Valuation
The Big Picture

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Valuing a Firm

■ The value of the firm is obtained by discounting expected cashflows to the firm, i.e., the residual cashflows after meeting all operating expenses and taxes, but prior to debt payments, at the weighted average cost of capital, which is the cost of the different components of financing used by the firm, weighted by their market value proportio
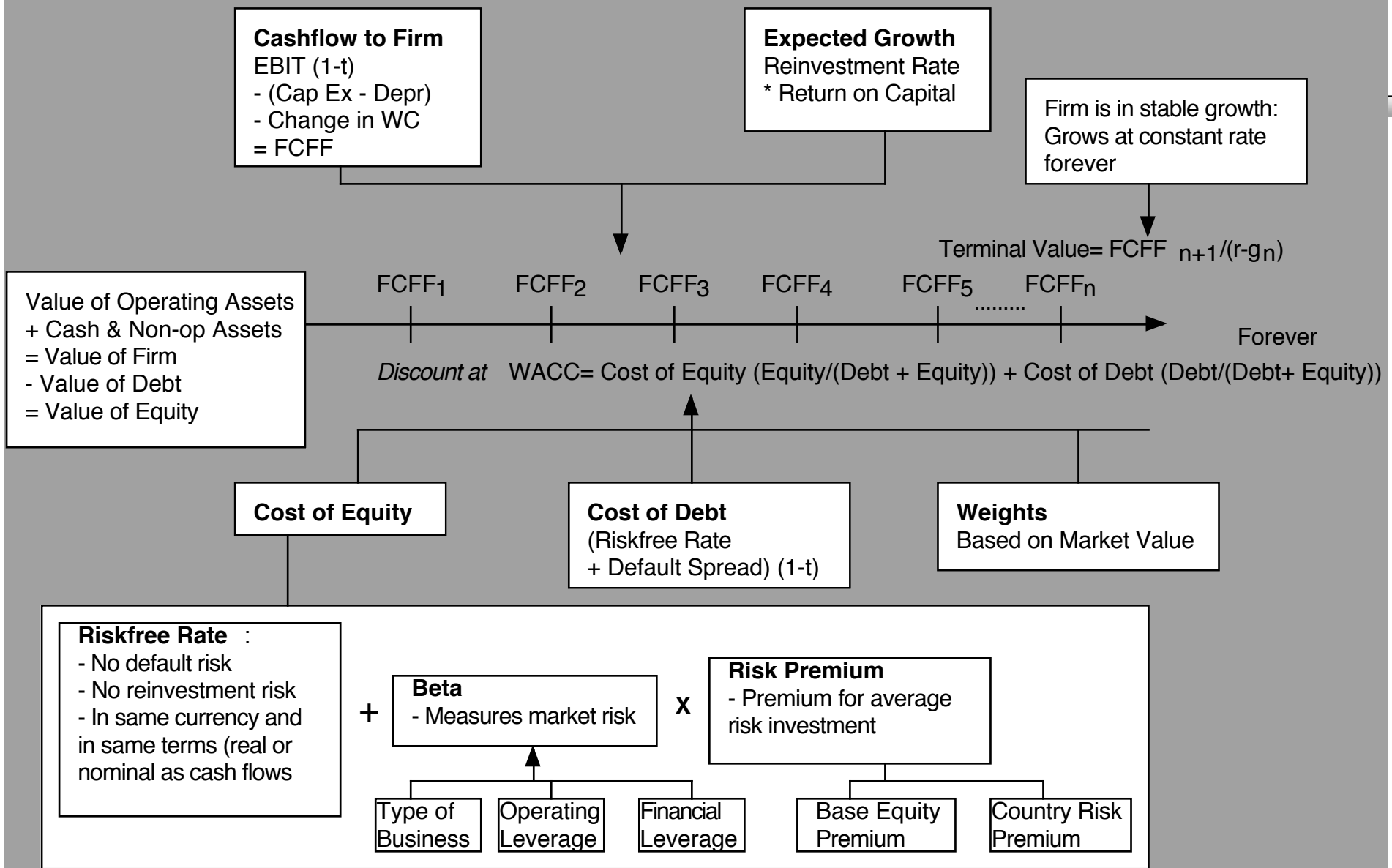
$$\text{Value of Firm} = \sum_{t=1}^{t=n} \frac{\text{CF to Firm}_t}{(1+\text{WACC})^t}$$

where,

CF to Firm$_t$ = Expected Cashflow to Firm in period t

WACC = Weighted Average Cost of Capital

DISCOUNTED CASHFLOW VALUATION

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

Expected Growth
Reinvestment Rate
* Return on Capital

Firm is in stable growth:
Grows at constant rate
forever

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

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

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

Forever

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

Cost of Equity

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

Weights
Based on Market Value

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

+

Beta
- Measures market risk

X

Risk Premium
- Premium for average
risk investment

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

Embraer: Status Quo ($)

Avg Reinvestment rate = 25.08%		Return on Capital 21.85%	

Reinvestment Rate 25.08%

Current Cashflow to Firm
EBIT(1-t) : $ 404
- Nt CpX   23
- Chg WC   9
= FCFF $ 372
Reinvestment Rate = 32/404= 7.9%

Expected Growth in EBIT (1-t)
.2185*.2508=.0548
5.48%

Stable Growth
g = 4.17%; Beta = 1.00;
Country Premium= 5%
Cost of capital = 8.76%
ROC= 8.76%; Tax rate=34%
Reinvestment Rate=g/ROC
       =4.17/8.76= 47.62%

Terminal Value$_5$= 288/(.0876-.0417) = 6272

$ Cashflows

Op. Assets $ 5,272
+ Cash: 795
- Debt   717
- Minor. Int.   12
=Equity   5,349
-Options   28
Value/Share $7.47
R$ 21.75

Year	1	2	3	4	5	Term Yr
EBIT(1-t)	426	449	474	500	527	549
- Reinvestment	107	113	119	126	132	- 261
= FCFF	319	336	355	374	395	= 288

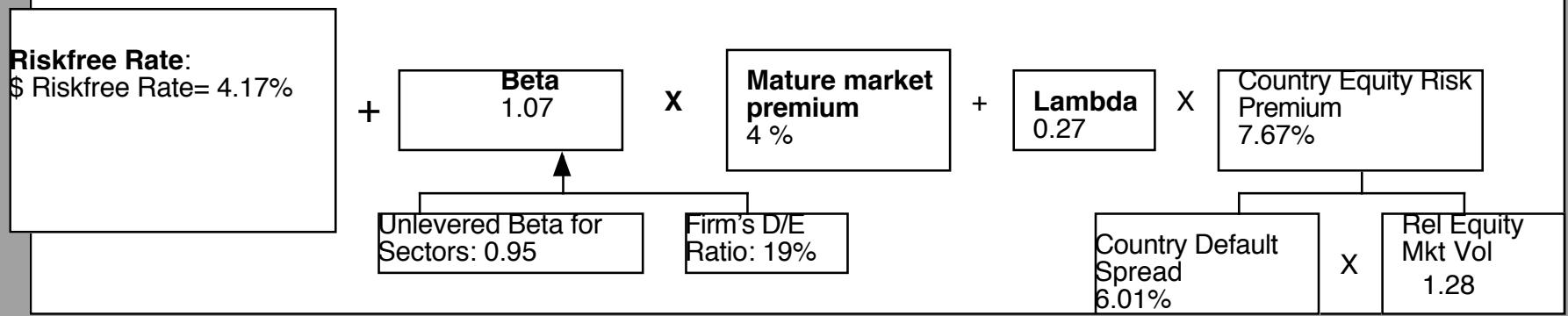*Discount at* $ Cost of Capital (WACC) = 10.52% (.84) + 6.05% (0.16) = 9.81%

On October 6, 2003
Embraer Price = R$15.51

Cost of Equity
10.52%

Cost of Debt
(4.17%+1%+4%)(1-.34)
= 6.05%

Weights
E = 84% D = 16%

Riskfree Rate:
$ Riskfree Rate= 4.17%

+

Beta 1.07

X

Mature market premium 4 %

+

Lambda 0.27

X

Country Equity Risk Premium 7.67%

Unlevered Beta for Sectors: 0.95

Firm's D/E Ratio: 19%

Country Default Spread 6.01%

X

Rel Equity Mkt Vol 1.28

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Ambev: Status Quo ($)

Current Cashflow to Firm
EBIT(1-t) :   504
- Nt CpX   146
- Chg WC   124
= FCFF $ 233
Reinvestment Rate = 270/504= 53.7%

Reinvestment Rate
53.7%

Return on Capital
16.24%

Expected Growth in EBIT (1-t)
.537*.1624=.0872
8.72%

Stable Growth
g = 4.70%; Beta = 1.00;
Country Premium= 5%
Cost of capital = 9.94%
ROC= 9.94%; Tax rate=34%
Reinvestment Rate=g/ROC
        =4.70/9.94= 47.31%

Terminal Value5= 641/(.0994-.047) = 12,249

$ Cashflows

Op. Assets $ 6546
+ Cash: 743
- Debt   1848
- Minor. Int.   137
=Equity   5304
-Options   0
Value/Sh $137.62
        R$ 433/sh

Year	1	2	3	4	5	6	7	8	9	10	Term Yr
EBIT (1-t)	$548	$595	$647	$704	$765	$832	$904	$983	$1069	$1162	1217
- Reinvestment	$294	$320	$348	$378	$411	$447	$486	$528	$574	$624	- 576
FCFF	$253	$276	$300	$326	$354	$385	$419	$455	$495	$538	= 641

Discount at $ Cost of Capital (WACC) = 11.41% (.84) + 7.06% (0.16) = 10.70%

**Cost of Equity
11.41%**

Cost of Debt
(4.70%+2%+4%)(1-.34)
= 7.06%

Weights
E = 84% D = 16%

On May 24, 2004
Ambev Common = R$1140
Ambev Pref = 500

Riskfree Rate:
$ Riskfree Rate= 4.70%

+

Beta
0.87

X

Mature market premium
4 %

+

Lambda
0.41

X

Country Equity Risk Premium
7.87%

Unlevered Beta for Sectors: 0.77

Firm's D/E Ratio: 19.4%

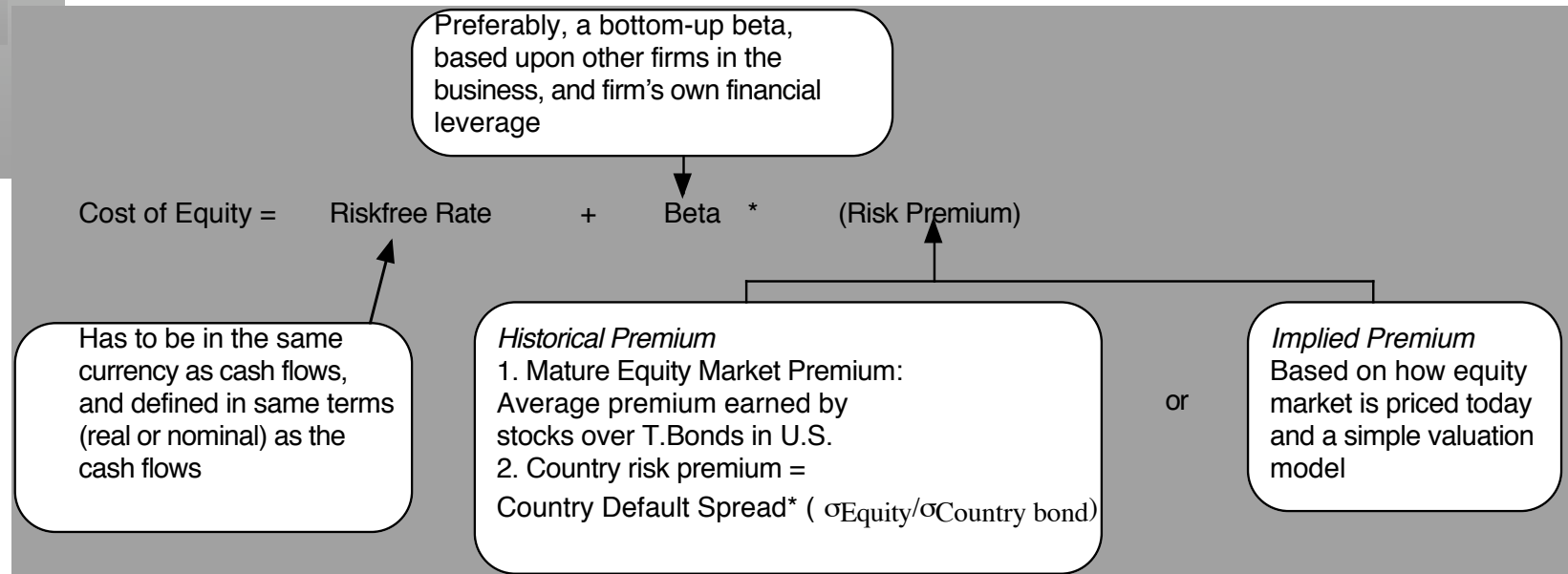Country Default Spread
6.50%

X

Rel Equity Mkt Vol
1.21

I. The Cost of Capital

The Cost of Capital is central to both corporate finance and valuation

- In corporate finance, the cost of capital is important because
  - It operates as the hurdle rate when considering new investments
  - It is the metric that allows firms to choose their optimal capital structure
- In valuation, it is the discount rate that we use to value the operating assets of the firm.

I. The Cost of Equity

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

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

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

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

or

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

A Simple Test

■ You are valuing Ambev in U.S. dollars and are attempting to estimate a risk free rate to use in the analysis. The risk free rate that you should use is

❏ The interest rate on a nominal real denominated Brazilian government bond

❏ The interest rate on an inflation-indexed Brazilian government bond

❏ The interest rate on a dollar denominated Brazilian government bond (11.20%)

❏ The interest rate on a U.S. treasury bond (4.70%)

Everyone uses historical premiums, but..

■ The historical premium is the premium that stocks have historically earned over riskless securities.

■ Practitioners never seem to agree on the premium; it is sensitive to
  • How far back you go in history…
  • Whether you use T.bill rates or T.Bond rates
  • Whether you use geometric or arithmetic averages.

■ For instance, looking at the US:

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

Two Ways of Estimating Country Risk Premiums…

- *Default spread on Country Bond*: In this approach, the country risk premium is based upon the default spread of the bond issued by the country (but only if it is denominated in a currency where a default free entity exists.
  - Brazil was rated B2 by Moody's and the default spread on the Brazilian dollar denominated C.Bond at the end of May 2004 was 6.50%. (11.2%-4.7%)
- *Relative Equity Market approach*: The country risk premium is based upon the volatility of the market in question relative to U.S market.

  Country risk premium = Risk Premium$_{US}$ * $\sigma_{Country\ Equity}$ / $\sigma_{US\ Equity}$

  Using a 4.82% premium for the US, this approach would yield:

  Total risk premium for Brazil = 4.82% (29.24%/18.59%) = 7.58%

  Country risk premium for Brazil = 7.58% - 4.82% = 2.76%

  (The standard deviation in weekly returns from 2001 to 2003 for the Bovespa was 29.24% whereas the standard deviation in the S&P 500 was 18.59%)

And a third approach

■ Country ratings measure default risk. While default risk premiums and equity risk premiums are highly correlated, one would expect equity spreads to be higher than debt spreads.

