The Free Cashflow to Firm Model

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DaimlerChrysler: Rationale for Model

- DaimlerChrysler is a mature firm in a mature industry. We will therefore assume that the firm is in stable growth.
- Since this is a relatively new organization, with two different cultures on the use of debt (Daimler has traditionally been more conservative and bank-oriented in its use of debt than Chrysler), the debt ratio will probably change over time. Hence, we will use the FCFF model.

Daimler Chrysler: Inputs to the Model

- In 1999, Daimler Chrysler had earnings before interest and taxes of 9,324 million DM and had an effective tax rate of 46.94%.
- Based upon this operating income and the book values of debt and equity as of 1998, DaimlerChrysler had an after-tax return on capital of 7.15%.
- The market value of equity is 62.3 billion DM, while the estimated market value of debt is 64.5 billion
- The bottom-up unlevered beta for automobile firms is 0.61, and Daimler is AAA rated.
- The long term German bond rate is 4.87% (in DM) and the mature market premium of 4% is used.
- We will assume that the firm will maintain a long term growth rate of 3%.

Daimler/Chrysler: Analyzing the Inputs

- Expected Reinvestment Rate = g/ ROC = 3%/7.15% = 41.98%
- Cost of Capital
  - Bottom-up Levered Beta = 0.61 (1+(1-.4694)(64.5/62.3)) = 0.945
  - Cost of Equity = 4.87% + 0.945 (4%) = 8.65%
  - After-tax Cost of Debt = (4.87% + 0.20%) (1-.4694)= 2.69%
  - Cost of Capital = 8.65%(62.3/(62.3+64.5))+ 2.69% (64.5/(62.3+64.5)) = 5.62%

Daimler Chrysler Valuation

- Estimating FCFF

Expected EBIT (1-t) = 9324 (1.03) (1-.4694) =	5,096 mil DM
Expected Reinvestment needs = 5,096(.42) =	2,139 mil DM
Expected FCFF next year =	2,957 mil DM

- Valuation of Firm

Value of operating assets = 2957 / (.056-.03) =	112,847 mil DM
+ Cash + Marketable Securities =	18,068 mil DM
Value of Firm =	130,915 mil DM
- Debt Outstanding =	64,488 mil DM
Value of Equity =	66,427 mil DM

Value per Share = 72.7 DM per share

Stock was trading at 62.2 DM per share on August 14, 2000

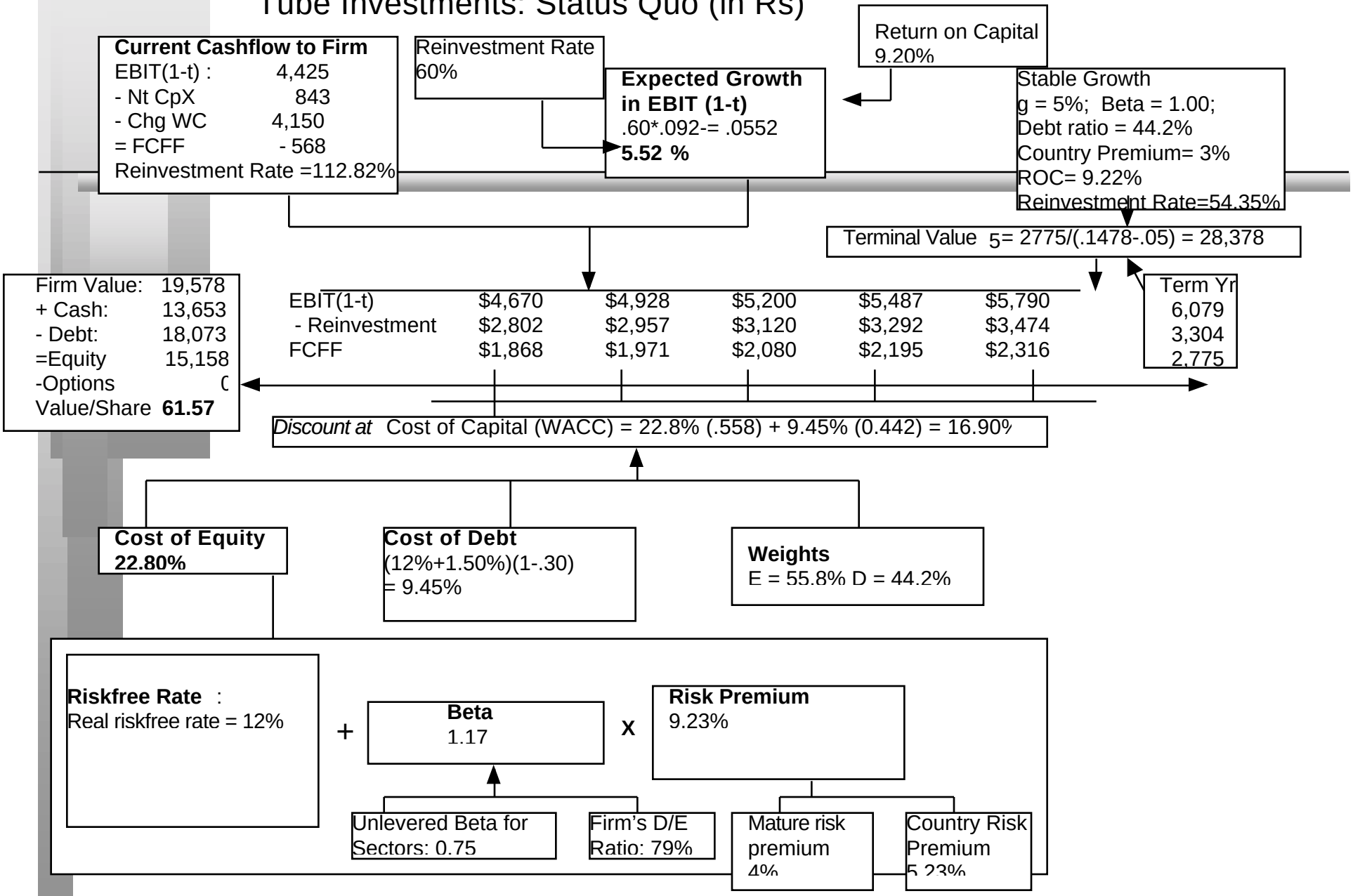
Circular Reasoning in FCFF Valuation

- In discounting FCFF, we use the cost of capital, which is calculated using the market values of equity and debt. We then use the present value of the FCFF as our value for the firm and derive an estimated value for equity. Is there circular reasoning here?
  - Yes
  - No
- If there is, can you think of a way around this problem?

Tube Investment: Rationale for Using 2-Stage FCFF Model

- Tube Investments is a diversified manufacturing firm in India. While its growth rate has been anemic, there is potential for high growth over the next 5 years.
- The firm's financing policy is also in a state of flux as the family running the firm reassesses its policy of funding the firm.

