default risk or the subsidized cost of debt?
  - a. The subsidized cost of debt (6%). That is what the company is paying.
  - b. The fair cost of debt (9.25%). That is what the company should require its projects to cover.
  - c. A number in the middle.