■ Another is to multiply the bond default spread by the relative volatility of stock and bond prices in that market. In this approach:

- Country risk premium = Default spread on country bond* $\sigma_{Country\ Equity}$ / $\sigma_{Country\ Bond}$
  - Standard Deviation in Bovespa (Equity) = 29.24%
  - Standard Deviation in Brazil C-Bond = 24.15%
  - Default spread on C-Bond = 6.50%
- Country Risk Premium for Brazil = 6.50% (29.24%/24.15%) = 7.87%

From Country Spreads to Corporate Risk premiums

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

E(Return) = Riskfree Rate + Country Spread + Beta (US premium)

   Implicitly, this is what you are assuming when you use the local Government's dollar borrowing rate as your riskfree rate.

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

E(Return) = Riskfree Rate + Beta (US premium + Country Spread)

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

   E(Return)=Riskfree Rate+ β (US premium) + λ (Country Spread)

Estimating Company Exposure to Country Risk: Determinants

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

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

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

Estimating Lambdas: The Revenue Approach

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

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

- ■ Consider, for instance, Embraer, Embratel and Ambev, all of which are incorporated and traded in Brazil. Embraer gets 3% of its revenues from Brazil, Embratel gets almost all of its revenues in Brazil and Ambev gets about 92% of its revenues in Brazil. The average Brazilian company gets about 77% of its revenues in Brazil:

  - • Lambda$_{Embraer}$ = 3%/ 77% = .04
  - • Lambda$_{Embratel}$ = 100%/77% = 1.30
  - • Lambda$_{Ambev}$ = 92%/77% = 1.19

- ■ There are two implications

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

Estimating Lambdas: Earnings Approach

Figure 2: EPS changes versus Country Risk: Embraer and Embratel
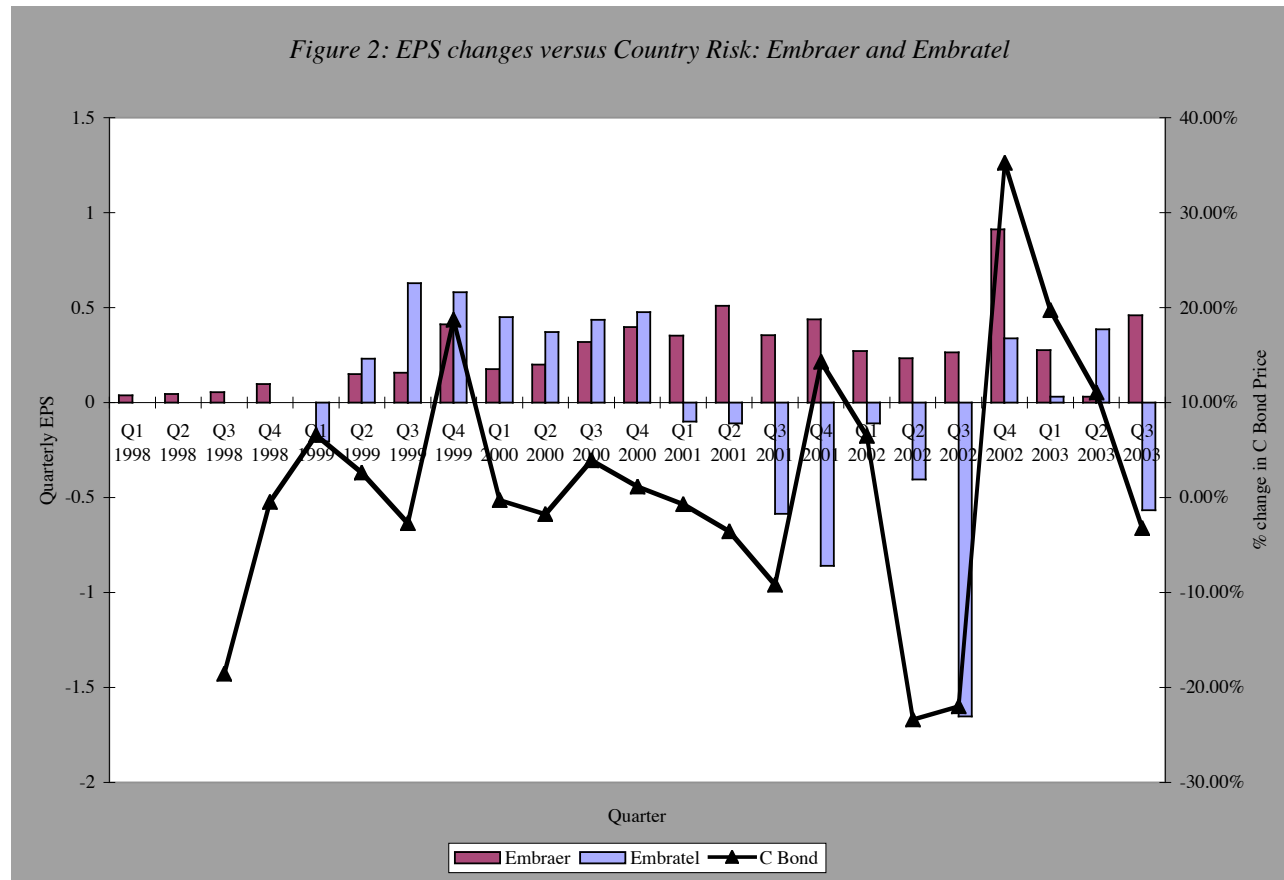
Estimating Lambdas: Stock Returns versus C-Bond Returns

$Return_{Embraer} = 0.0195 + \textbf{0.2681}\ Return_{C\ Bond}$

$Return_{Ambev} = 0.0290 + \textbf{0.4136}\ Return_{C\ Bond}$

$Return_{Vale} = 0.02169 \textbf{+ 0.3760}.Return_{C\ Bond}$

$Return_{Embratel} = -0.0308 + \textbf{2.0030}\ Return_{C\ Bond}$

$Return_{Petrobras} = -0.0308 + \textbf{0.6600}\ Return_{C\ Bond}$

Embraer versus C Bond: 2000-2003
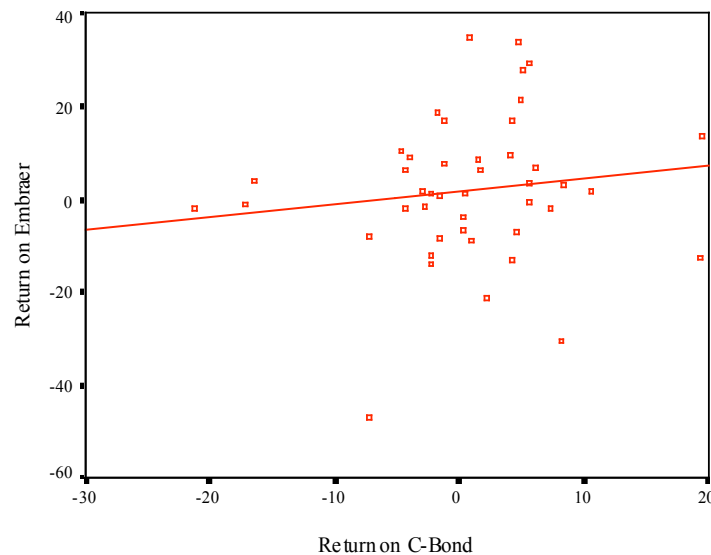
Embratel versus C Bond: 2000-2003
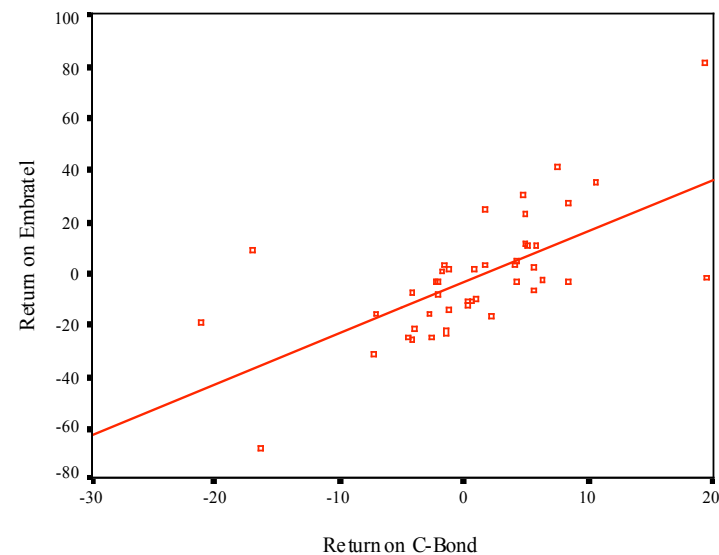
Estimating a US Dollar Cost of Equity for Ambev

- Assume that the beta for Ambev is 0.87, and that the riskfree rate used is 4.70%. Also assume that the risk premium for the US is 4.82% and the country risk premium for Brazil is 7.87%.
- Approach 1: Assume that every company in the country is equally exposed to country risk. In this case,

E(Return) = 4.70% + 0.87(4.82%) + 7.87% = 16.76%

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

E(Return) = 4.70 % + 0.87 (4.82%+ 7.87%) = 15.74%

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

E(Return) = 4.70% + 0.87(4.82%) + 0.41 (7.87%) = 12.12%

Implied Equity Premium for the S&P 500: January 1, 2004

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

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

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

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

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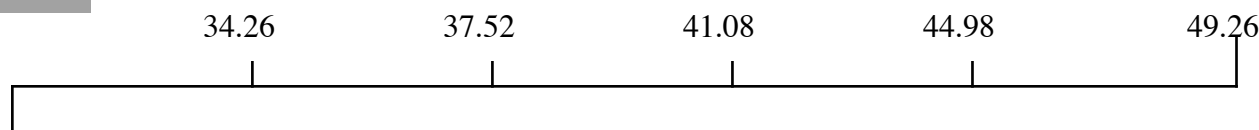
January 1, 2004
S&P 500 is at 1111.91

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

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

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

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Implied Premiums in the US

Implied Premium for US Equity
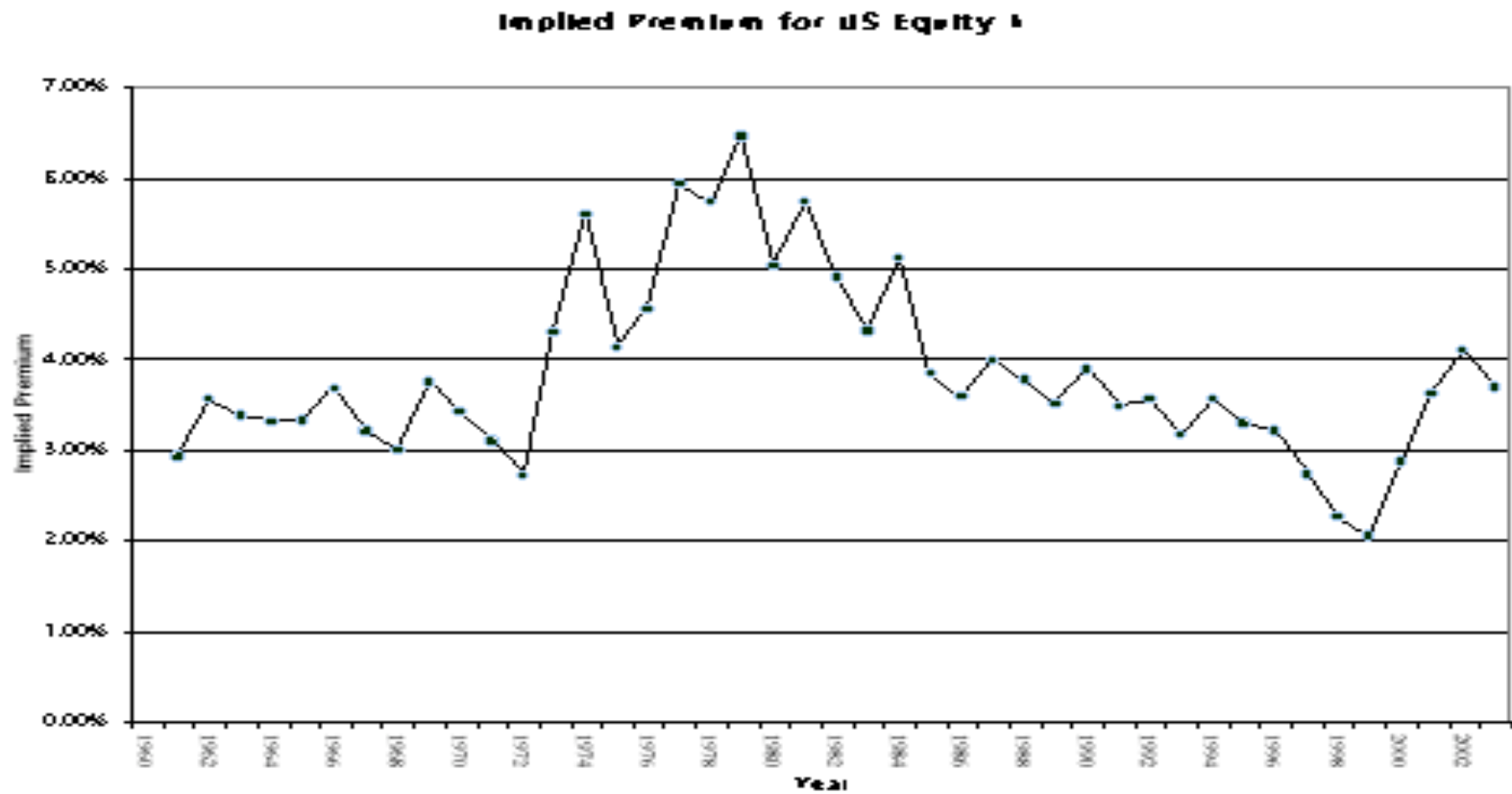
Implied Premiums: From Bubble to Bear Market… January 2000 to December 2002

Implied Equity Risk Premiums: Monthly - January 2000 to January 2003
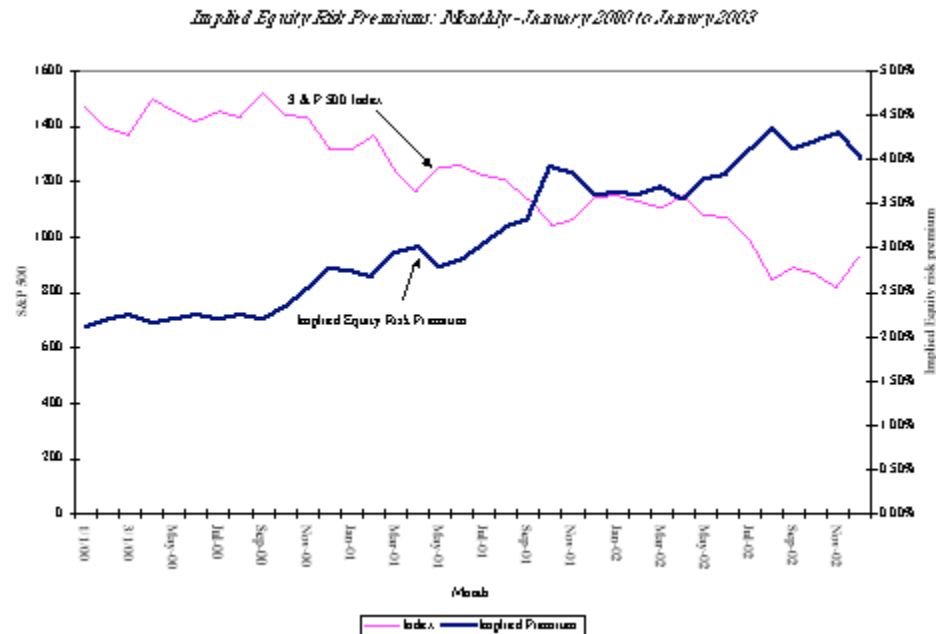
An Intermediate Solution

- The historical risk premium of 4.82% for the United States is too high a premium to use in valuation. It is much higher than the actual implied equity risk premium in the market

- The current implied equity risk premium requires us to assume that the market is correctly priced today. (If I were required to be market neutral, this is the premium I would use)

- The average implied equity risk premium between 1960-2003 in the United States is about 4%. We will use this as the premium for a mature equity market.