Tube Investments: Status Quo (in Rs)



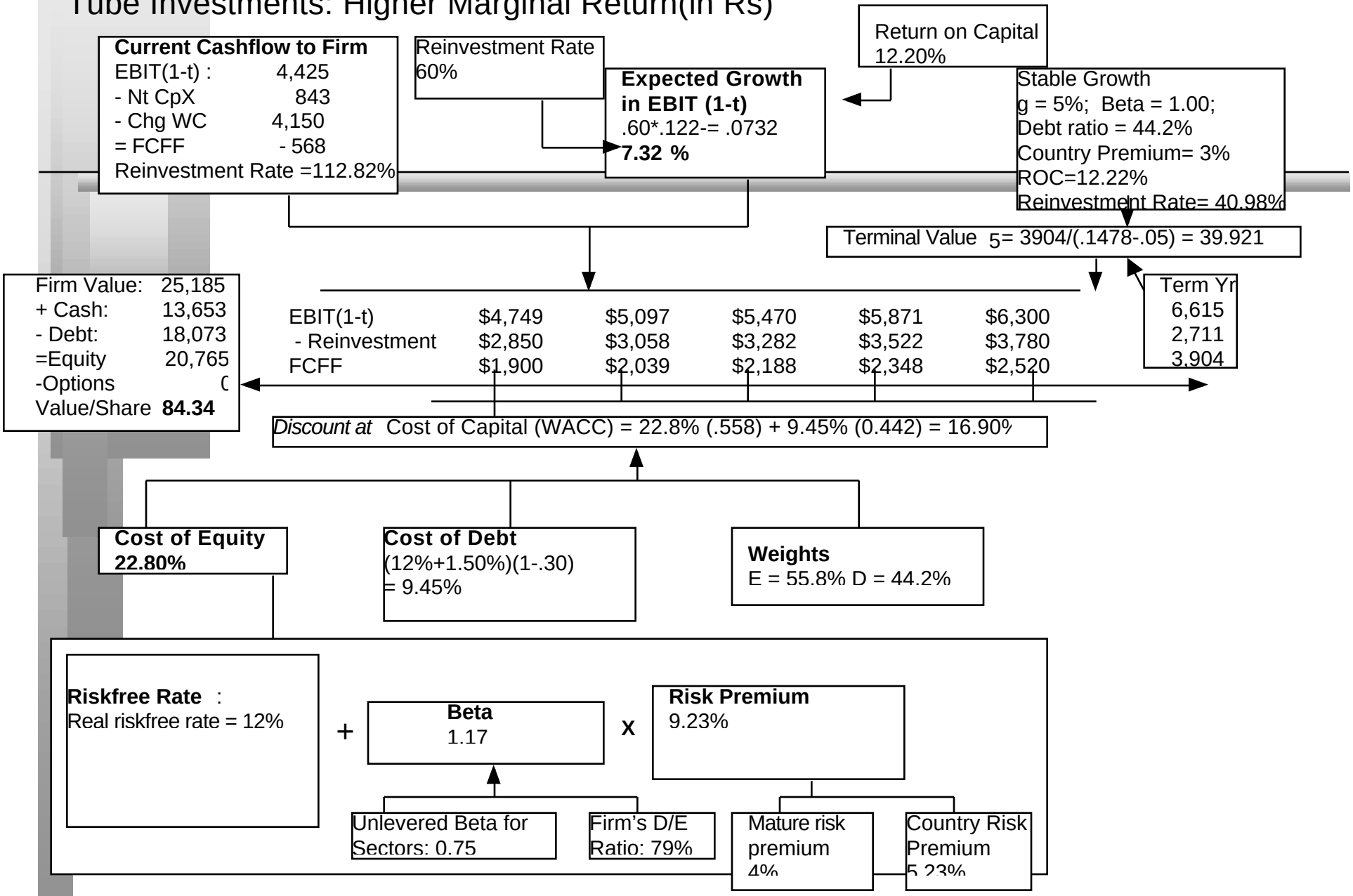
Stable Growth Rate and Value

- In estimating terminal value for Tube Investments, I used a stable growth rate of 5%. If I used a 7% stable growth rate instead, what would my terminal value be? (Assume that the cost of capital and return on capital remain unchanged.)

The Effects of Return Improvements on Value

- The firm is considering changes in the way in which it invests, which management believes will increase the return on capital to 12.20% on just new investments (and not on existing investments) over the next 5 years.
- The value of the firm will be higher, because of higher expected growth.

Tube Investments: Higher Marginal Return(in Rs)

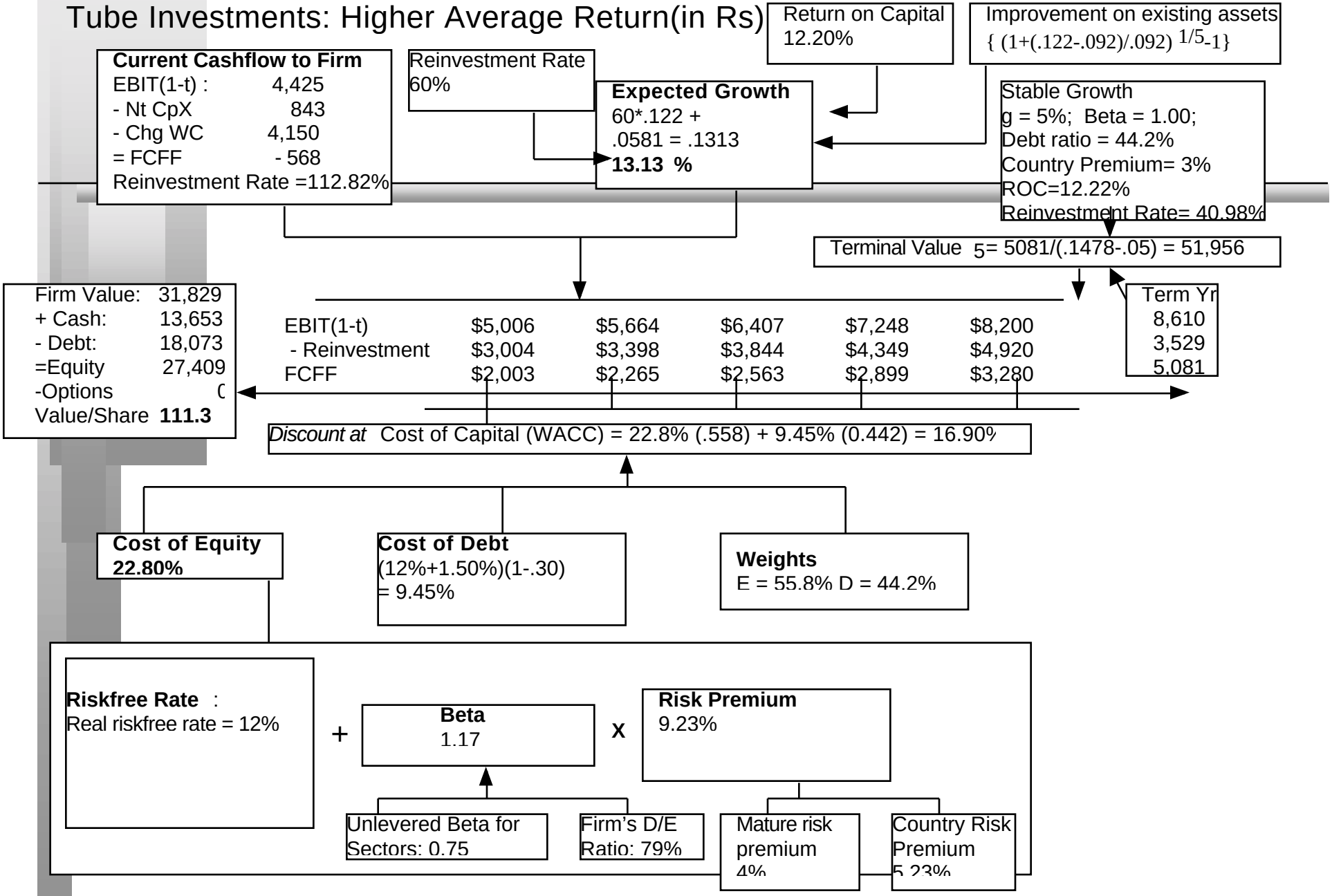


Return Improvements on Existing Assets

- If Tube Investments is also able to increase the return on capital on existing assets to 12.20% from 9.20%, its value will increase even more.
- The expected growth rate over the next 5 years will then have a second component arising from improving returns on existing assets:
- Expected Growth Rate = $.122*.60 +\{ (1+(.122-.092)/.092)^{1/5}-1\}$

  $=.1313$ or 13.13%

Tube Investments: Higher Average Return(in Rs)



Tube Investments and Tsingtao: Should there be a corporate governance discount?

- Stockholders in Asian, Latin American and many European companies have little or no power over the managers of the firm. In many cases, insiders own voting shares and control the firm and the potential for conflict of interests is huge. Would you discount the value that you estimated to allow for this absence of stockholder power?
  - Yes
  - No.

Dealing with Operating Leases: A Valuation of the Home Depot

- The Home Depot does not carry much in terms of traditional debt on its balance sheet. However, it does have significant operating leases.
- When doing firm valuation, these operating leases have to be treated as debt. This, in turn, will mean that operating income has to get restated.

Operating Leases at The Home Depot in 1998

- The pre-tax cost of debt at the Home Depot is 5.80%

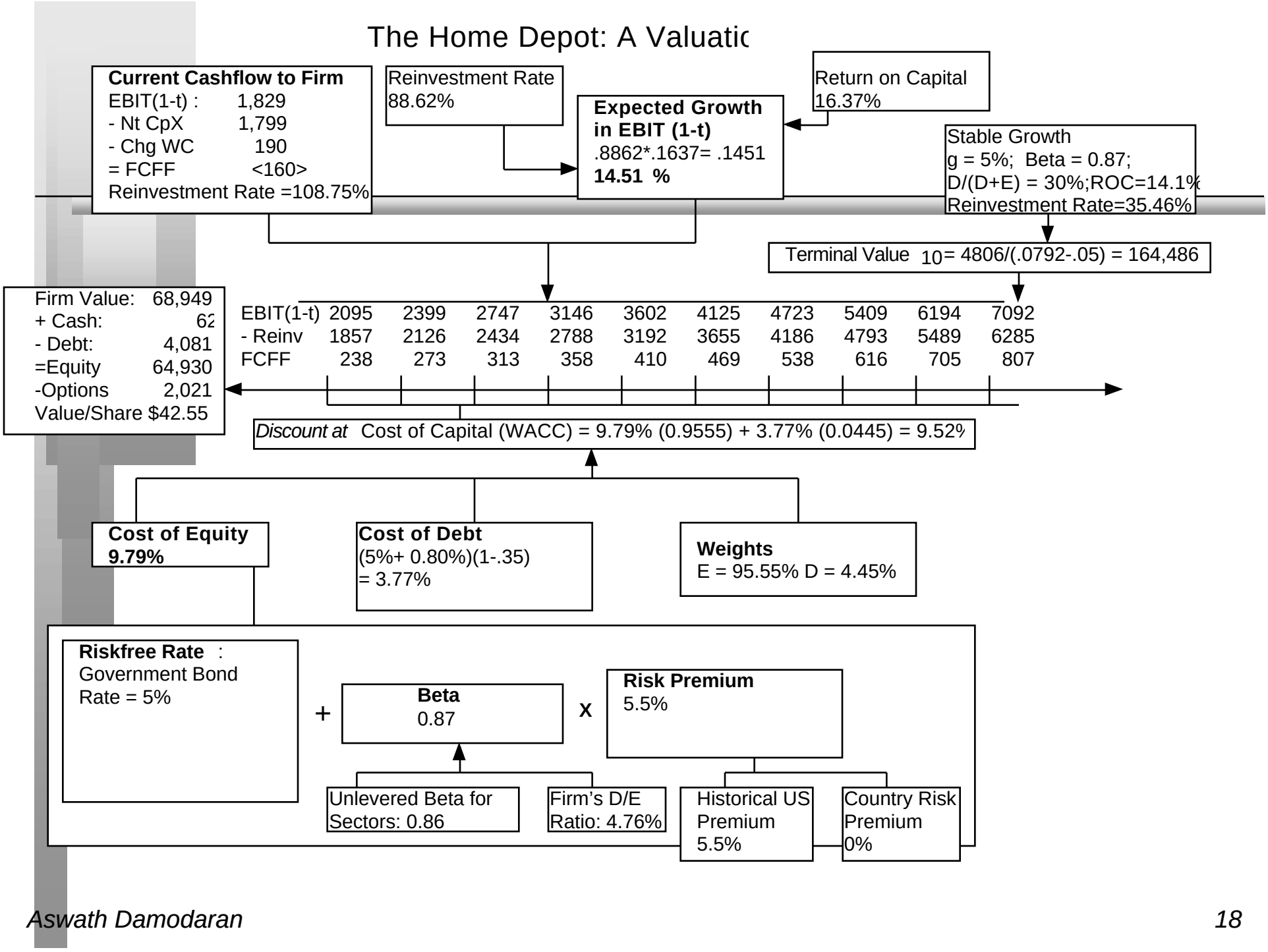
Year	Commitment	Present Value
1	$ 294.00	$277.88
2	$ 291.00	$259.97
3	$ 264.00	$222.92
4	$ 245.00	$195.53
5	$ 236.00	$178.03
6 and beyond	$ 270.00	$1,513.37

- Debt Value of leases = $ 2,647.70

Other Adjustments from Operating Leases

	Operating Lease Expensed	Operating Lease converted to Debt
EBIT	$ 2,661mil	$ 2,815 mil
EBIT (1-t)	$1,730 mil	$1,829 mil
Debt	$1,433 mil	$ 4,081 mil

The Home Depot: A Valuatic



Dealing with R&D: Bristol Myers

- Bristol Myers, like most pharmaceutical firms, has a significant amount of research and development expenses. These expenses, though treated as operating expenditures, by accountants, are really capital expenditures.
- When R&D expenses are reclassified as capital expenditures, there is a ripple effect on the following:
  - Operating income
  - Capital Expendiutures
  - Depreciation and Amortization
  - Reinvestment Rates
  - Return on Capital

Converting R&D Expenses to Capital Expenses

Year	*R&D Expense*	*Unamortized portion*		*Amortization this year*
Current	1939.00	1.00	1939.00	
-1	1759.00	0.90	1583.10	$175.90
-2	1577.00	0.80	1261.60	$157.70
-3	1385.00	0.70	969.50	$138.50
-4	1276.00	0.60	765.60	$127.60
-5	1199.00	0.50	599.50	$119.90
-6	1108.00	0.40	443.20	$110.80
-7	1128.00	0.30	338.40	$112.80
-8	1083.00	0.20	216.60	$108.30
-9	983.00	0.10	98.30	$98.30
-10	881.00	0.00	0.00	$88.10
Value of Research Asset =			**$8,214.80**	
Amortization this year =				**$1,237.90**