Implied Premium for Brazil: May 2004

- Level of the Index = 22236
- Dividends on the Index = 5.17% of 22236
- Other parameters (all in US dollars)
  - Riskfree Rate = 4.70%
  - Expected Growth (in dollars)
    - Next 5 years = 14% (Used expected growth rate in Earnings for ADRs)
    - After year 5 = 5.20% (Slightly higher than riskfree rate because of higher expected real growth)
- Solving for the expected return:
  - Expected return on Equity = 12.96%
  - Implied Equity premium = 12.96% - 4.70% = 8.26%
  - Implied Equity premium for US on same day = 3.95%
  - Implied country premium for Brazil = 4.31%

Estimating Beta

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

$$R_j = a + b\ R_m$$

• where a is the intercept and b is the slope of the regression.

■ The slope of the regression corresponds to the beta of the stock, and measures the riskiness of the stock.

■ This beta has three problems:

• It has high standard error

• It reflects the firm's business mix over the period of the regression, not the current mix

• It reflects the firm's average financial leverage over the period rather than the current leverage.

Beta Estimation : The Index Effect

HISTORICAL BETA

TNLP4   BZ Equity   TELE NORTE LESTE PART-PREF

Relative Index   IBOV   BRAZIL BOVESPA STOCK IDX
                              *Identifies latest observation

Period   Weekly
Range 5/31/02 To 5/21/04
Market   Trade

Y = 1.12 X - 0.32

ADJ BETA   1.08
RAW BETA   1.12
Alpha(Intercept)   -0.32
R2 (Correlation)   0.84
Std Dev of Error   2.21
Std Error of Beta   0.05
Number of Points   103

ADJ BETA = (0.67) * RAW BETA
          + (0.33) * 1.0

Determinants of Betas

Beta of Equity (Levered Beta)

Beta of Firm (Unlevered Beta)

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

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

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

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

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

Implciations
Highly levered firms should have highe betas than firms with less debt.
Equity Beta (Levered beta) =
Unlev Beta (1 + (1- t) (Debt/Equity Ratio))

The Solution: Bottom-up Betas

■ The bottom up beta can be estimated by :
  - Taking a weighted (by sales or operating income) average of the unlevered betas of the different businesses a firm is in.

$$\sum_{j=1}^{j=k} \beta_j \left[\frac{\text{Operating Income}_j}{\text{Operating Income}_{\text{Firm}}} \right]$$

  (The unlevered beta of a business can be estimated by looking at other firms in the same business)
  - Lever up using the firm's debt/equity ratio

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

■ The bottom up beta will give you a better estimate of the true beta when
  - It has lower standard error ($SE_{\text{average}} = SE_{\text{firm}} / \sqrt{n}$ (n = number of firms)
  - It reflects the firm's current business mix and financial leverage
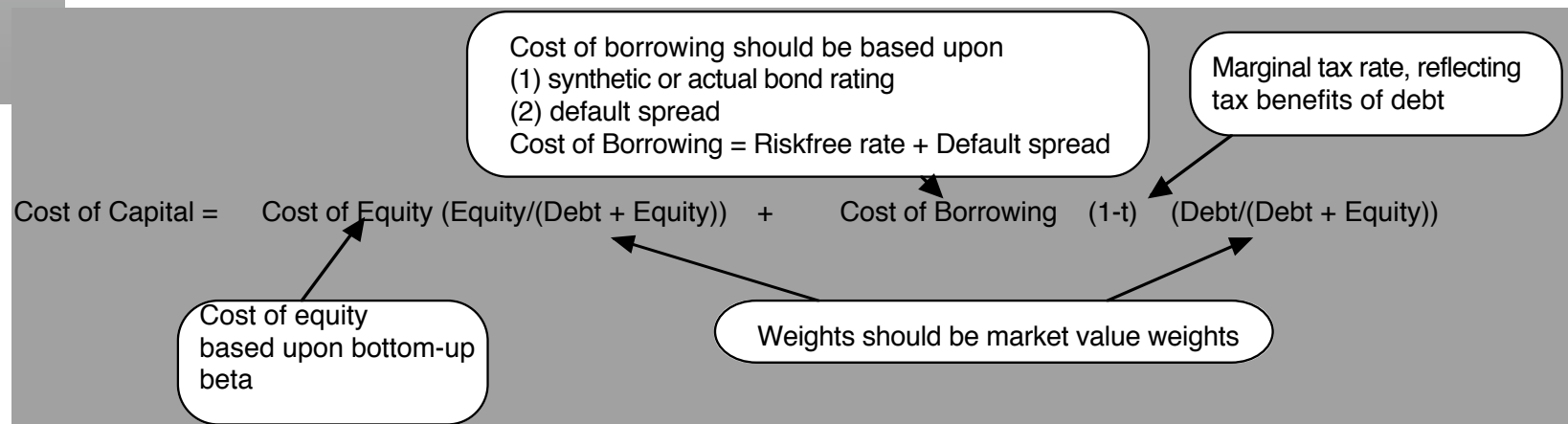 - It can be estimated for divisions and private firms.

Bottom-up Betas: Embraer, Ambev, Vale and Petrobras

Company	Business	Unlevered beta	D/E Ratio	Weights	Levered Beta
Embraer	Aerospace	0.95	18.95%	100%	1.07
Ambev	Alcoholic beverages	0.75	19.43%	80%	0.85
	Soft Drinks	0.85	19.43%	20%	0.96
	Company	0.77	19.43%		0.87
Vale	Mining	0.98	25.66%	71%	1.15
	Aluminum	0.72	25.66%	9%	0.84
	Steel	0.63	25.66%	14%	0.74
	Transportation	0.73	25.66%	5%	0.85
	Other	0.74	25.66%	1%	0.87
	Company	0.89	25.66%	100%	1.04
Petrobras	Integrated Oil	0.56	49.58%	100%	0.74

Gross Debt versus Net Debt Approaches: Embraer in October 2003

- Net Debt Ratio for Embraer = (Debt - Cash)/ Market value of Equity

$$= (1953-2320)/ 11,042 = -3.32\%$$

- Levered Beta for Embraer = 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, though, 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.

From Cost of Equity to Cost of Capital

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

Marginal tax rate, reflecting tax benefits of debt

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

Cost of equity based upon bottom-up beta

Weights should be market value weights

Estimating Synthetic Ratings

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

  Interest Coverage Ratio = EBIT / Interest Expenses

- For Embraer's interest coverage ratio, we used the interest expenses and EBIT from 2002.

  Interest Coverage Ratio = 2166/ 222 = 9.74

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

  Interest Coverage Ratio = 2213/ 570 = 3.88

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

  Interest Coverage Ratio = 6,371/1989 = 3.20

Interest Coverage Ratios, Ratings and Default Spreads

If Interest Coverage Ratio is		Estimated Bond Rating	Default Spread(2003)	Default Spread(2004)
> 8.50	(>12.50)	AAA	0.75%	0.35%
6.50 - 8.50	(9.5-12.5)	AA	1.00%	0.50%
5.50 - 6.50	(7.5-9.5)	A+	1.50%	0.70%
4.25 - 5.50	(6-7.5)	A	1.80%	0.85%
3.00 - 4.25	(4.5-6)	A–	2.00%	1.00%
2.50 - 3.00	(4-4.5)	BBB	2.25%	1.50%
2.25- 2.50	(3.5-4)	BB+	2.75%	2.00%
2.00 - 2.25	((3-3.5)	BB	3.50%	2.50%
1.75 - 2.00	(2.5-3)	B+	4.75%	3.25%
1.50 - 1.75	(2-2.5)	B	6.50%	4.00%
1.25 - 1.50	(1.5-2)	B –	8.00%	6.00%
0.80 - 1.25	(1.25-1.5)	CCC	10.00%	8.00%
0.65 - 0.80	(0.8-1.25)	CC	11.50%	10.00%
0.20 - 0.65	(0.5-0.8)	C	12.70%	12.00%
< 0.20	(<0.5)	D	15.00%	20.00%

The first number under interest coverage ratios is for larger market cap companies and the second in brackets is for smaller market cap companies. For Embraer and Ambev , I used the interest coverage ratio table for smaller/riskier firms (the numbers in brackets) which yields a lower rating for the same interest coverage ratio.

Estimating the cost of debt

Company	EBIT	Interest Expense	Interest Coverage	Rating	Company Spread	Country Spread	Cost of Debt($)
Embraer (2003)	2166	222	9.76	AA	1.00%	4%	9.17%
Ambev	2213	570	3.88	BB+	2.00%	4%	10.70%
Vale	6371	1989	3.20	BB	2.50%	4%	11.20%
Petrobras	14974	3195	4.69	A-	1%	4%	9.70%

Riskfree Rate = 4.17% for Embraer in 2003, 4.70% for all other firms

Cost of debt ($) = Riskfree Rate + Company Spread + Country Spread

(I have assumed that all of these companies will have to bear only a portion of the total country default spread of Brazil which is 4.50%)

Weights for the Cost of Capital Computation

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

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

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

Estimating Cost of Capital: Embraer

- Equity
  - Cost of Equity = 4.17% + 1.07 (4%) + 0.27 (7.67%) = 10.52%
  - Market Value of Equity =11,042 million BR ($ 3,781 million)
- Debt
  - Cost of debt = 4.17% + 4.00% +1.00%= 9.17%
  - Market Value of Debt = 2,093 million BR ($717 million)
- Cost of Capital

  Cost of Capital = 10.52 % (.84) + 9.17% (1- .34) (0.16)) = 9.81%

The book value of equity at Embraer is 3,350 million BR.

The book value of debt at Embraer is 1,953 million BR; Interest expense is 222 mil; Average maturity of debt = 4 years

Estimated market value of debt = 222 million (PV of annuity, 4 years, 9.17%) + $1,953 million/$1.0917^4$ = 2,093 million BR

Estimating Cost of Capital: Ambev

- **Equity**
  - Cost of Equity = 4.7% + 0.87 (4%) + 0.41 (7.87%) = 11.41%
  - Market Value of Equity = 29,886 million BR ($ 9,508 million)
- **Debt**
  - Cost of debt = 4.7% + 4.00% +2.00%= 10.70%
  - Market Value of Debt = 5,808 million BR ($1,848 million)
- **Cost of Capital**

    Cost of Capital = 11.41 % (.837) + 10.7% (1- .34) (0.163)) = 10.70%

The book value of equity at Ambev is 4,209 million BR.

The book value of debt at Ambev is 5,980 million BR; Interest expense is 570 mil; Average maturity of debt = 3 years

Estimated market value of debt = 570 million (PV of annuity, 3 years, 10.7%) + $5,980 million/$1.107^3$ = 5,808 million BR

Estimating Cost of Capital: Vale

- **Equity**
  - Cost of Equity = 4.7% + 1.04 (4%) + 0.37 (7.87%) = 11.77%
  - Market Value of Equity = 56,442 million BR ($ 17,958 million)
- **Debt**
  - Cost of debt = 4.7% + 4.00% +2.50%= 11.20%
  - Market Value of Debt = 14,484 million BR ($ 4,612 million)
- **Cost of Capital**

Cost of Capital = 11.77 % (.796) + 11.2% (1- .34) (0.204)) = 10.88%

The book value of equity at Vale is 15,937 million BR.

The book value of debt at Vale is 13,709 million BR; Interest expense is 1,989 mil; Average maturity of debt = 2 years

Estimated market value of debt = 1,989 million (PV of annuity, 2 years, 11.2%) + 13,709 million/1.112^2 = 14,484 million BR

Estimating Cost of Capital: Petrobras

- ■ Equity
  - Cost of Equity = 4.70% + 0.79 (4%) + 0.66(7.87%) = 12.58%
  - Market Value of Equity = 85,218 million BR ($ 27,114 million)
- ■ Debt
  - Cost of debt = 4.7% + 4.00% + 1.00%= 9.70%
  - Market Value of Debt = 39,367 million BR ($ 12,537 million)
- ■ Cost of Capital

Cost of Capital = 12.58 % (.684) + 9.7% (1- .34) (0.316)) = 10.63%

The book value of equity at Petrobras is 50.987 million BR.

The book value of debt at Petrobras is 42,248 million BR; Interest expense is 1,989 mil; Average maturity of debt = 4 years

Estimated market value of debt = 3,195 million (PV of annuity, 4 years, 9.7%) + 42,248 million/1.097^4 = 39,367 million BR

If you had to do it….Converting a Dollar Cost of Capital to a Nominal Real Cost of Capital - Ambev

■ Approach 1: Use a BR riskfree rate in all of the calculations above. For instance, if the BR riskfree rate was 12%, the cost of capital would be computed as follows:

- Cost of Equity = 12% + 0.87(4%) + 0.41(7.87%) = 18.71%
- Cost of Debt = 12% + 2% = 14%
- (This assumes the riskfree rate has no country risk premium embedded in it.)

■ Approach 2: Use the differential inflation rate to estimate the cost of capital. For instance, if the inflation rate in BR is 8% and the inflation rate in the U.S. is 2%

$$\text{Cost of capital} = (1 + \text{Cost of Capital}_\$) \left[\frac{1 + \text{Inflation}_{BR}}{1 + \text{Inflation}_\$} \right]$$

$$= 1.107 \ (1.08/1.02)\text{-}1 \quad = 17.21\%$$

II. Valuing Control and Synergy
Acquisition Valuation

It is not what you buy but what you pay for it….

Issues in Acquisition Valuation

■ Acquisition valuations are complex, because the valuation often involved issues like synergy and control, which go beyond just valuing a target firm. It is important on the right sequence, including

- When should you consider synergy?

- Where does the method of payment enter the process.

■ Can synergy be valued, and if so, how?

■ What is the value of control? How can you estimate the value?

The Value of Control

■ Control has value because you think that you can run a firm better than the incumbent management.

■ Value of Control = Value of firm, run optimally - Value of firm, status quo

■ The value of control should be **inversely proportional to the perceived quality** of that management and its capacity to maximize firm value.

■ **Value of control will be much greater for a poorly managed firm** that operates at below optimum capacity than it is for a well managed firm. It should be negligible or firms which are operating at or close to their optimal value

Price Enhancement versus Value Enhancement

Stock price performance of companies that changed their names to include Web-oriented designations like ".com," from 30 trading days before the name-change announcement to 30 days after. The study looked at stocks of companies that changed their names from January 1998 through March 26, 1999.
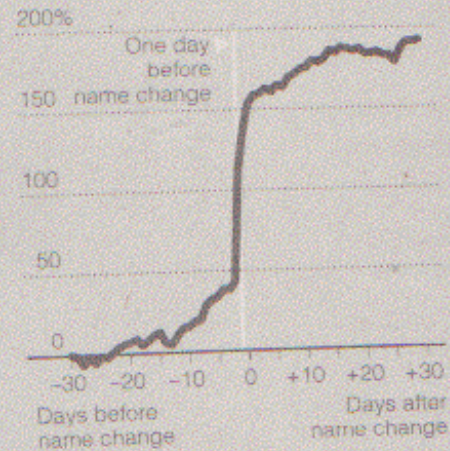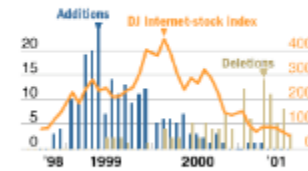
Source: "A Rose.com by Any Other Name," by Michael J. Cooper, P. Raghavendra Rau and Orlin Dimitrov of Purdue University

NAME THAT STOCK

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

New Name, Higher Price
But the stocks still get a bounce when dot-com goes away. Chart shows returns in the days before and after the name change.
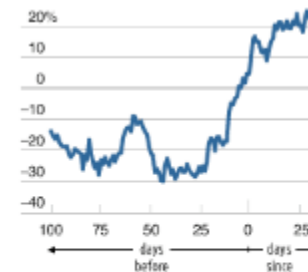
Sources: Thomson Datastream; P. Raghavendra Rau, Michael J. Cooper, Igor Osobov, Purdue Univ.; Ajay Khorana, Virginia Univ.; Ajay Patel, Wake Forest Univ.

Ambev: Status Quo ($)

Return on Capital
16.24%

Reinvestment Rate
53.7%

Expected Growth in EBIT (1-t)
.537*.1624=.0872
8.72%

Stable Growth
g = 4.70%; Beta = 1.00;
Country Premium= 5%
Cost of capital = 9.94%
ROC= 9.94%; Tax rate=34%
Reinvestment Rate=g/ROC
=4.70/9.94= 47.31%

Current Cashflow to Firm
EBIT(1-t) :   504
- Nt CpX   146
- Chg WC   124
= FCFF $ 233
Reinvestment Rate = 270/504= 53.7%

Terminal Value5= 641/(.0994-.047) = 12,249

$ Cashflows

Op. Assets $ 6546
+ Cash: 743
- Debt   1848
- Minor. Int.   137
=Equity   5304
-Options   0
Value/Sh $137.62
            R$ 433/sh

Year	1	2	3	4	5	6	7	8	9	10	Term Yr
											1217
EBIT (1-t)	$548	$595	$647	$704	$765	$832	$904	$983	$1069	$1162	- 576
- Reinvestment	$294	$320	$348	$378	$411	$447	$486	$528	$574	$624	= 641
FCFF	$253	$276	$300	$326	$354	$385	$419	$455	$495	$538	

Discount at $ Cost of Capital (WACC) = 11.41% (.84) + 7.06% (0.16) = 10.70%

Cost of Equity
11.41%

Cost of Debt
(4.70%+2%+4%)(1-.34)
= 7.06%

Weights
E = 84% D = 16%

On May 24, 2004
Ambev Common = R$1140
Ambev Pref = 500

Riskfree Rate:
$ Riskfree Rate= 4.70%

+

Beta
0.87

X

Mature market premium
4 %

+

Lambda
0.41

X

Country Equity Risk Premium
7.87%

Unlevered Beta for Sectors: 0.77

Firm's D/E Ratio: 19.4%

Country Default Spread
6.50%

X

Rel Equity Mkt Vol
1.21

The Paths to Value Creation

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

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

I. Ways of Increasing Cash Flows from Assets in Place

More efficient operations and cost cuttting: Higher Margins

Divest assets that have negative EBIT

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

Revenues

* Operating Margin

= EBIT

- Tax Rate * EBIT

= EBIT (1-t)

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

Live off past over-investment

Better inventory management and tighter credit policies

II. Value Enhancement through Growth

Reinvest more in projects

Do acquisitions

Increase operating margins

Increase capital turnover ratio

Reinvestment Rate

* Return on Capital

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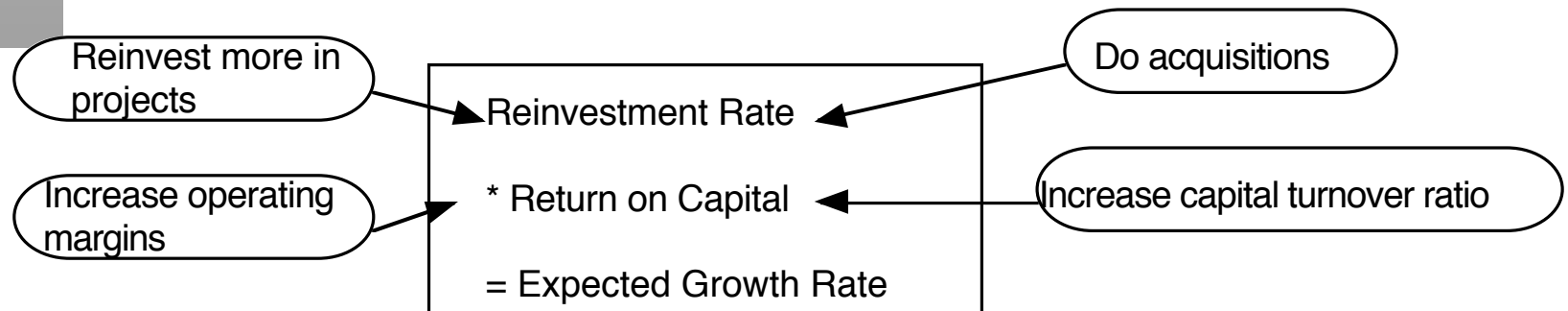
III. Building Competitive Advantages: Increase length of the growth period

Increase length of growth period

```
                    Build on existing          Find new
                    competitive                competitive
                    advantages                 advantages
```

```
   Brand            Legal              Switching          Cost
   name             Protection         Costs              advantages
```
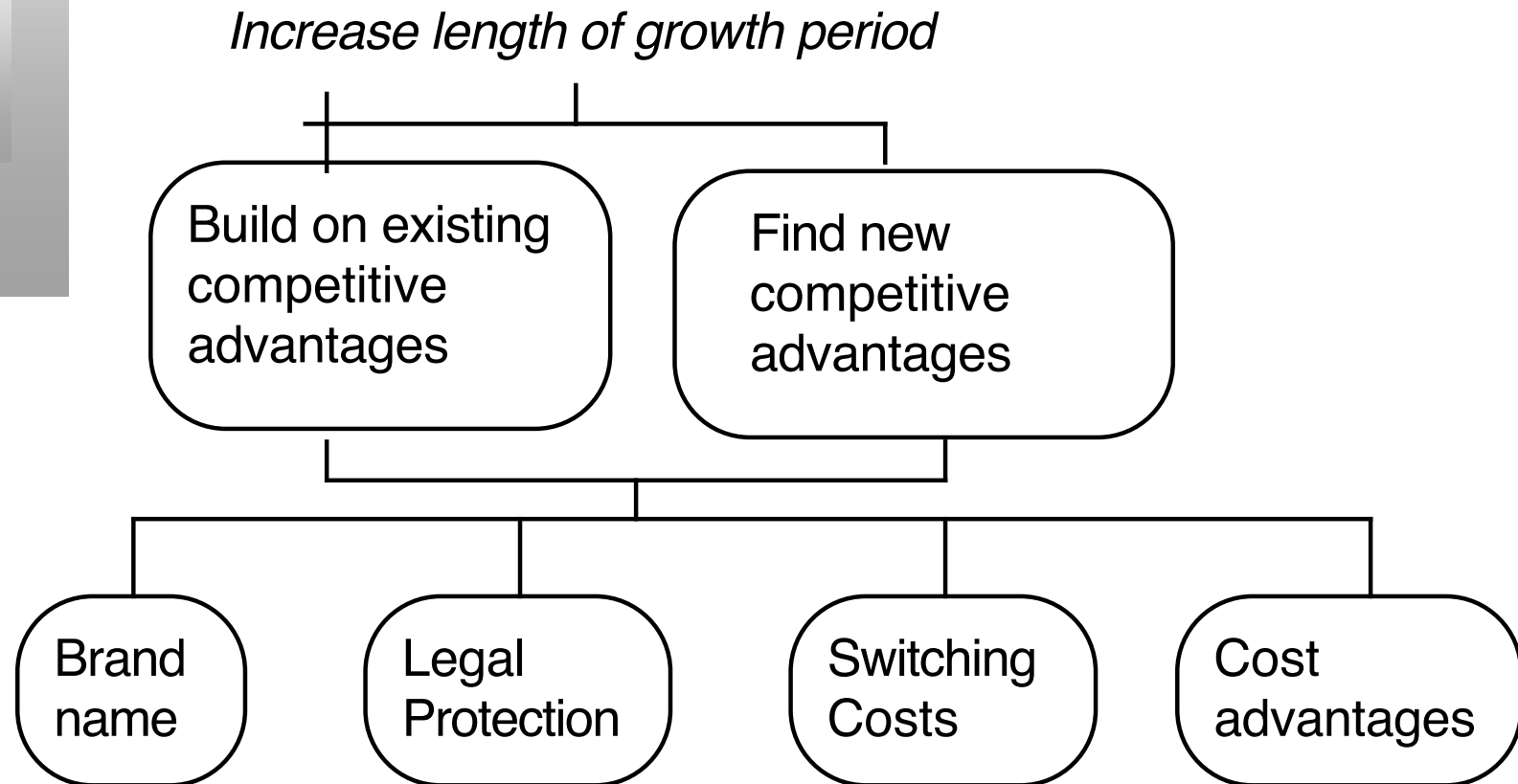
Illustration: Valuing a brand name: Coca Cola

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

Gauging Barriers to Entry

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

Reducing Cost of Capital

Outsourcing

Flexible wage contracts & cost structure

Reduce operating leverage

Change financing mix

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

Make product or service less discretionary to customers

Match debt to assets, reducing default risk

Changing product characteristics

More effective advertising

Swaps

Derivatives

Hybrids
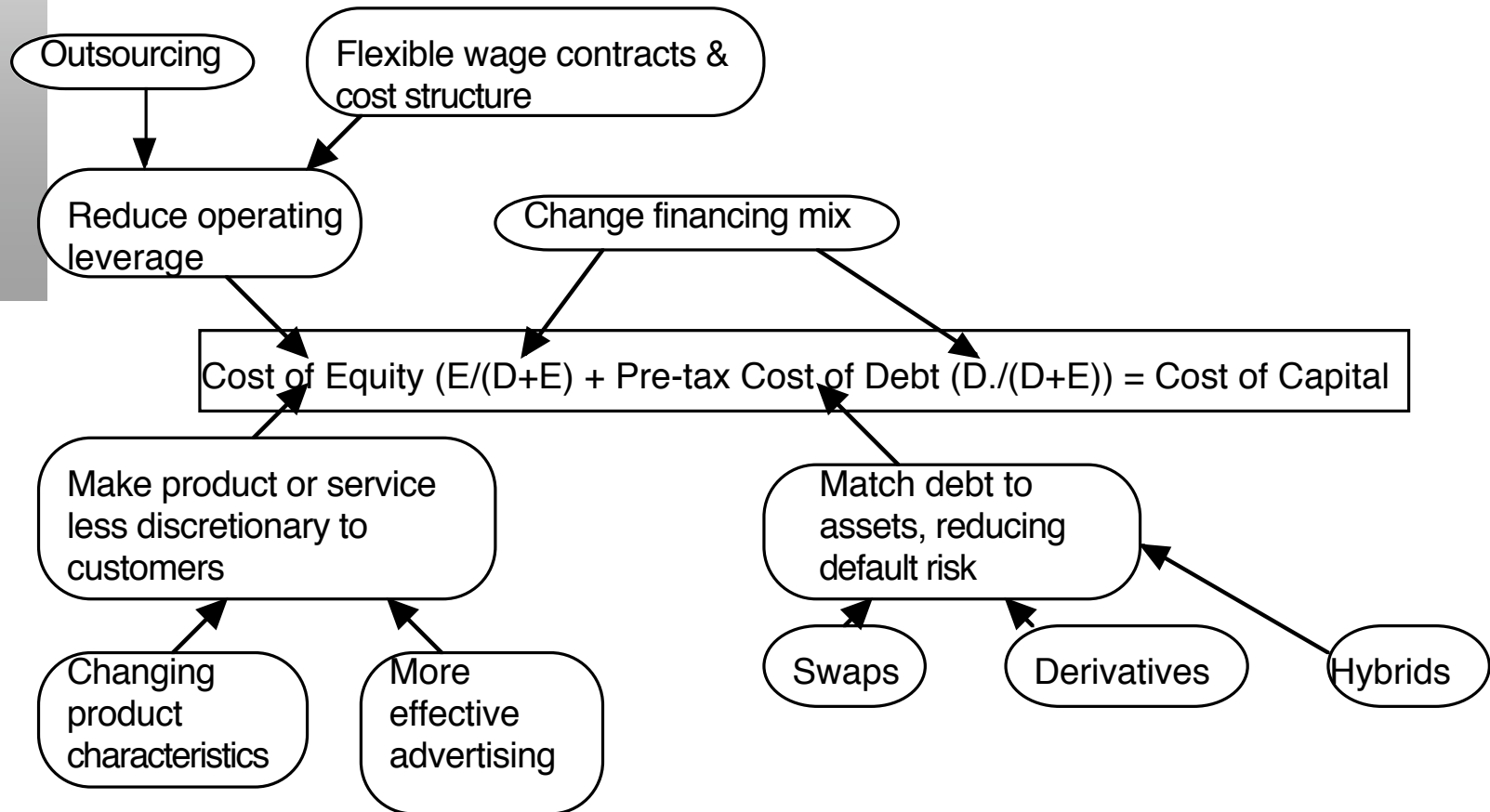
Embraer : Optimal Capital Structure

Debt Ratio	Beta	Cost of Equity	Bond Rating	Interest rate on debt	Tax Rate	Cost of Debt (after-tax)	WACC	Firm Value (G)
0%	0.95	10.05%	AAA	8.92%	34.00%	5.89%	10.05%	$3,577
10%	1.02	10.32%	AAA	8.92%	34.00%	5.89%	9.88%	$3,639
20%	1.11	10.67%	AA	9.17%	34.00%	6.05%	9.75%	$3,690
30%	1.22	11.12%	A	9.97%	34.00%	6.58%	9.76%	$3,686
40%	1.37	11.72%	A-	10.17%	34.00%	6.71%	9.72%	$3,703
50%	1.58	12.56%	B	14.67%	34.00%	9.68%	11.12%	$3,218
60%	1.89	13.81%	CCC	18.17%	34.00%	11.99%	12.72%	$2,799
70%	2.42	15.90%	CC	19.67%	34.00%	12.98%	13.86%	$2,562
80%	3.48	20.14%	CC	19.67%	33.63%	13.05%	14.47%	$2,450
90%	6.95	34.05%	CC	19.67%	29.90%	13.79%	15.81%	$2,236