The Consequences of a Research Asset

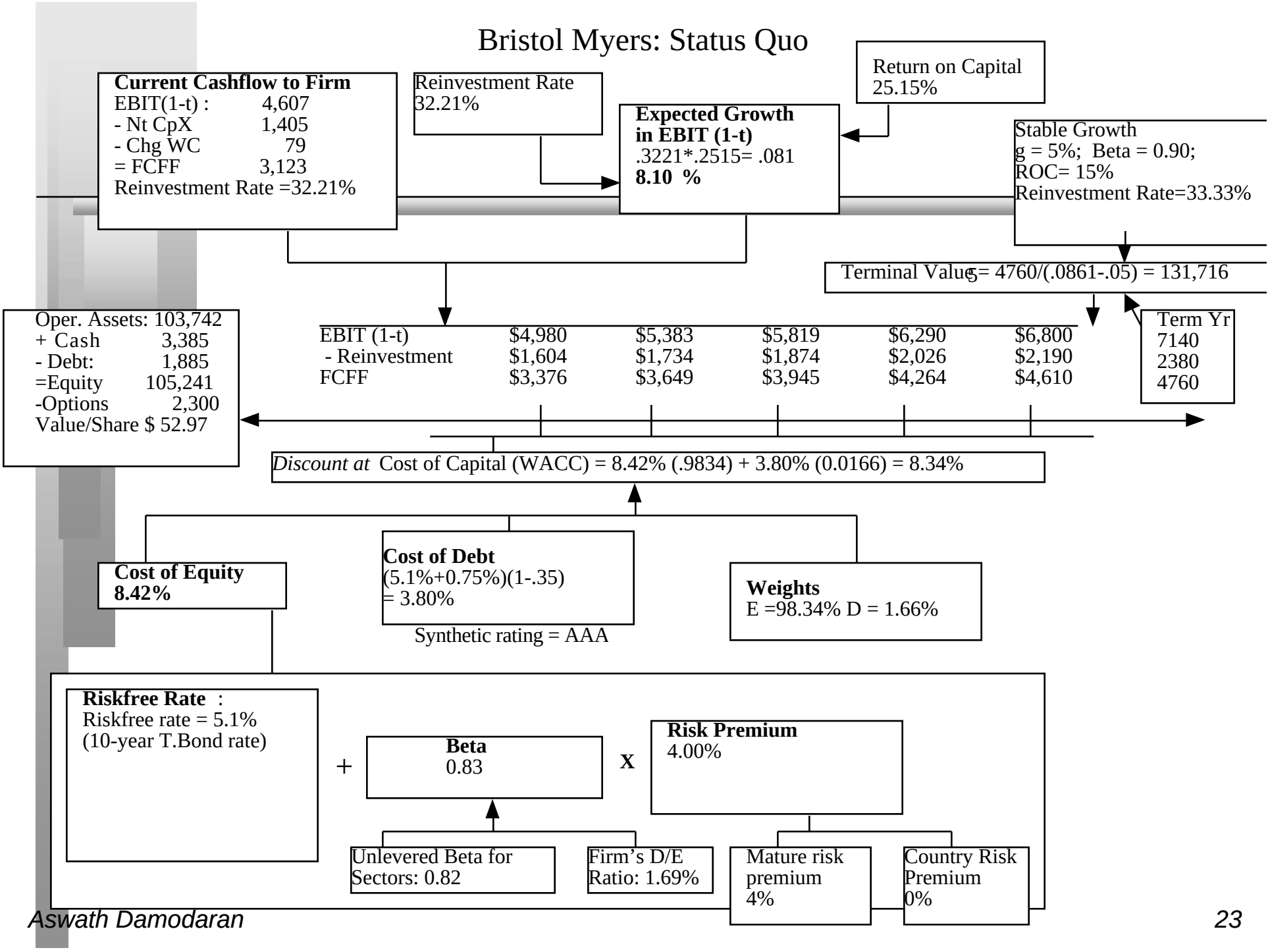
- Amortization of asset for current year = $ 1,238 million
- Adjustment to Operating Income :
  - Add back the R& D Expenses $1,939 million
  - Subtract out the amortization $1,238 million
  - Increase in Operating Income $ 701 million (Increase)
- Tax Effect of R&D Expensing
  - The entire R&D expense of $1,939 million is tax-deductible, rather than just the amortization of $1,238 million
  - This creates a tax benefit that can be computed as follows:

  Additional tax benefit of expensing = (1939-1238) (.35) = $ 245 million

Capitalizing R& D: The Effects

	R&D expensed	R&D capitalized	Effect
EBIT =	$ 6,009 mil	$6,710 mil	Increase $ 701
EBIT (1-t)	$ 3,906 mil	$4,607 mil	Increase $ 701
Capital spending =	$1,505 mil	$ 3,444 mil	Increase $1939
Depreciation =	$ 801 mil	$ 2,039 mil	Increase $ 1238
Net Cap Ex	$ 704mil	$1,405 mil	Increase $ 701
Non-cash WC Chg =	$ 79 mil	$ 79 mil	Unchanged
Reinvestment Rate	20.04%	32.21%	Increase
BV of Equity	$ 10,105 mil	$ 18,320 mil	Increase
ROC	38.65%	25.21%	Decrease

Bristol Myers: Status Quo



Why does the cost of capital matter?

- Value of a Firm = Present Value of Cash Flows to the Firm, discounted back at the cost of capital.
- If the cash flows to the firm are held constant, and the cost of capital is minimized, the value of the firm will be maximized.

Firm Value, Cost of Capital and Debt Ratios: A Simple Example

- Strunks Inc., a leading manufacturer of chocolates and other candies, has cash flows to the firm of $200 million.
- Strunks is in a relatively stable market, and these cash flows are expected to grow at 6% forever, and to be unaffected by the debt ratio of the firm.
- The value of the firm at any cost of capital can be written as:

  Firm Value = Cash flow to the firm (1+g)/(Cost of capital - g)

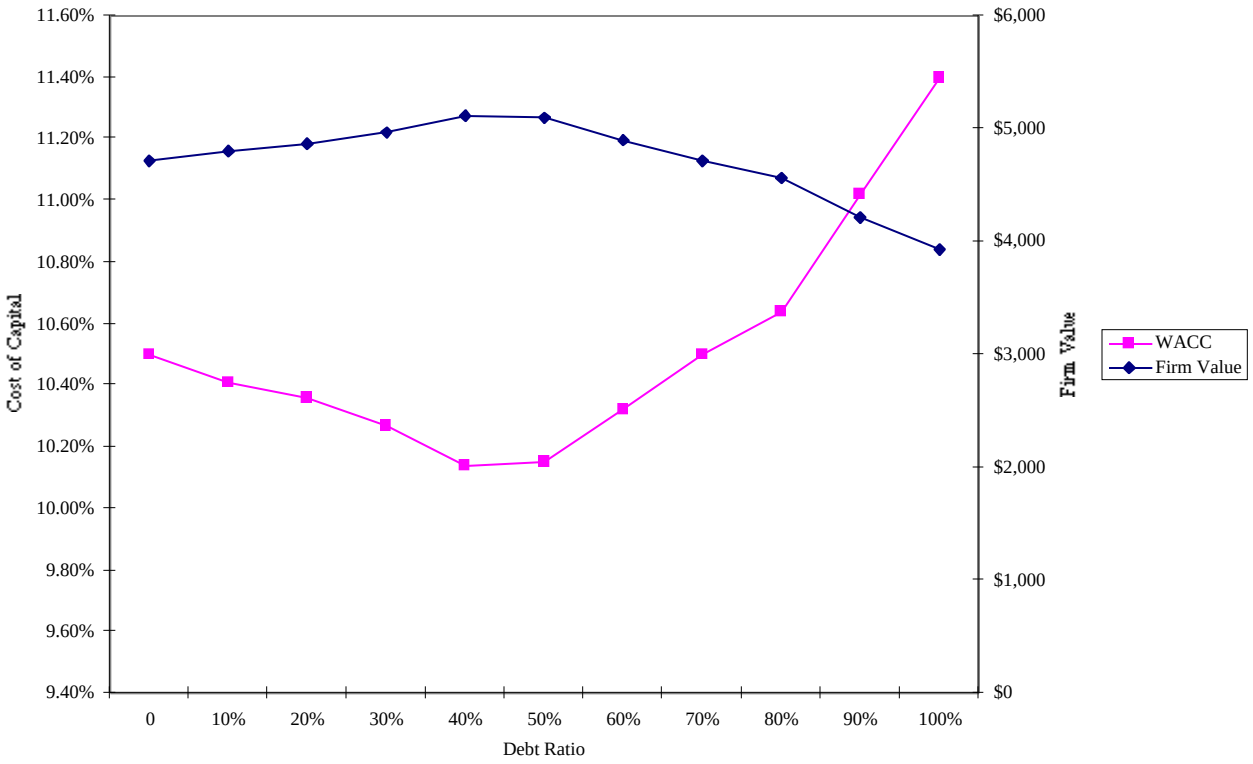
  = 200 (1.06)/(Cost of capital - .06)

Cost of Capital and Firm Value

D/(D+E)	*Cost of Equity*	*Cost of Debt*	*WACC*	*Firm Value*
0	10.50%	4.80%	10.50%	$4,711
10%	11.00%	5.10%	10.41%	$4,807
20%	11.60%	5.40%	10.36%	$4,862
30%	12.30%	5.52%	10.27%	$4,970
40%	13.10%	5.70%	10.14%	$5,121
50%	14.00%	6.30%	10.15%	$5,108
60%	15.00%	7.20%	10.32%	$4,907
70%	16.10%	8.10%	10.50%	$4,711
80%	17.20%	9.00%	10.64%	$4,569
90%	18.40%	10.20%	11.02%	$4,223
100%	19.70%	11.40%	11.40%	$3,926

A Pictorial View

Figure 19.2: Cost of Capital and Firm Value



Current Cost of Capital: Boeing

- The beta for Boeing's stock in March 1999was 1.01. The treasury bond rate at that time was 5%. Using an estimated market risk premium of 5.5%, we estimated the cost of equity for Boeing to be 10.58%:

  Cost of Equity = Riskfree rate + Beta * (Market Premium)

  =5.00% + 1.01 (5.5%) = 10.58%

- Boeing's senior debt was rated AA;, the estimated pre-tax cost of debt for Boeing is 5.50%. The tax rate used for the analysis is 35%.