Ambev: Optimal Capital Structure

Debt Ratio	Beta	Cost of Equity	Bond Rating	Interest rate on debt	Tax Rate	Cost of Debt (after-tax)	WACC	Firm Value (G)
0%	0.85	11.33%	AAA	9.20%	34.00%	6.07%	11.33%	$33,840
10%	0.91	11.58%	AA	9.20%	34.00%	6.07%	11.03%	$35,530
20%	0.99	11.89%	A-	9.70%	34.00%	6.40%	10.79%	$36,966
30%	1.09	12.29%	B-	14.70%	34.00%	9.70%	11.52%	$32,873
40%	1.23	12.83%	CC	18.70%	34.00%	12.34%	12.63%	$28,005
50%	1.49	13.87%	C	20.70%	25.24%	15.48%	14.67%	$21,930
60%	1.95	15.71%	D	28.70%	14.22%	24.62%	21.05%	$12,721
70%	2.59	18.30%	D	28.70%	12.19%	25.20%	23.13%	$11,098
80%	3.89	23.49%	D	28.70%	10.67%	25.64%	25.21%	$9,804
90%	7.78	39.06%	D	28.70%	9.48%	25.98%	27.29%	$8,748

Vale: Optimal Capital Structure

Debt Ratio	Beta	Cost of Equity	Bond Rating	Interest rate on debt	Tax Rate	Cost of Debt (after-tax)	WACC	Firm Value (G)
0%	0.89	11.17%	AAA	9.20%	34.00%	6.07%	11.17%	$67,576
10%	0.95	11.43%	AA	9.20%	34.00%	6.07%	10.89%	$70,723
20%	1.04	11.76%	A+	9.40%	34.00%	6.20%	10.65%	$73,819
30%	1.14	12.18%	A-	9.70%	34.00%	6.40%	10.44%	$76,537
40%	1.28	12.73%	BB	11.20%	34.00%	7.39%	10.60%	$74,451
50%	1.48	13.52%	B-	14.70%	34.00%	9.70%	11.61%	$63,058
60%	1.77	14.69%	CC	18.70%	34.00%	12.34%	13.28%	$50,122
70%	2.35	17.01%	CC	18.70%	29.68%	13.15%	14.31%	$44,418
80%	3.90	23.20%	D	28.70%	15.46%	24.26%	24.05%	$20,372
90%	7.79	38.79%	D	28.70%	13.74%	24.76%	26.16%	$18,043

Aswath Damodaran

Ambev: Restructured ($)

Current Cashflow to Firm
EBIT(1-t) :   504
- Nt CpX   146
- Chg WC   124
= FCFF $ 233
Reinvestment Rate = 270/504= 53.7%

Reinvestment Rate
60%

Return on Capital
18%

**Expected Growth
in EBIT (1-t)**
.60*.18=.108
10.80%

Stable Growth
g = 4.70%; Beta = 1.00;
Country Premium= 5%
Cost of capital = 9.94%
ROC= 9.94%; Tax rate=34%
Reinvestment Rate=g/ROC
     =4.70/9.94= 47.31%

$ Cashflows

Terminal Value$_5$= 766/(.0994-.047) = 14.990

Op. Assets $ 7567
+ Cash: 743
- Debt   1848
- Minor. Int.   137
=Equity   6277
-Options   0
Value/Sh $162.89
        R$ 512/sh

Year	1	2	3	4	5	6	7	8	9	10
EBIT (1-t)	$558	$618	$685	$759	$841	$932	$1,032	$1144	$1,267	$1,404
- Reinvestment	$335	$371	$411	$455	$505	$559	$619	$686	$760	$843
FCFF	$223	$247	$274	$304	$336	$373	$413	$458	$507	$562

Term Yr
1470
- 704
= 766

Discount at $ Cost of Capital (WACC) = 11.53% (.80) + 6.40% (0.20) = 10.50%

**Cost of Equity
11.53%**

Cost of Debt
(4.70%+1%+4%)(1-.34)
= 6.40%

Weights
E = 80% D = 20%

On May 24, 2004
Ambev Common = R$1140
Ambev Pref = 500

Riskfree Rate:
$ Riskfree Rate= 4.70%

+

Beta
0.90

X

**Mature market
premium**
4 %

+

Lambda
0.41

X

Country Equity Risk
Premium
7.87%

Unlevered Beta for
Sectors: 0.77

Firm's D/E
Ratio: 25%

Country Default
Spread
6.50%

X

Rel Equity
Mkt Vol
1.21

Value of stock in a publicly traded firm

■ When a firm is badly managed, the market still assesses the probability that it will be run better in the future and attaches a value of control to the stock price today:

$$\text{Value per share } = \frac{\text{Status Quo Value } + \text{ Probability of control change (Optimal } - \text{ Status Quo Value)}}{\text{Number of shares outstanding}}$$

■ With voting shares and non-voting shares, a disproportionate share of the value of control will go to the voting shares. In the extreme scenario where non-voting shares are completely unprotected:

$$\text{Value per non-voting share } = \frac{\text{Status Quo Value}}{\#\text{ Voting Shares } + \#\text{ Non-voting shares}}$$

$$\text{Value per voting share } = \text{Value of non-voting share } + \frac{\text{Probability of control change (Optimal } - \text{ Status Quo Value)}}{\#\text{ Voting Shares}}$$

Valuing Ambev voting and non-voting shares

- Status Quo Value = $5,304 million* 3.14 = 16,655 million BR
- Optimal Value = $6,277 million *3.14 = 19,710 million BR
- Number of shares
  - Voting =15.735
  - Non-voting =22.801
  - Total = 38.536
- Value/ non-voting share = 16,655/38.536 = 433 BR/share
- Value/ voting share = 433 + (19710-16655)/15.735 = 626 BR/share

Operating Synergy

■ The key to the existence of synergy is that the **target firm controls a specialized resource** that becomes more valuable if combined with the bidding firm's resources. The specialized resource will vary depending upon the merger:

- *In horizontal mergers:* economies of scale, which reduce costs, or from increased market power, which increases profit margins and sales. (Examples: Bank of America and Security Pacific, Chase and Chemical)

- *In vertical integration:* Primary source of synergy here comes from controlling the chain of production much more completely.

- *In functional integration*: When a firm with strengths in one functional area acquires another firm with strengths in a different functional area, the potential synergy gains arise from exploiting the strengths in these areas.

Valuing operating synergy

(a) What **form** is the synergy expected to take? Will it **reduce costs** as a percentage of sales and increase profit margins (as is the case when there are economies of scale)? Will it **increase future growth** (as is the case when there is increased market power)?)

(b) **When can the synergy be reasonably expected to start** affecting cashflows? (Will the gains from synergy show up instantaneously after the takeover? If it will take time, when can the gains be expected to start showing up?)

A procedure for valuing synergy

(1) the firms involved in the merger are **valued independently**, by discounting expected cash flows to each firm at the weighted average cost of capital for that firm.

(2) the **value of the combined firm, with no synergy**, is obtained by adding the values obtained for each firm in the first step.

(3) The **effects of synergy are built into expected growth rates and cashflows**, and the combined firm is re-valued with synergy.

Value of Synergy = Value of the combined firm, with synergy - Value of the combined firm, without synergy

Synergy Effects in Valuation Inputs

If synergy is	Valuation Inputs that will be affected are
Cost Savings	*Operating Margin* of combined firm will be greater than the revenue-weighted operating margin of individual firms.
Growth Synergy	More projects:*Higher Reinvestment Rate* (Retention)
	Better projects: *Higher Return on Capital* (ROC)
	Longer Growth Period
	Again, these inputs will be estimated for the combined firm.

Financial Synergy

- **Sources of Financial Synergy**
  - *Diversification*: Acquiring another firm as a way of reducing risk cannot create wealth for two publicly traded firms, with diversified stockholders, but it could create wealth for private firms or closely held publicly traded firms.
  - *Cash Slack*: When a firm with significant excess cash acquires a firm, with great projects but insufficient capital, the combination can create value.
  - *Tax Benefits*: The tax paid by two firms combined together may be lower than the taxes paid by them as individual firms. This can arise either because of an increase in depreciation, use of tax-loss carryforwards or (as in Brazil) an increase in tax-deductible interest on capital.
  - *Debt Capacity*: It is possible that a combined firm can have higher debt capacity and/or a lower cost of debt that two firms standing alone. This, in turn, will increase firm value.

Structure of the Transaction
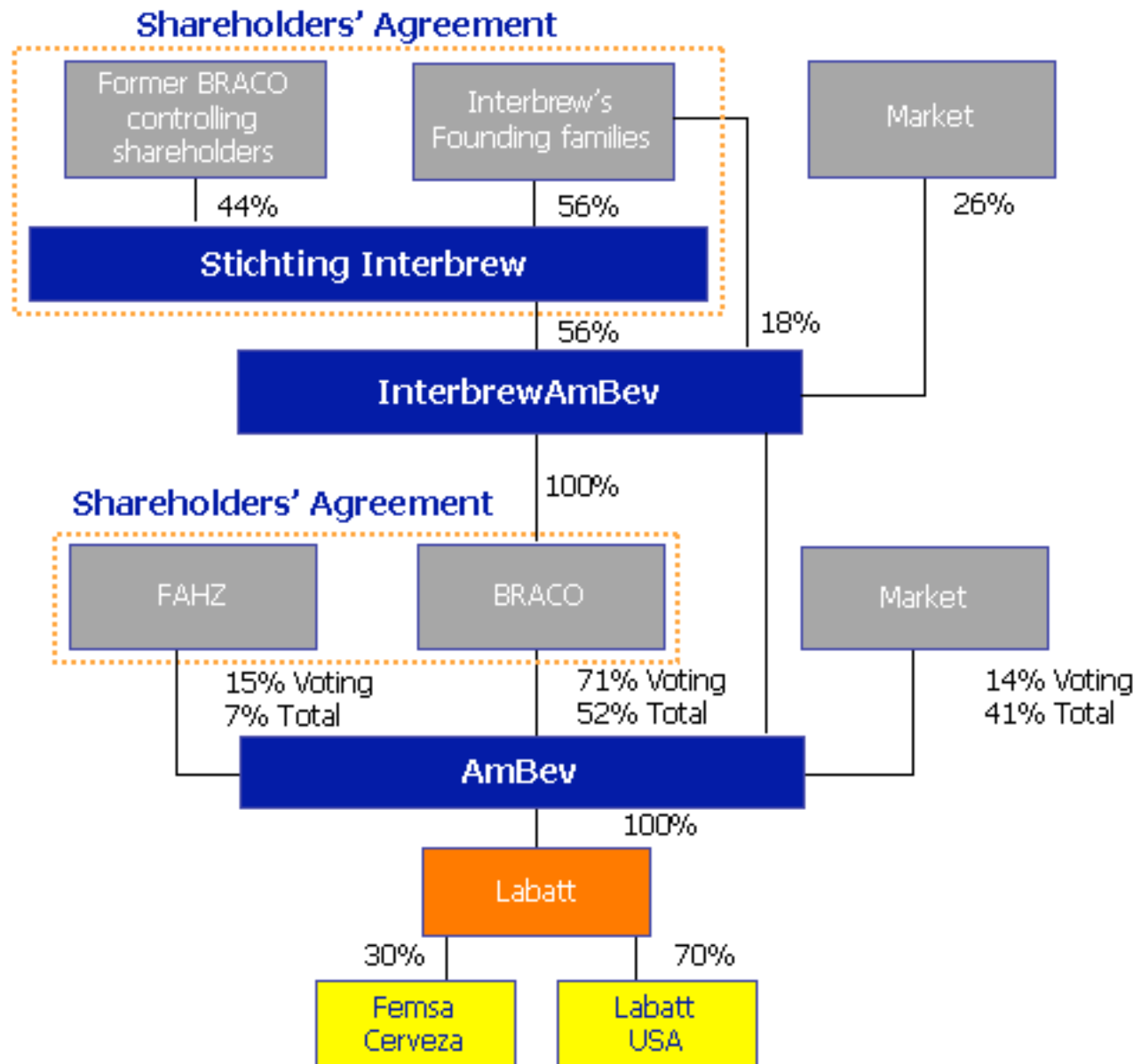
J.P. Morgan's estimate of annual operating synergies in Ambev/Labatt Merger

J.P. Morgan's estimate of total synergies in Labatt/Ambev Merger

Operational Evidence on Synergy

o A stronger test of synergy is to **evaluate whether merged firms improve their performance (profitability and growth),** relative to their competitors, after takeovers.

   o McKinsey and Co. examined 58 acquisition programs between 1972 and 1983 for evidence on two questions -

      o Did the return on the amount invested in the acquisitions exceed the cost of capital?

      o Did the acquisitions help the parent companies outperform the competition?

   o They concluded that **28 of the 58 programs failed both tests**, and 6 failed at least one test.

o KPMG in a more recent study of global acquisitions concludes that most mergers (>80%) fail - the merged companies do worse than their peer group.

o **Large number of acquisitions that are reversed within fairly short time periods**. bout 20.2% of the acquisitions made between 1982 and 1986 were divested by 1988. In studies that have tracked acquisitions for longer time periods (ten years or more) the **divestiture rate of acquisitions rises to almost 50%.**

Labatt DCF valuation

■ Labatt is the Canadian subsidiary of Interbrew and is a mature firm with sold brand names. It can be valued using a stable growth firm valuation model.

■ Base Year inputs
- EBIT (1-t) = $411 million
- Expected Growth Rate = 3%
- Return on capital = 9%
- Cost of capital = 7%

■ Valuation
- Reinvestment Rate = g/ ROC = 3/9= 33.33%
- Value of Labatt = 411 (1-.333)/ (.07-.03) = $6.85 billion

■ Ambev is paying for Labatt with 23.3 billion shares (valued at about $5.8 billion) and is assuming $ 1.5 billion in debt, resulting in a value for the firm of about $ 7.3 billion.

Who gets the benefits of synergy?

Total Synergy = $ 2 billion

Premium paid to Labatt Stockholders = $7.3 billion - $6.85 billion = $ 450 million

Voting Shares in Ambev

Non-voting Shares in Ambev

$1.55 billion to be shared?
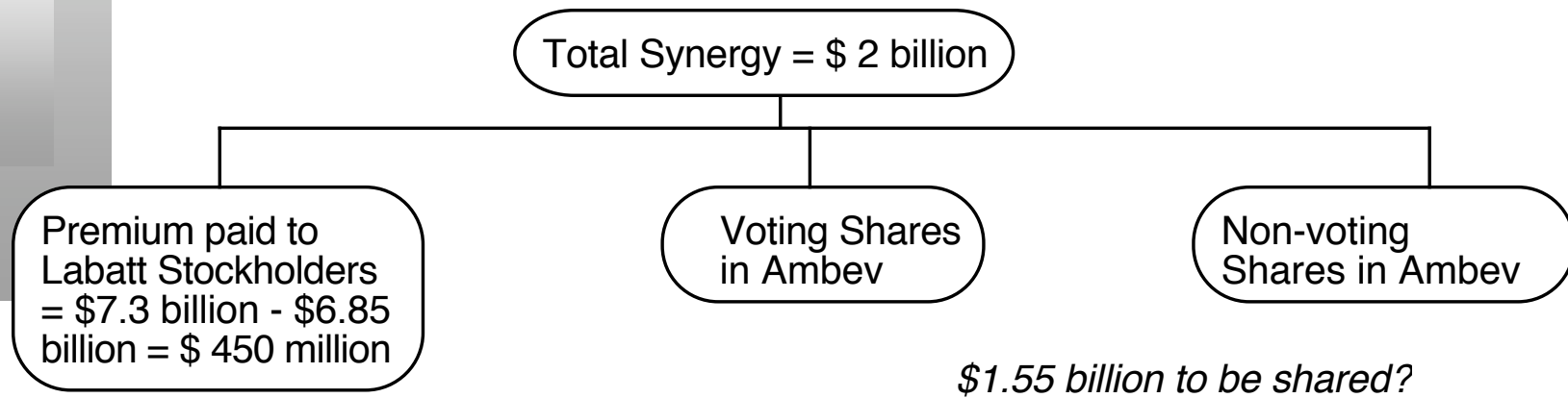
III. Valuing Equity in Cyclical firms and firms with negative earnings : The Search for Normalcy

Aswath Damodaran

http://www.damodaran.com

Begin by analyzing why the earnings are not not normal

A Framework for Analyzing Companies with Negative or Abnormally Low Earnings

Why are the earnings negative or abnormally low?

- Temporary Problems
- Cyclicality: Eg. Auto firm in recession
- Life Cycle related reasons: Young firms and firms with infrastructure problems
- Leverage Problems: Eg. An otherwise healthy firm with too much debt.
- Long-term Operating Problems: Eg. A firm with significant production or cost problems.

Normalize Earnings

- If firm's size has not changed significantly over time
- If firm's size has changed over time

Average Dollar Earnings (Net Income if Equity and EBIT if Firm made by the firm over time

Use firm's average ROE (if valuing equity) or average ROC (if valuing firm) on current BV of equity (if ROE) or current BV of capital (if ROC)

Value the firm by doing detailed cash flow forecasts starting with revenues and reduce or eliminate the problem over time.:
(a) *If problem is structural*: Target for operating margins of stable firms in the sector.
(b) *If problem is leverage*: Target for a debt ratio that the firm will be comfortable with by end of period, which could be its own optimal or the industry average.
(c) *If problem is operating*: Target for an industry-average operating margin.

1. If the earnings decline or increase is temporary and will be quickly reversed… Normalize

■ You can normalize earnings in three ways:

- Company's history: Averaging earnings or operating margins over time and estimating a normalized earning for the base year

- Industry average: You can apply the average operating margin for the industry to the company's revenues this year to get a normalized earnings.

- Normalized prices: If your company is a commodity company, you can normalize the price of the commodity across a cycle and apply it to the production in the current year.

Aracruz in 2001: The Effect of Commodity Prices

Aracruz Celulose: Revenues, Profits and the Price of Paper
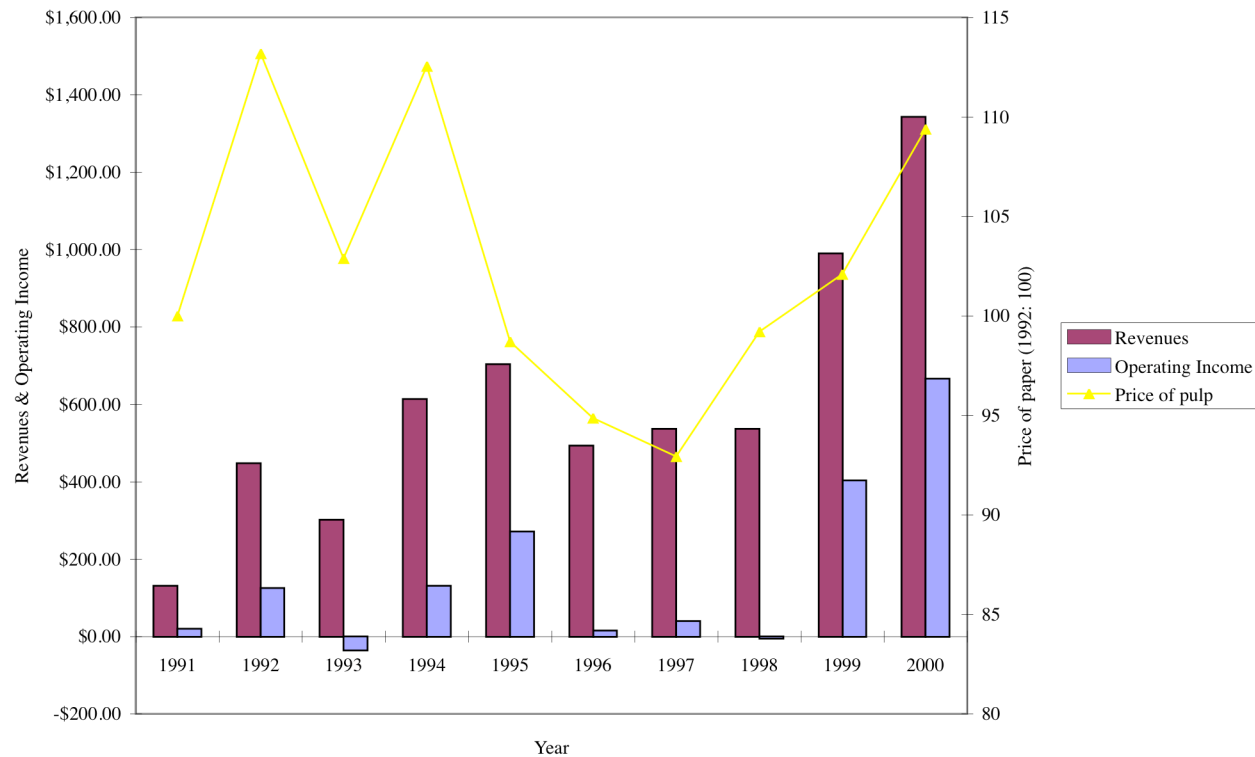
Normalizing Earnings

	Revenues	Operating Income	Operating Margin	Price of pulp
1991	$131.19	$19.54	14.89%	100
1992	$447.84	$125.45	28.01%	113.18
1993	$301.93	-$34.86	-11.55%	102.89
1994	$614.05	$131.34	21.39%	112.54
1995	$703.00	$271.00	38.55%	98.71
1996	$493.00	$15.00	3.04%	94.86
1997	$536.83	$39.12	7.29%	92.93
1998	$535.98	-$4.93	-0.92%	99.20
1999	$989.75	$403.35	40.75%	102.09
2000	$1,342.35	$665.85	49.60%	109.39
Normalized 2000	$1,342.35	$324.59	24.18%	
Normalized 2000	$1,258.78	$582.28		102.58

Aracruz (2000): Normalized Earnings ($)

Normalized ROC
10.55%

Stable Growth
g = 3%;
Cost of capital = 8.85
ROC= 8.85%
Reinvestment Rate=g/ROC
=3/8.85= 33.90%

Reinvestment Rate
80%

Normalized Earnings
Actual EBIT = $665.85 million
Normalized EBIT = $582 million
Tax Rate = 34%

**Expected Growth
in EBIT (1-t)**
80% * 10% = 8%

Terminal Value$_5$= 457/(.0885-.03) = 7,805

$ Cashflows

						Term Yr
						691
EBIT (1-t)	$425	$470	$519	$574	$635	- 234
- Reinvestment	$242	$267	$295	$326	$361	= 457
= FCFF	$183	$203	$224	$248	$274	

Op. Assets $ 5332
+ Cash: 847
- Debt   1395
=Equity   4785

Discount at $ Cost of Capital (WACC) = 13.97% (.73) + 4.95% (0.27) = 11.52%

Cost of Equity
13.97%

Cost of Debt
(7.50%(1-.34)
= 4.95%

Weights
E = 73% D = 27%

Aswath Damodaran

2. If the earnings are negative because the firm is early in its life cycle…

■ When operating income is negative or margins are expected to change over time, we use a three step process to estimate growth:

- Estimate growth rates in revenues over time
  - Use historical revenue growth to get estimates of revenue growth in the near future
  - Decrease the growth rate as the firm becomes larger
  - Keep track of absolute revenues to make sure that the growth is feasible
- Estimate expected operating margins each year
  - Set a target margin that the firm will move towards
  - Adjust the current margin towards the target margin
- Estimate the capital that needs to be invested to generate revenue growth and expected margins
  - Estimate a sales to capital ratio that you will use to generate reinvestment needs each year.

Discounted Cash Flow Valuation: High Growth with Negative Earnings

Current Revenue	Current Operating Margin		Reinvestment		Stable Growth		

Sales Turnover Ratio

Competitive Advantages

Stable Revenue Growth | Stable Operating Margin | Stable Reinvestment

EBIT

Revenue Growth

Expected Operating Margin

Tax Rate - NOLs

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

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

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

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

Forever

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

Cost of Equity

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

Weights
Based on Market Value

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

+

Beta
- Measures market risk

X

Risk Premium
- Premium for average risk investment

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

Current Revenue $ 1,117

Current Margin: -36.71%

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

Stable Growth

Stable Revenue Growth: 6%

Stable Operating Margin: 10.00%

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

EBIT -410m

Sales Turnover Ratio: 3.00

Competitive Advantages

NOL: 500 m

Revenue Growth: 42%

Expected Margin: -> 10.00%

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

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

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

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

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

Forever

Cost of Equity 12.90%

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

Weights
Debt= 1.2% -> 15%

Riskfree Rate :
T. Bond rate = 6.5%

Beta
1.60 -> 1.00

Risk Premium
4%

+   X

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

Internet/ Retail

Operating Leverage

Current D/E: 1.21%

Base Equity Premium

Country Risk Premium

Aswath Damodaran

3. If earnings are negative because the firm has structural/ leverage problems…

■ Survival Scenario: The firm survives and solves its structural problem (brings down its financial leverage). In this scenario, margins improve and the debt ratio returns to a sustainable level.

■ Failure Scenario: The firm does not solve its structural problems or fails to make debt payments, leading to default and liquidation.

Global Crossing Valuation Diagram

	Current Revenue $ 3,804	Current Margin: -49.82%		Cap ex growth slows and net cap ex decreases			Stable Growth			

EBIT -1895m

Revenue Growth: 13.33%

EBITDA/Sales -> 30%

Stable Revenue Growth: 5%

Stable EBITDA/Sales 30%

Stable ROC=7.36% Reinvest 67.93%

NOL: 2,076m

Terminal Value= 677(.0736-.05) =$ 28,683

	1	2	3	4	5	6	7	8	9	10	Term. Year
Revenues	$3,804	$5,326	$6,923	$8,308	$9,139	$10,053	$11,058	$11,942	$12,659	$13,292	$13,902
EBITDA	($95)	$ 0	$346	$831	$1,371	$1,809	$2,322	$2,508	$3,038	$3,589	$ 4,187
EBIT	($1,675)	($1,738)	($1,565)	($1,272)	$320	$1,074	$1,550	$1,697	$2,186	$2,694	$ 3,248
EBIT (1-t)	($1,675)	($1,738)	($1,565)	($1,272)	$320	$1,074	$1,550	$1,697	$2,186	$2,276	$ 2,111
+ Depreciation	$1,580	$1,738	$1,911	$2,102	$1,051	$736	$773	$811	$852	$894	$ 939
- Cap Ex	$3,431	$1,716	$1,201	$1,261	$1,324	$1,390	$1,460	$1,533	$1,609	$1,690	$ 2,353
- Chg WC	$ 0	$46	$48	$42	$25	$27	$30	$27	$21	$19	$ 20
FCFF	($3,526)	($1,761)	($903)	($472)	$22	$392	$832	$949	$1,407	$1,461	$ 677

Forever

Value of Op Assets	$ 5,530
+ Cash & Non-op	$ 2,260
= Value of Firm	$ 7,790
- Value of Debt	$ 4,923
= Value of Equity	$ 2867
- Equity Options	$ 14
Value per share	$ 3.22

	1	2	3	4	5	6	7	8	9	10
Beta	3.00	3.00	3.00	3.00	3.00	2.60	2.20	1.80	1.40	1.00
Cost of Equity	16.80%	16.80%	16.80%	16.80%	16.80%	15.20%	13.60%	12.00%	10.40%	8.80%
Cost of Debt	12.80%	12.80%	12.80%	12.80%	12.80%	11.84%	10.88%	9.92%	8.96%	6.76%
Debt Ratio	74.91%	74.91%	74.91%	74.91%	74.91%	67.93%	60.95%	53.96%	46.98%	40.00%
Cost of Capital	13.80%	13.80%	13.80%	13.80%	13.80%	12.92%	11.94%	10.88%	9.72%	7.98%

Cost of Equity 16.80%

Cost of Debt 4.8%+8.0%=12.8% Tax rate = 0% -> 35%

Weights Debt= 74.91% -> 40%

Riskfree Rate: T. Bond rate = 4.8%

Global Crossing November 2001 Stock price = $1.86

Beta 3.00> 1.10

X

Risk Premium 4%

+

Internet/ Retail	Operating Leverage	Current D/E: 441%	Base Equity Premium	Country Risk Premium

The Going Concern Assumption

- Traditional valuation techniques are built on the assumption of a going concern, I.e., a firm that has continuing operations and there is no significant threat to these operations.
  - In discounted cashflow valuation, this going concern assumption finds its place most prominently in the terminal value calculation, which usually is based upon an infinite life and ever-growing cashflows.
  - In relative valuation, this going concern assumption often shows up implicitly because a firm is valued based upon how other firms - most of which are healthy - are priced by the market today.
- When there is a significant likelihood that a firm will not survive the immediate future (next few years), traditional valuation models may yield an over-optimistic estimate of value.

DCF Valuation + Distress Value

■ A DCF valuation values a firm as a going concern. If there is a significant likelihood of the firm failing before it reaches stable growth and if the assets will then be sold for a value less than the present value of the expected cashflows (a distress sale value), DCF valuations will understate the value of the firm.

■ Value of Equity= DCF value of equity (1 - Probability of distress) + Distress sale value of equity (Probability of distress)

Bond Price to estimate probability of distress

■ Global Crossing has a 12% coupon bond with 8 years to maturity trading at $ 653. To estimate the probability of default (with a treasury bond rate of 5% used as the riskfree rate):

$$653 = \sum_{t=1}^{t=8} \frac{120(1-\pi_{Distress})^t}{(1.05)^t} + \frac{1000(1-\pi_{Distress})^8}{(1.05)^N}$$

■ Solving for the probability of bankruptcy, we get

  • With a 10-year bond, it is a process of trial and error to estimate this value. The solver function in excel accomplishes the same in far less time.

$$\pi_{Distress} = \text{Annual probability of default} = 13.53\%$$

■ To estimate the cumulative probability of distress over 10 years:

■ Cumulative probability of surviving 10 years = $(1 - .1353)^{10} = 23.37\%$

■ Cumulative probability of distress over 10 years = $1 - .2337 = .7663$ or 76.63%

Valuing Global Crossing with Distress

■ Probability of distress
- Cumulative probability of distress = 76.63%

■ Distress sale value of equity
- Book value of capital = $14,531 million
- Distress sale value = 25% of book value = .25*14531 = $3,633 million
- Book value of debt = $7,647 million
- Distress sale value of equity = $ 0

■ Distress adjusted value of equity
- Value of Global Crossing = $3.22 (1-.7663) + $0.00 (.7663) = $ 0.75

Real Options: Fact and Fantasy

Aswath Damodaran

Underlying Theme: Searching for an Elusive Premium

■ Traditional discounted cashflow models under estimate the value of investments, where there are options embedded in the investments to

- Delay or defer making the investment (delay)
- Adjust or alter production schedules as price changes (flexibility)
- Expand into new markets or products at later stages in the process, based upon observing favorable outcomes at the early stages (expansion)
- Stop production or abandon investments if the outcomes are unfavorable at early stages (abandonment)

■ Put another way, real option advocates believe that you should be paying a premium on discounted cashflow value estimates.