  After-tax Cost of debt = Pre-tax interest rate (1- tax rate)

  = 5.50% (1- 0.35) = 3.58%

- Cost of Capital = Cost of Equity (Equity/(Equity + Debt)) + After-tax Cost of Debt (Debt/(Debt +Equity))

  = 10.58% [32,595/(32595+8194)] + 3.58% [8,194 /(32595+8194)] = 9.17%

Mechanics of Cost of Capital Estimation

1. Estimate the Cost of Equity at different levels of debt:
   - Equity will become riskier -> Beta will increase -> Cost of Equity will increase.
   - Estimation will use levered beta calculation
2. Estimate the Cost of Debt at different levels of debt:
   - Default risk will go up and bond ratings will go down as debt goes up -> Cost of Debt will increase.
   - To estimating bond ratings, we will use the interest coverage ratio (EBIT/Interest expense)
3. Estimate the Cost of Capital at different levels of debt
4. Calculate the effect on Firm Value and Stock Price.

Ratings and Financial Ratios

	AAA	*AA*	*A*	*BBB*	*BB*	*B*	*CCC*
EBIT interest cov. (x)	12.9	9.2	7.2	4.1	2.5	1.2	(0.9)
EBITDA interest cov.	18.7	14.0	10.0	6.3	3.9	2.3	0.2
Funds flow/total debt	89.7	67.0	49.5	32.2	20.1	10.5	7.4
Free oper. cash flow/total debt (%)	40.5	21.6	17.4	6.3	1.0	(4.0)	(25.4)
Return on capital (%)	30.6	25.1	19.6	15.4	12.6	9.2	(8.8)
Oper.income/sales (%)	30.9	25.2	17.9	15.8	14.4	11.2	5.0
Long-term debt/capital (%)	21.4	29.3	33.3	40.8	55.3	68.8	71.5

Synthetic Ratings

- The synthetic rating for a firm can be estimated by
  - Using one of the financial ratios specified above
  - Using a score based upon all of the financial ratios specified above
- If you use only one financial ratio, you want to pick the ratio that has the greatest power in explaining differences in ratings.
  - For manufacturing firms, this is the interest coverage ratio.
- If you want to use multiple ratios, you have to determine how you will weight each ratio in coming up with a score.
  - One approach used is a multiple discriminant analysis, where the weights are based upon how well the ratios predict ultimate default. (Altman Z score is one example).

Process of Ratings and Rate Estimation

- We use the median interest coverage ratios for large manufacturing firms to develop “interest coverage ratio” ranges for each rating class.
- We then estimate a spread over the long term bond rate for each ratings class, based upon yields at which these bonds trade in the market place. (We used a sampling of 5 corporate bonds within each ratings class to make these estimates)

Interest Coverage Ratios and Bond Ratings

If Interest Coverage Ratio is	Estimated Bond Rating
> 8.50	AAA
6.50 - 8.50	AA
5.50 - 6.50	A+
4.25 - 5.50	A
3.00 - 4.25	A–
2.50 - 3.00	BBB
2.00 - 2.50	BB
1.75 - 2.00	B+
1.50 - 1.75	B
1.25 - 1.50	B –
0.80 - 1.25	CCC
0.65 - 0.80	CC
0.20 - 0.65	C
< 0.20	D

Spreads over long bond rate for ratings classes: February 1999

Rating	*Spread*	*Interest Rate on Debt*
AAA	0.20%	5.20%
AA	0.50%	5.50%
A+	0.80%	5.80%
A	1.00%	6.00%
A-	1.25%	6.25%
BBB	1.50%	6.50%
BB	2.00%	7.00%
B+	2.50%	7.50%
B	3.25%	8.25%
B-	4.25%	9.25%
CCC	5.00%	10.00%
CC	6.00%	11.00%
C	7.50%	12.50%
D	10.00%	15.00%

Current Income Statement for Boeing: 1998

Sales & Other Operating Revenues	$56,154.00
- Operating Costs & Expenses	$52,917.00
EBITDA	$3,237.00
- Depreciation	$1,517.00
EBIT	$1,720.00
+ Extraordinary Income	$130.00
EBIT with extraordinary income	$1,850.00
- Interest Expenses	$453.00
Earnings before Taxes	$1,397.00
- Income Taxes	$277.00
Net Earnings (Loss)	$1,120.00

Adjusted Operating Income (for leases) = $1,720 million + Imputed interest expense on operating lease debt = $ 1,720 + $31 = $ 1,751 million

Estimating Cost of Equity

- To estimate the cost of equity at each debt ratio, we first estimate the levered beta at each debt ratio:

$$\beta_{levered} = \beta_{unlevered} [1+(1\text{-tax rate})(Debt/Equity)]$$

- The levered beta is used in conjunction with the riskfree rate and risk premium to estimate a cost of equity at each debt ratio:

Cost of Equity = Riskfree rate + Beta * Risk Premium

Estimating Cost of Equity: Boeing at Different Debt Ratios

Unlevered Beta = 0.87 (Bottom-up Beta, based upon comparable firms)

Market premium = 5.5% Treasury Bond rate = 5.00% t=35%

Debt Ratio	*Beta*	*Cost of Equity*
0%	0.87	9.79%
10%	0.93	10.14%
20%	1.01	10.57%
30%	1.11	11.13%
40%	1.25	11.87%
50%	1.51	13.28%
60%	1.92	15.54%
70%	2.56	19.06%
80%	3.83	26.09%
90%	7.67	47.18%

Estimating Cost of Debt

Firm Value = Market value of debt + Market value of Equity = 32,595 + 8,194

D/(D+E)	0.00%	10.00%	Second Iteration
D/E	0.00%	11.11%	
$ Debt	$0	$4,079	$4,079
EBITDA	$3,268	$3,268	$3,268
Depreciation	$1,517	$1,517	$1,517
EBIT	$1,751	$1,751	$1,751
Interest Expense	$0	$212	$224
Pre-tax Int. cov	∞	8.26	7.80
Likely Rating	AAA	AA	AA
Interest Rate	5.20%	5.50%	5.50%
Eff. Tax Rate	35.00%	35.00%	35.00%
Cost of Debt	3.38%		3.58%

The Ratings Table

If Interest Coverage Ratio is	Estimated Bond Rating	Default spread
> 8.50	AAA	0.20%
6.50 - 8.50	AA	0.50%
5.50 - 6.50	A+	0.80%
4.25 - 5.50	A	1.00%
3.00 - 4.25	A–	1.25%
2.50 - 3.00	BBB	1.50%
2.00 - 2.50	BB	2.00%
1.75 - 2.00	B+	2.50%
1.50 - 1.75	B	3.25%
1.25 - 1.50	B –	4.25%
0.80 - 1.25	CCC	5.00%
0.65 - 0.80	CC	6.00%
0.20 - 0.65	C	7.50%
< 0.20	D	10.00%

A Test: Can you do the 20% level?