Three Basic Questions

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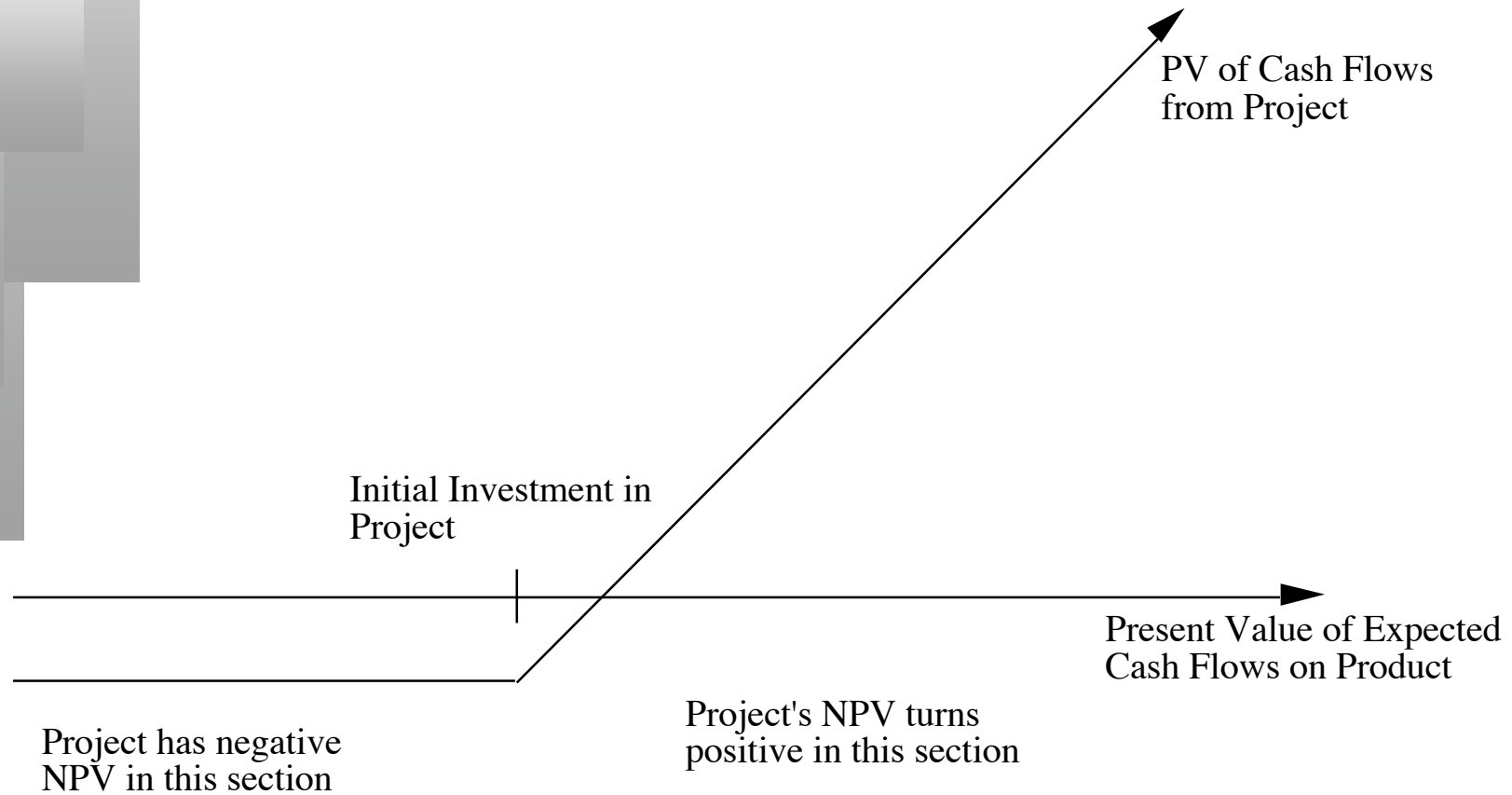- Can that value be estimated using an option pricing model?

When is there an option embedded in an action?

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

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

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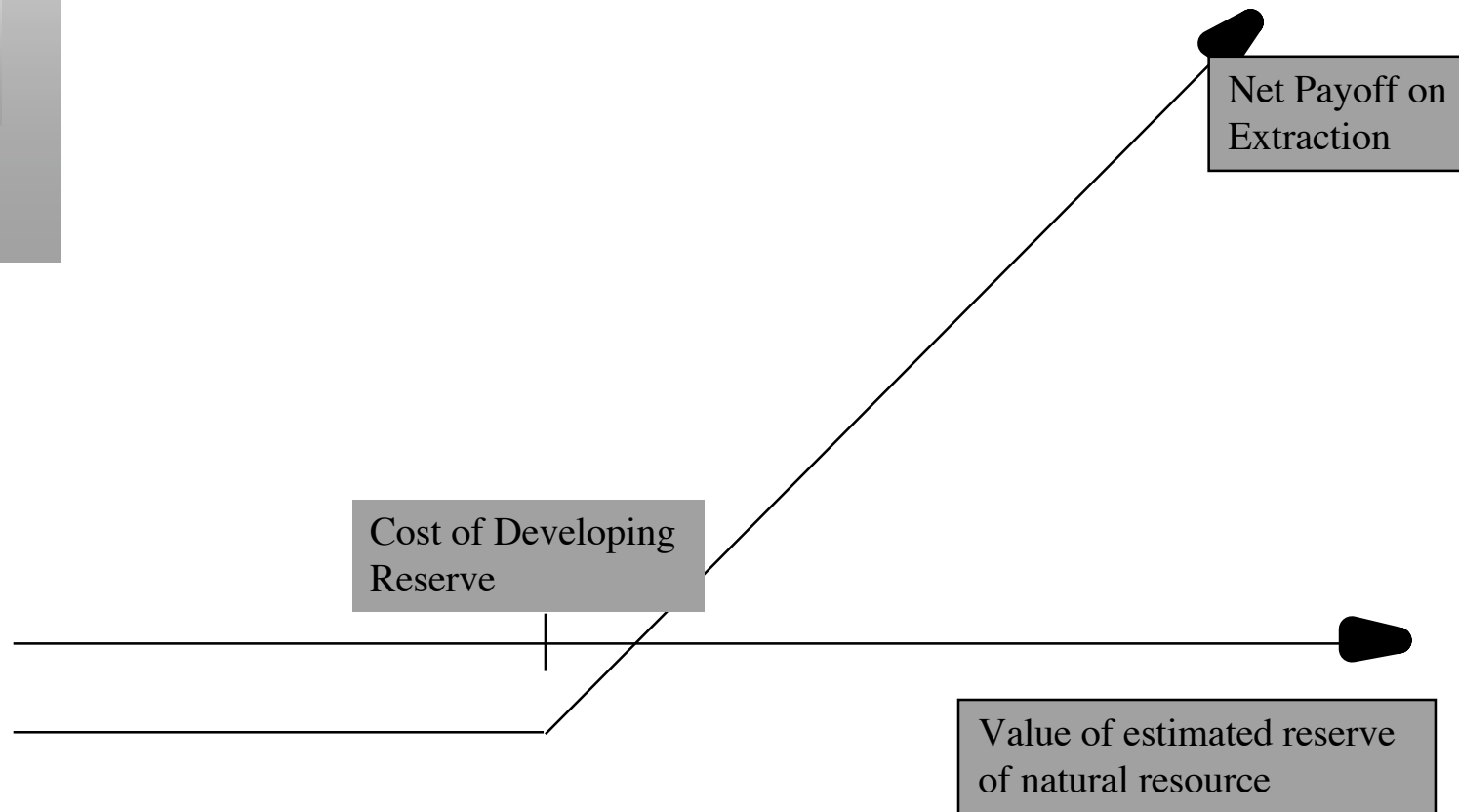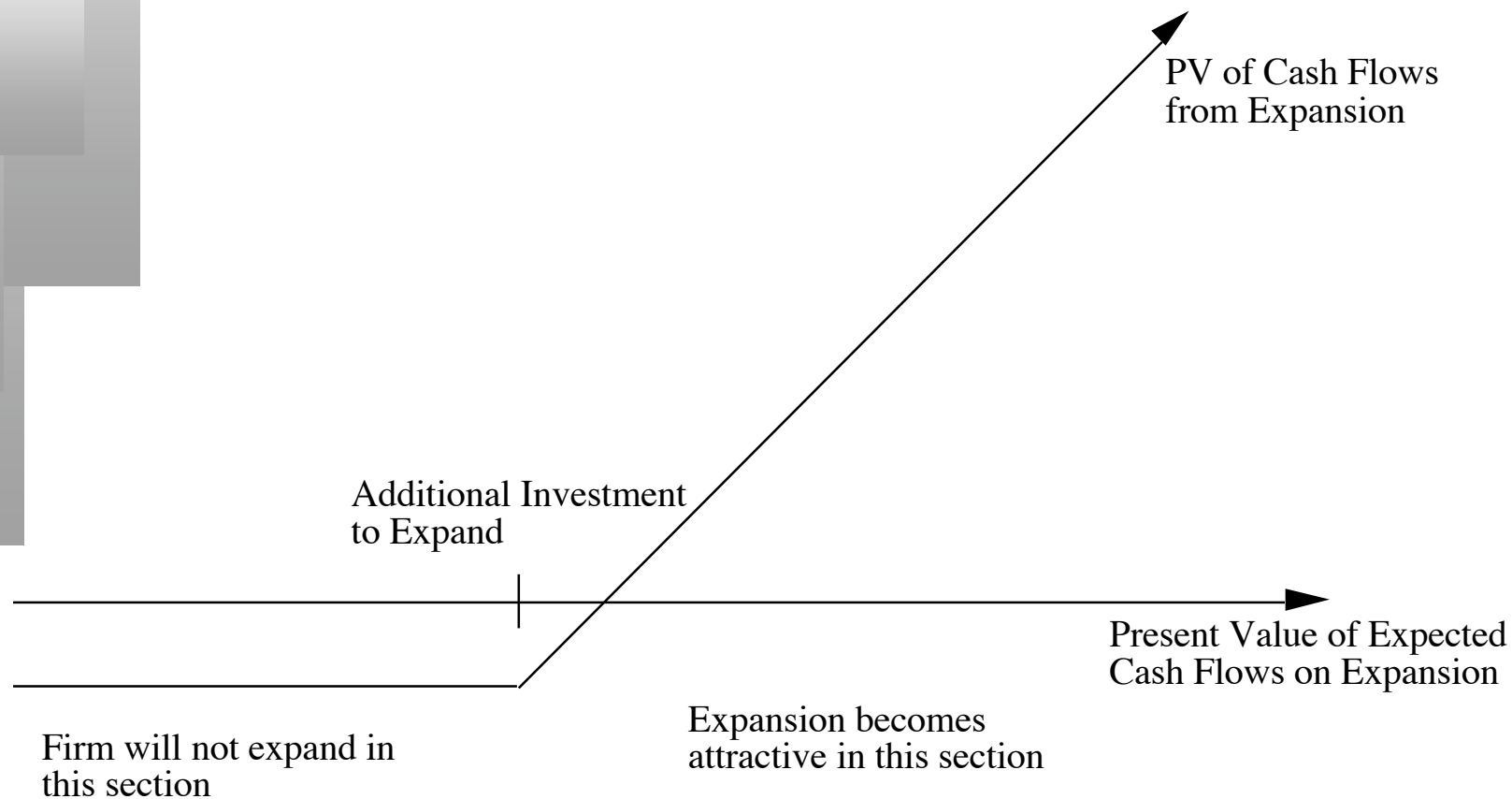
Payoff Diagram on a Call

Net Payoff
on Call

Strike
Price

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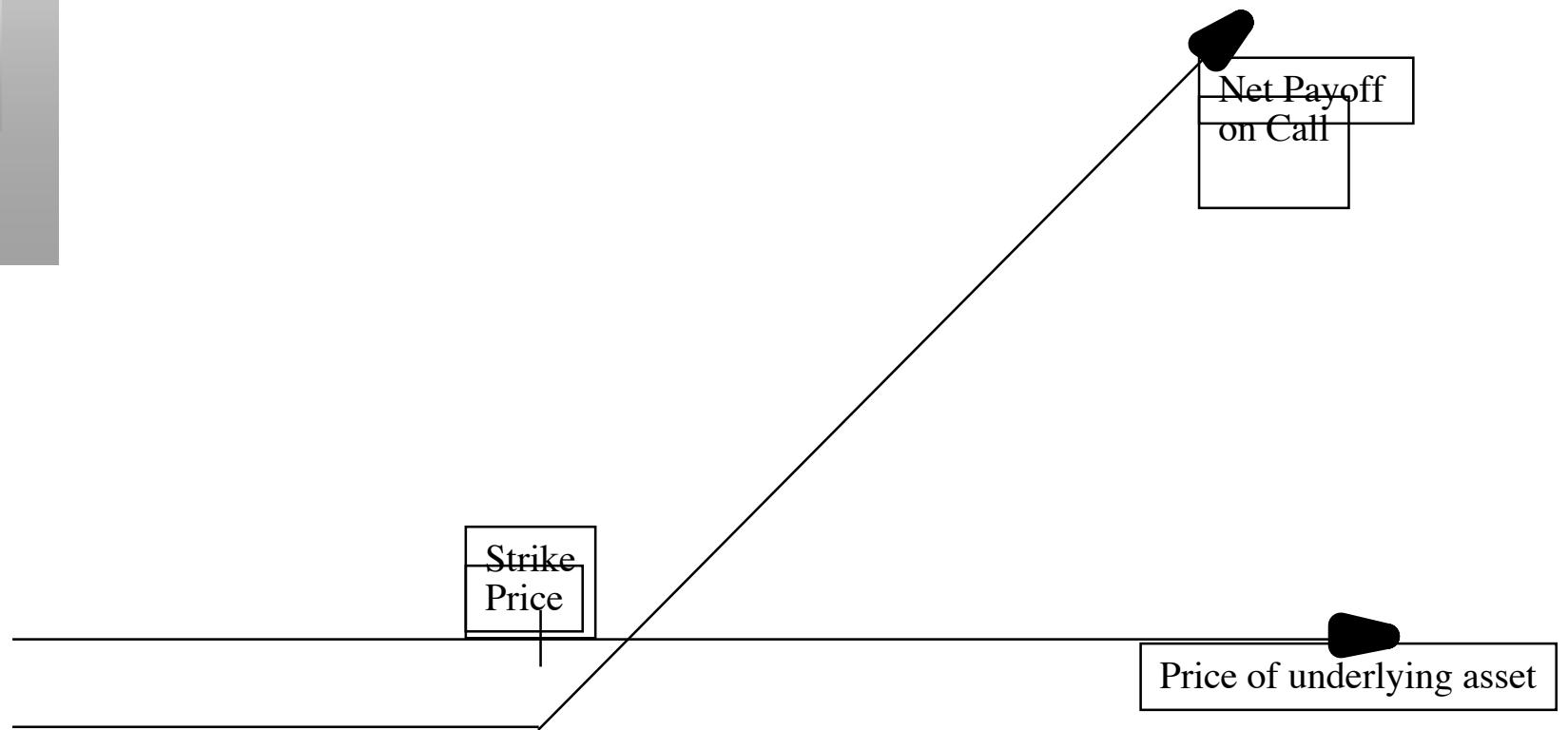
Example 1: Product Patent as an Option

PV of Cash Flows
from Project

Initial Investment in
Project

Present Value of Expected
Cash Flows on Product

Project's NPV turns
positive in this section

Project has negative
NPV in this section

Example 2: Undeveloped Oil Reserve as an option

Net Payoff on Extraction

Cost of Developing Reserve

Value of estimated reserve of natural resource

Example 3: Expansion of existing project as an option

PV of Cash Flows
from Expansion

Additional Investment
to Expand

Present Value of Expected
Cash Flows on Expansion

Firm will not expand in
this section

Expansion becomes
attractive in this section

When does the option have significant economic value?