D/(D+E)	0.00%	10.00%	20%	Second Iteration
D/E	0.00%	11.11%		
$ Debt	$0	$4,079		
EBITDA	$3,268	$3,268	$3,268	
Depreciation	$1,517	$1,517	$1,517	
EBIT	$1,751	$1,751	$1,751	
Interest Expense	$0	$224		
Pre-tax Int. cov	∞	7.80		
Likely Rating	AAA	AA		
Interest Rate	5.20%	5.50%		
Eff. Tax Rate	35.00%	35.00%		
Cost of Debt	3.38%	3.58%		

Bond Ratings, Cost of Debt and Debt Ratios

	0%	105	20%	30%	40%	50%	60%	70%	80%	90%
EBITDA	$3,268	$3,268	$3,268	$3,268	$3,268	$3,268	$3,268	$3,268	$3,268	$3,268
Depreciation	$1,517	$1,517	$1,517	$1,517	$1,517	$1,517	$1,517	$1,517	$1,517	$1,517
EBIT	$1,751	$1,751	$1,751	$1,751	$1,751	$1,751	$1,751	$1,751	$1,751	$1,751
Interest	$ -	$ 224	$ 510	$ 857	$1,632	$2,039	$2,692	$3,569	$4,079	$4,589
Pre-tax Int. cov	∞	7.80	3.43	2.04	1.07	0.86	0.65	0.49	0.43	0.38
Likely Rating	AAA	AA	A-	BB	CCC	CCC	CC	C	C	C
Interest Rate	5.20%	5.50%	6.25%	7.00%	10.00%	10.00%	11.00%	12.50%	12.50%	12.50%
Eff. Tax Rate	35.00%	35.00%	35.00%	35.00%	35.00%	30.05%	22.76%	17.17%	15.02%	13.36%
Cost of Debt	3.38%	3.58%	4.06%	4.55%	6.50%	7.00%	8.50%	10.35%	10.62%	10.83%

Why does the tax rate change?

- You need taxable income for interest to provide a tax savings

	40%	50%
EBIT	$ 1,751	$ 1,751
Interest Expense	$ 1,632	$ 2,039
Coverage ratio	1.07	0.86
Rating	CCC	CCC
Interest rate	10.00%	10.00%
Tax Rate	35.00%	30.05%
Cost of Debt	6.50%	7.00%

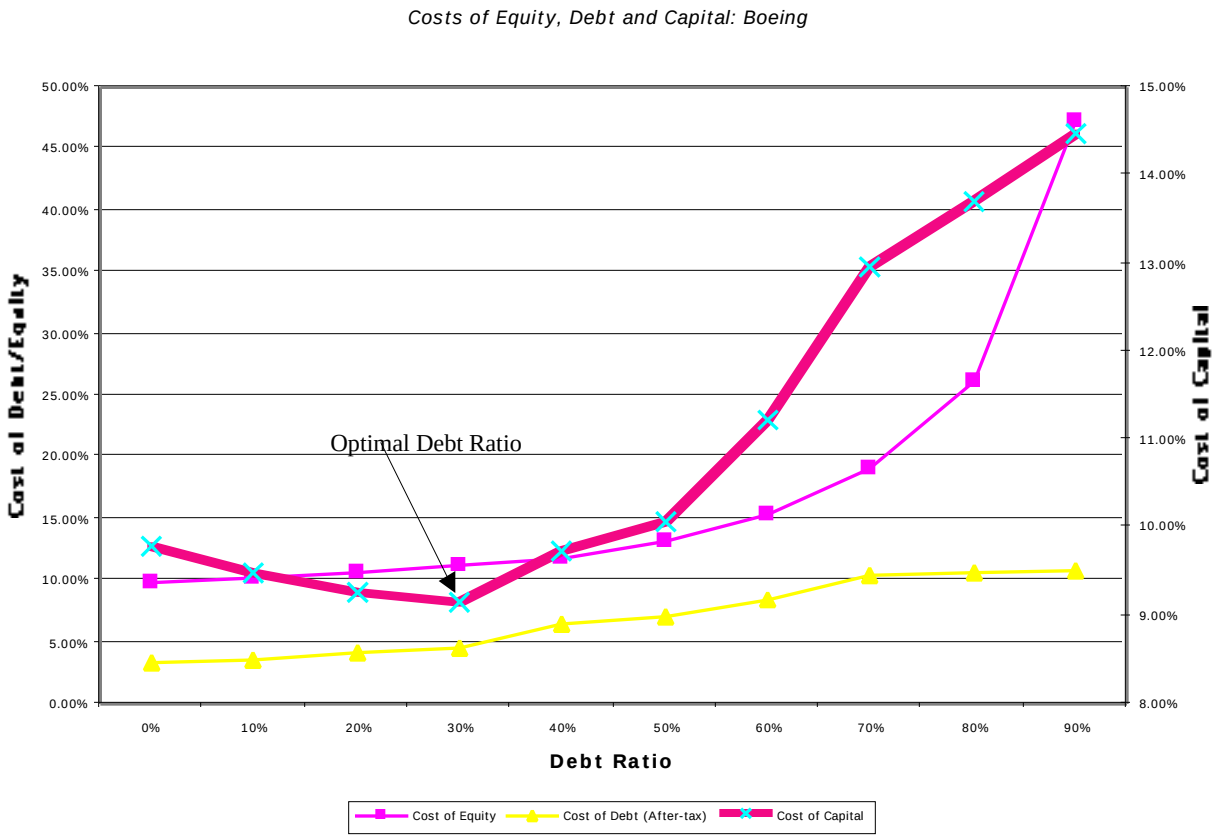
Maximum Tax Benefit = 35% of $1,751 = $613 million

Tax Rate to use for cost of debt = 613/2039 = 30.05%

Boeing's Cost of Capital Schedule

Debt Ratio	Beta	Cost of Equity	Cost of Debt	Cost of Capital
0%	0.87	9.79%	3.38%	9.79%
10%	0.93	10.14%	3.58%	9.48%
20%	1.01	10.57%	4.06%	9.27%
30%	1.11	11.13%	4.55%	9.16%
40%	1.25	11.87%	6.50%	9.72%
50%	1.48	13.15%	7.00%	10.07%
60%	1.88	15.35%	8.50%	11.24%
70%	2.56	19.06%	10.35%	12.97%
80%	3.83	26.09%	10.62%	13.72%
90%	7.67	47.18%	10.83%	14.47%

Boeing: Cost of Capital Chart



The Home Depot: Cost of Capital Schedule

Debt Ratio	Beta	Cost of Equity	Rating	Interest rate	Tax Rate	Cost of Debt (After-tax)	Cost of Capital
0%	0.84	9.64%	AAA	5.20%	35.00%	3.38%	9.64%
10%	0.90	9.98%	A	6.00%	35.00%	3.90%	9.37%
20%	0.98	10.40%	BB	7.00%	35.00%	4.55%	9.23%
30%	1.08	10.93%	CCC	10.00%	35.00%	6.50%	9.60%
40%	1.27	11.96%	CC	11.00%	24.95%	8.26%	10.48%
50%	1.54	13.47%	C	12.50%	17.56%	10.30%	11.89%
60%	1.92	15.58%	C	12.50%	14.63%	10.67%	12.64%
70%	2.57	19.11%	C	12.50%	12.54%	10.93%	13.39%
80%	3.85	26.17%	C	12.50%	10.98%	11.13%	14.14%
90%	7.70	47.34%	C	12.50%	9.76%	11.28%	14.89%

Effect of Moving to the Optimal on Firm Value

- Re-estimate firm value at each debt ratio, using the new cost of capital.
  - For a stable growth firm, this would be

    Firm Value = CF to Firm (1 + g) / (WACC -g)
  - For a high growth firm, this would require that the cash flows during the high growth phase be estimated and discounted back.
- Estimate the annual savings in financing costs from the change in cost of capital and compute the present value of these savings in perpetuity.
- Annual Savings = (Cost of capital$_{before}$ - Cost of capital$_{after}$) Firm Value
  - If you assume no growth in firm value, this would yield

    Annual Saving / Cost of capital$_{after}$
  - If you assume perpetual growth in savings, this would yield

    Annual Saving / (Cost of capital$_{after}$-g)

But what growth rate do we use? One solution

- The estimate of growth used in valuing a firm can clearly have significant implications for the final number.
- One way to bypass this estimation is to estimate the growth rate implied in today's market value. For instance,
  - Boeing's current market value = 32,595 + 8,194 = $ 40,789 million
  - Boeing's free cash flow to the firm = $1,176 million
  - Boeing's current cost of capital = 9.17%

  Assuming a perpetual growth model,

  Firm Value = Cash flow to firm (1+g) / (Cost of capital - g)

  40,789 = 1,176 (1+g)/(.0917-g)

  Solving for g,

  Implied growth rate = .0611 or 6.11%

Change in Firm Value for Boeing: Firm Valuation Approach

- Boeing's free cash flow to the firm = $1,176 million
- Boeing's implied growth rate = 6.11%
- New cost of capital = 9.16%
- Boeing's new firm value = 1,176 *1.0611/(.0916-.0611)
  = $ 40,990 million
- Boeing's current firm value = $ 40,789 million
- Change in firm value = $ 40,990 - $40,789 = $201 million

Effect on Firm Value on Boeing: Annual Savings Approach

- Firm Value before the change = 32,595 + 8,194 = $ 40,789 million

  $WACC_b$ = 9.17% Annual Cost = $62,068 *12.22%= $7,583 million

  $WACC_a$ = 9.16% Annual Cost = $62,068 *11.64% = $7,226 million

  Δ WACC = 0.01% Change in Annual Cost = $ 6.14 million

- If there is no growth in the firm value, (Conservative Estimate)
  - Increase in firm value = $ 6.14 / .0916 = $ 67 million
  - Change in Stock Price = $ 67 /1010.7= $ 0.07 per share
- If there is growth (of 6.11%) in firm value over time,
  - Increase in firm value = $ 6.14 /(.0916-.0611) = $ 206 million
  - Change in Stock Price = $206/1010.7 = $ 0.20 per share

Effect on Firm Value of Moving to the Optimal: The Home Depot

- Firm Value before the change = 85,668 + 4,081 = $ 89,749 million

  $WACC_b$ = 9.51% Annual Cost = $89,749 *9.51%= $ 8,537 million

  $WACC_a$ = 9.23% Annual Cost = $89,749 *9.23% =$ 8,281 million

  Δ WACC = 0.28% Change in Annual Cost = $ 256 million

- If there is growth (of 6%) in firm value over time,
  - Increase in firm value = $ 256 (1.06) /(.0923-.06) = $ 8,406 million
  - Change in Stock Price = $ 8,406/1478.63 = $ 5.69 per share

A Test: The Repurchase Price

- Let us suppose that the CFO of The Home Depot approached you about buying back stock. He wants to know the maximum price that he should be willing to pay on the stock buyback. (The current price is $ 57.94) Assuming that firm value will grow by 6% a year, estimate the maximum price.

- What would happen to the stock price after the buyback if you were able to buy stock back at $ 57.94?

The Downside Risk

- Doing What-if analysis on Operating Income
  - A. Standard Deviation Approach
    - Standard Deviation In Past Operating Income
    - Standard Deviation In Earnings (If Operating Income Is Unavailable)
    - Reduce Base Case By One Standard Deviation (Or More)
  - B. Past Recession Approach
    - Look At What Happened To Operating Income During The Last Recession. (How Much Did It Drop In % Terms?)
    - Reduce Current Operating Income By Same Magnitude
- Constraint on Bond Ratings

Boeing's Operating Income History

Year	EBITDA	% Change
1989	$ 1,217	19.54%
1990	$ 2,208	81.46%
1991	$ 2,785	26.15%
1992	$ 2,988	7.30%
1993	$ 2,722	-8.91%
1994	$ 2,302	-15.42%
1995	$ 1,998	-13.21%
1996	$ 3,750	87.69%
1997	$ 2,301	-38.64%
1998	$ 3,106	34.98%

Boeing: Operating Income and Optimal Capital Structure

% Drop in EBITDA	*EBITDA*	*Optimal Debt Ratio*
0%	$ 3,268	30%
5%	$ 3,105	20%
10%	$ 2,941	20%
15%	$ 2,778	10%
20%	$ 2,614	0%

Constraints on Ratings

- Management often specifies a 'desired Rating' below which they do not want to fall.
- The rating constraint is driven by three factors
  - it is one way of protecting against downside risk in operating income (so do not do both)
  - a drop in ratings might affect operating income
  - there is an ego factor associated with high ratings
- Caveat: Every Rating Constraint Has A Cost.
  - Provide Management With A Clear Estimate Of How Much The Rating Constraint Costs By Calculating The Value Of The Firm Without The Rating Constraint And Comparing To The Value Of The Firm With The Rating Constraint.

Ratings Constraints for Boeing

- Assume that Boeing imposes a rating constraint of BBB or greater.
- The optimal debt ratio for Boeing is then 20% (see next page)
- The cost of imposing this rating constraint can then be calculated as follows:

Value at 30% Debt	= $ 41,003 million
- Value at 20% Debt	= $ 39,416 million
Cost of Rating Constraint	= $ 1,587 million

What if you do not buy back stock..

- The optimal debt ratio is ultimately a function of the underlying riskiness of the business in which you operate and your tax rate
- Will the optimal be different if you took projects instead of buying back stock?
  - NO. As long as the projects financed are in the same business mix that the company has always been in and your tax rate does not change significantly.
  - YES, if the projects are in entirely different types of businesses or if the tax rate is significantly different.

Analyzing Financial Service Firms

- The interest coverage ratios/ratings relationship is likely to be different for financial service firms.
- The definition of debt is messy for financial service firms. In general, using all debt for a financial service firm will lead to high debt ratios. Use only interest-bearing long term debt in calculating debt ratios.
- The effect of ratings drops will be much more negative for financial service firms.
- There are likely to regulatory constraints on capital

Long Term Interest Coverage Ratios for Financial Service Firms

Long Term Interest Coverage Ratio	*Rating is*	*Spread is*	*Operating Income Decline*
< 0.25	D	12.00%	-50%
0.25 - 0.50	C	9.00%	-40%
0.50 - 0.75	CC	7.50%	-40%
0.75 - 0.90	CCC	6.00%	-40%
0.90 - 1.00	B-	5.00%	-25%
1.00 - 1.25	B	4.00%	-20%
1.25 - 1.50	B+	3.00%	-20%
1.50 - 2.00	BB	2.50%	-20%
2.00 - 2.25	BBB	2.00%	-10%
2.25 - 3.00	A-	1.50%	-5%
3.00 - 3.90	A	1.25%	-5%
3.90 - 4.85	A+	1.00%	-5%
4.85 - 6.65	AA	0.70%	-5%
> 6.65	AAA	0.30%	0%

J.P. Morgan: Optimal Capital Structure

Debt Ratio	Cost of Capital	Firm Value
0%	12.39%	$19,333
10%	11.97%	$20,315
20%	11.54%	$20,332
30%	11.19%	$21,265
40%	10.93%	$20,858
50%	10.80%	$18,863
60%	10.68%	$19,198
70%	11.06%	$13,658
80%	13.06%	$10,790
90%	15.76%	$7,001

Analyzing Companies after Abnormal Years

- The operating income that should be used to arrive at an optimal debt ratio is a “normalized” operating income
- A normalized operating income is the income that this firm would make in a normal year.
  - For a cyclical firm, this may mean using the average operating income over an economic cycle rather than the latest year’s income
  - For a firm which has had an exceptionally bad or good year (due to some firm-specific event), this may mean using industry average returns on capital to arrive at an optimal or looking at past years
  - For any firm, this will mean not counting one time charges or profits

Analyzing a Private Firm

- The approach remains the same with important caveats
  - It is far more difficult estimating firm value, since the equity and the debt of private firms do not trade
  - Most private firms are not rated.
  - If the cost of equity is based upon the market beta, it is possible that we might be overstating the optimal debt ratio, since private firm owners often consider all risk.

Estimating the Optimal Debt Ratio for a Private Software Firm

- We first estimate the market value of the firm using the average Value/EBITDA multiple of 21.8 for the software industry and the EBITDA for InfoSoft of $ 3 million:

  Firm Value = $ 3 million * 21.8 = $ 65.4 million

- We then estimate a synthetic rating for the firm, using its current interest coverage ratio and the ratings table designed for smaller and riskier firms. The current interest coverage ratio for InfoSoft was:

  Interest Coverage Ratio = EBIT / Interest Expense = $ 2 million/$ 315,000 = 6.35

Interest Coverage Ratios, Spreads and Ratings: Small Firms

Interest Coverage Ratio	*Rating*	*Spread over T Bond Rate*
> 12.5	AAA	0.20%
9.50-12.50	AA	0.50%
7.5 - 9.5	A+	0.80%
6.0 - 7.5	A	1.00%
4.5 - 6.0	A-	1.25%
3.5 - 4.5	BBB	1.50%
3.0 - 3.5	BB	2.00%
2.5 - 3.0	B+	2.50%
2.0 - 2.5	B	3.25%
1.5 - 2.0	B-	4.25%
1.25 - 1.5	CCC	5.00%
0.8 - 1.25	CC	6.00%
0.5 - 0.8	C	7.50%
< 0.5	D	10.00%

Optimal Debt Ratio for InfoSoft

Debt Ratio	*Beta*	*Cost of Equity*	*Rating*	*Interest rate*	*Cost of Debt (After-tax)*	*Cost of Capital*
0%	1.43	12.87%	AAA	5.20%	3.02%	12.87%
10%	1.52	13.38%	A-	6.25%	3.63%	12.40%
20%	1.64	14.01%	B-	9.25%	5.37%	12.28%
30%	1.82	15.02%	CC	11.00%	7.00%	12.61%
40%	2.16	16.86%	C	12.50%	9.50%	13.91%
50%	2.63	19.48%	D	15.00%	12.60%	16.04%
60%	3.29	23.10%	D	15.00%	13.00%	17.04%
70%	4.39	29.13%	D	15.00%	13.29%	18.04%
80%	6.58	41.20%	D	15.00%	13.50%	19.04%
90%	13.16	77.40%	D	15.00%	13.67%	20.04%

Determinants of Optimal Debt Ratios

- Firm Specific Factors
  - 1. Tax Rate
  - Higher tax rates - - > Higher Optimal Debt Ratio
  - Lower tax rates - - > Lower Optimal Debt Ratio
  - 2. Cash flow generation = EBITDA / MV of Firm
  - Higher Pre-tax Returns - - > Higher Optimal Debt Ratio
  - Lower Pre-tax Returns - - > Lower Optimal Debt Ratio
  - 3. Variance in Earnings [Shows up when you do 'what if' analysis]
  - Higher Variance - - > Lower Optimal Debt Ratio
  - Lower Variance - - > Higher Optimal Debt Ratio
- Macro-Economic Factors
  - 1. Default Spreads

    Higher - - > Lower Optimal Debt Ratio

    Lower - - > Higher Optimal Debt Ratio

Application Test: Your firm's optimal financing mix

- Using the optimal capital structure spreadsheet provided:
  - Estimate the optimal debt ratio for your firm
  - Estimate the new cost of capital at the optimal
  - Estimate the effect of the change in the cost of capital on firm value
  - Estimate the effect on the stock price
- In terms of the mechanics, what would you need to do to get to the optimal immediately?

III. The APV Approach to Optimal Capital Structure

- In the adjusted present value approach, the value of the firm is written as the sum of the value of the firm without debt (the unlevered firm) and the effect of debt on firm value

Firm Value = Unlevered Firm Value + (Tax Benefits of Debt - Expected Bankruptcy Cost from the Debt)

- The optimal dollar debt level is the one that maximizes firm value

Implementing the APV Approach

- Step 1: Estimate the unlevered firm value. This can be done in one of two ways:
  - Estimating the unlevered beta, a cost of equity based upon the unlevered beta and valuing the firm using this cost of equity (which will also be the cost of capital, with an unlevered firm)
  - Alternatively, Unlevered Firm Value = Current Market Value of Firm - Tax Benefits of Debt (Current) + Expected Bankruptcy cost from Debt
- Step 2: Estimate the tax benefits at different levels of debt. The simplest assumption to make is that the savings are perpetual, in which case
  - Tax benefits = Dollar Debt * Tax Rate
- Step 3: Estimate a probability of bankruptcy at each debt level, and multiply by the cost of bankruptcy (including both direct and indirect costs) to estimate the expected bankruptcy cost.

Estimating Expected Bankruptcy Cost

- Probability of Bankruptcy
  - Estimate the synthetic rating that the firm will have at each level of debt
  - Estimate the probability that the firm will go bankrupt over time, at that level of debt (Use studies that have estimated the empirical probabilities of this occurring over time - Altman does an update every year)
- Cost of Bankruptcy
  - The direct bankruptcy cost is the easier component. It is generally between 5-10% of firm value, based upon empirical studies
  - The indirect bankruptcy cost is much tougher. It should be higher for sectors where operating income is affected significantly by default risk (like airlines) and lower for sectors where it is not (like groceries)

Tax Benefits at Debt Ratios

Debt Ratio	*$ Debt*	*Tax Rate*	*Tax Benefits*
0%	$0	35.00%	$0
10%	$4,079	35.00%	$1,428
20%	$8,158	35.00%	$2,855
30%	$12,237	35.00%	$4,283
40%	$16,316	35.00%	$5,710
50%	$20,394	30.05%	$6,128
60%	$24,473	22.76%	$5,571
70%	$28,552	17.17%	$4,903
80%	$32,631	15.02%	$4,903
90%	$36,710	13.36%	$4,903

Tax Benefits capped when interest expenses exceed EBIT

Expected Bankruptcy Costs

Debt Ratio	*Bond Rating*	*Probability of Default*	*Expected Bankruptcy Cost*
0%	AA	0.28%	$32
10%	AA	0.28%	$32
20%	A-	1.41%	$161
30%	BB	12.20%	$1,389
40%	CCC	50.00%	$5,693
50%	CCC	50.00%	$5,693
60%	CC	65.00%	$7,401
70%	C	80.00%	$9,109
80%	C	80.00%	$9,109
90%	C	80.00%	$9,109

Boeing: APV at Debt Ratios

Debt Ratio	*Unlevered Value*	*Tax Benefits*	*Bankruptcy Costs*	*Value of Levered Firm*
0%	$37,953	$0	$32	$37,921
10%	$37,953	$1,428	$32	$39,349
20%	$37,953	$2,855	$161	$40,648
30%	**$37,953**	**$4,283**	**$1,389**	**$40,847**
40%	$37,953	$5,710	$5,693	$37,970
50%	$37,953	$6,128	$5,693	$38,388
60%	$37,953	$5,571	$7,401	$36,123
70%	$37,953	$4,903	$9,109	$33,747
80%	$37,953	$4,903	$9,109	$33,747
90%	$37,953	$4,903	$9,109	$33,747

Exp. Bk. Cst: Expected Bankruptcy cost