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

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

Exclusivity: Putting Real Options to the Test

- **Product Options: Patent on a drug**
  - Patents restrict competitors from developing similar products
  - Patents do not restrict competitors from developing other products to treat the same disease.
- **Natural Resource options: An undeveloped oil reserve or gold mine.**
  - Natural resource reserves are limited.
  - It takes time and resources to develop new reserves
- **Growth Options: Expansion into a new product or market**
  - Barriers may range from strong (exclusive licenses granted by the government - as in telecom businesses) to weaker (brand name, knowledge of the market) to weakest (first mover).
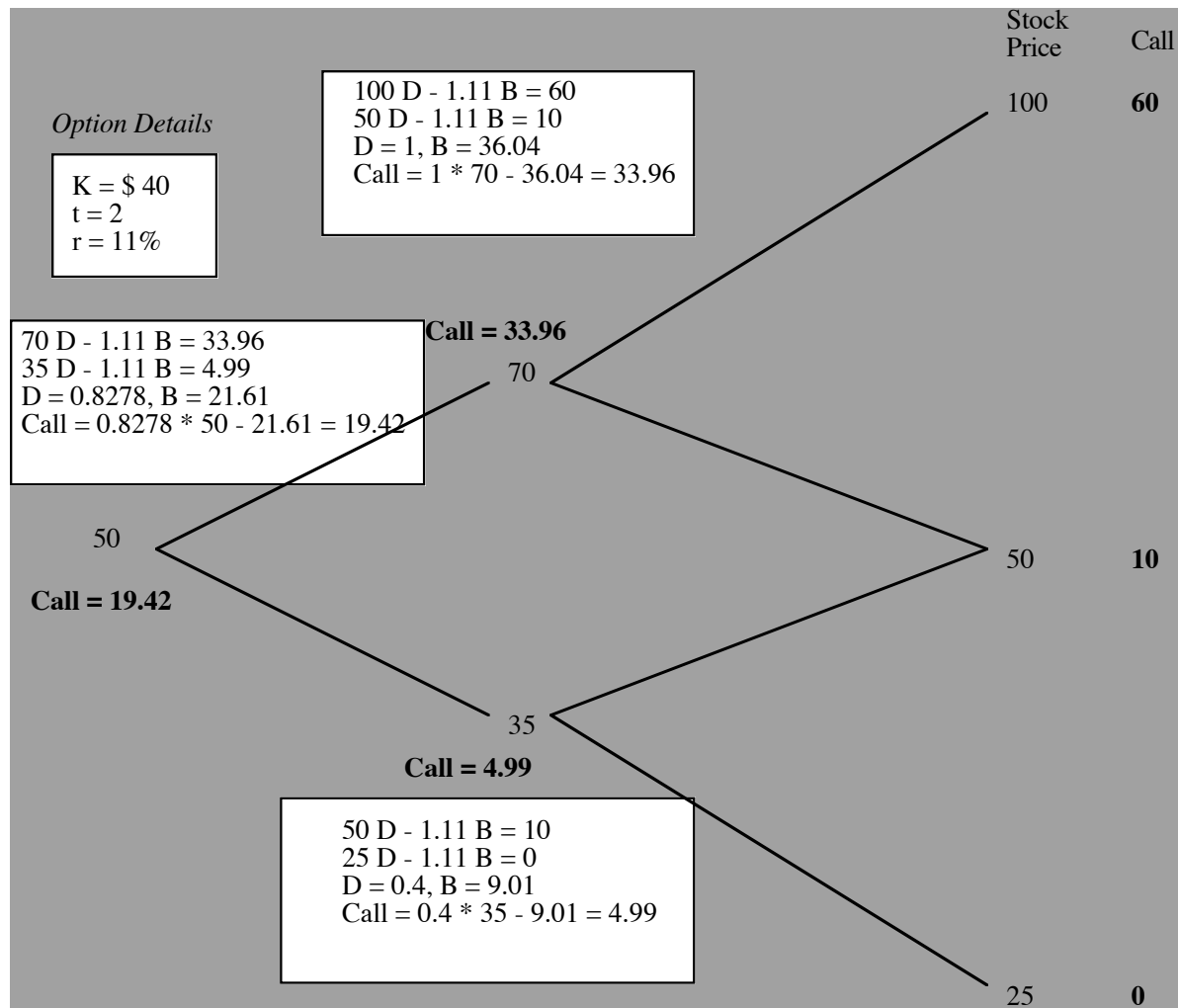
Determinants of option value

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

When can you use option pricing models to value real options?

- All option pricing models rest on two foundations.
  - The first is the notion of a replicating portfolio where you combine the underlying asset and borrowing/lending to create a portfolio that has the same cashflows as the option.
  - The second is arbitrage. Since both the option and the replicating portfolio have the same cashflows, they should trade at the same value.
- As a result, option pricing models work best when
  - The underlying asset is traded - this yield not only observable prices and volatility as inputs to option pricing models but allows for the possibility of creating replicating portfolios
  - An active marketplace exists for the option itself.
- When option pricing models are used to value real assets where neither replication nor arbitrage are usually feasible, we have to accept the fact that
  - The value estimates that emerge will be far more imprecise.
  - The value can deviate much more dramatically from market price because of the difficulty of arbitrage.

# Illustrating Replication: The Binomial Option Pricing Model

Stock Price   Call

Option Details

100 D - 1.11 B = 60
50 D - 1.11 B = 10
D = 1, B = 36.04
Call = 1 * 70 - 36.04 = 33.96

100   **60**

K = $ 40
t = 2
r = 11%

70 D - 1.11 B = 33.96
35 D - 1.11 B = 4.99
D = 0.8278, B = 21.61
Call = 0.8278 * 50 - 21.61 = 19.42

Call = 33.96

70

50

Call = 19.42

50   **10**

35

Call = 4.99

50 D - 1.11 B = 10
25 D - 1.11 B = 0
D = 0.4, B = 9.01
Call = 0.4 * 35 - 9.01 = 4.99

25   **0**

Aswath Damodaran

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The Black Scholes Model

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

where,

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

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

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

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

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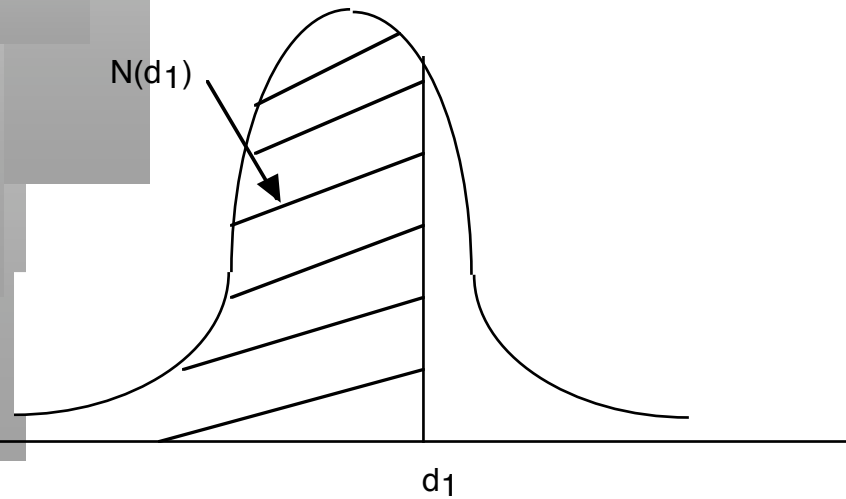
d	N(d)	d	N(d)	d	N(d)
-3.00	0.0013	-1.00	0.1587	1.05	0.8531
-2.95	0.0016	-0.95	0.1711	1.10	0.8643
-2.90	0.0019	-0.90	0.1841	1.15	0.8749
-2.85	0.0022	-0.85	0.1977	1.20	0.8849
-2.80	0.0026	-0.80	0.2119	1.25	0.8944
-2.75	0.0030	-0.75	0.2266	1.30	0.9032
-2.70	0.0035	-0.70	0.2420	1.35	0.9115
-2.65	0.0040	-0.65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

1. Obtaining Inputs for Patent Valuation

Input	Estimation Process
1. Value of the Underlying Asset	• Present Value of Cash Inflows from taking project now • This will be noisy, but that adds value.
2. Variance in value of underlying asset	• Variance in cash flows of similar assets or firms • Variance in present value from capital budgeting simulation.
3. Exercise Price on Option	• Option is exercised when investment is made. • Cost of making investment on the project ; assumed to be constant in present value dollars.
4. Expiration of the Option	• Life of the patent
5. Dividend Yield	• Cost of delay • Each year of delay translates into one less year of value-creating cashflows Annual cost of delay $= \dfrac{1}{n}$

Valuing a Product Patent as an option: Avonex

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

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

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

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

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

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

  d1 = 1.1362   N(d1) = 0.8720

  d2 = -0.8512   N(d2) = 0.2076

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

2. Valuing an Oil Reserve

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

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

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

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

Valuing an oil reserve as a real option

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

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

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

- Time to expiration on the option = 20 years

- Variance in the value of the underlying asset = 0.03

- Riskless rate = 8%

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

Extending the option pricing approach to value natural resource firms

Input to model	Corresponding input for valuing firm
Value of underlying asset	Value of cumulated estimated reserves of the resource owned by the firm, discounted back at the dividend yield for the development lag.
Exercise Price	Estimated cumulated cost of developing estimated reserves
Time to expiration on option	Average relinquishment period across all reserves owned by firm (if known) or estimate of when reserves will be exhausted, given current production rates.
Riskless rate	Riskless rate corresponding to life of the option
Variance in value of asset	Variance in the price of the natural resource
Dividend yield	Estimated annual net production revenue as percentage of value of the reserve.

Valuing Gulf Oil

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

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

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

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

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

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

Valuing Undeveloped Reserves

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

  d1 = 1.6548   N(d1) = 0.9510

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

Valuing Gulf Oil

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

■ The present value of these developed reserves, discounted at the weighted average cost of capital of 12.5%, yields:

- Value of already developed reserves = 915 (1 - 1.125^{-10})/.125 = $5065.83

■ Adding the value of the developed and undeveloped reserves

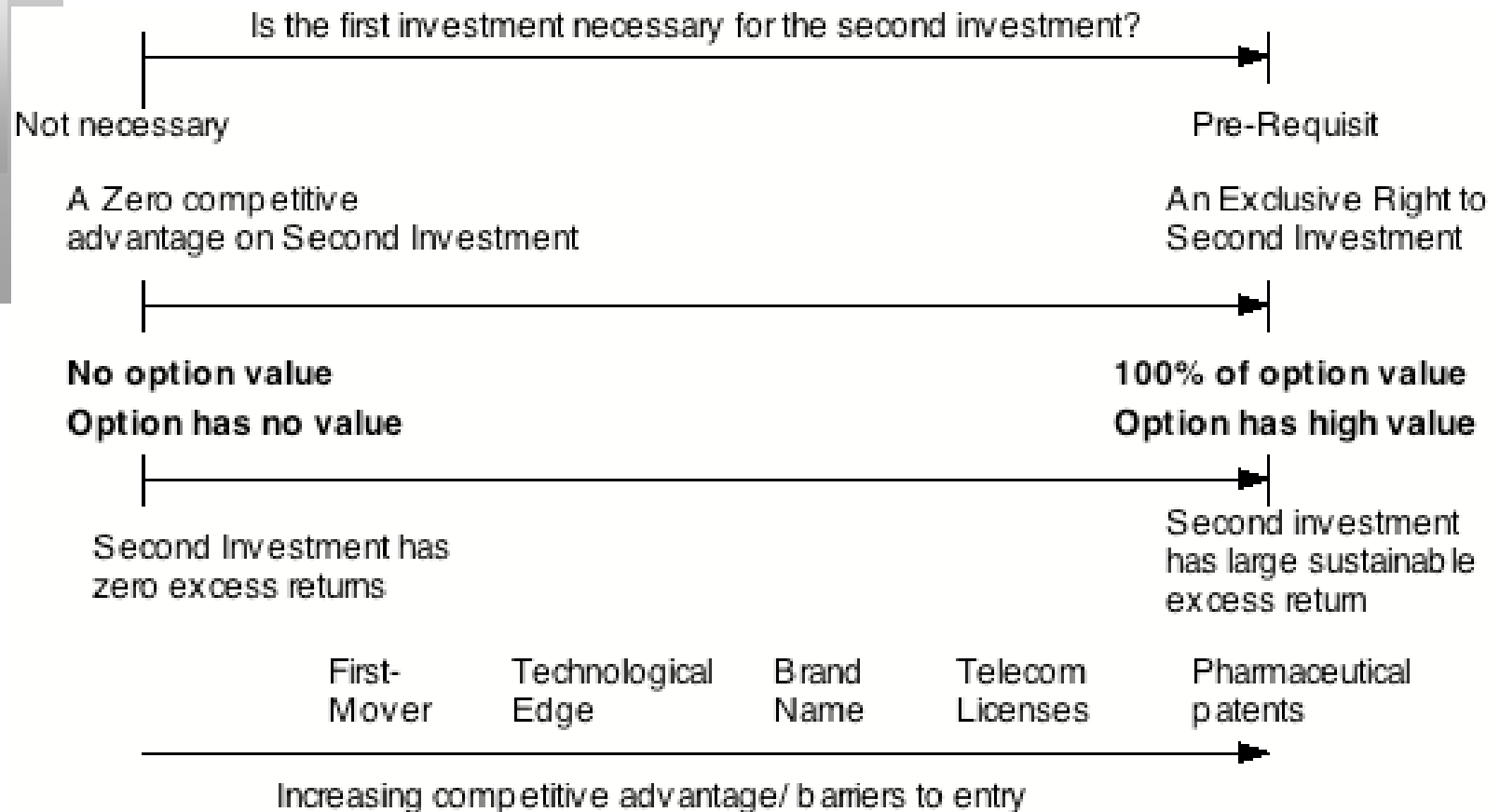|	
Value of undeveloped reserves	= $ 13,306 million
Value of production in place	= $ 5,066 million
Total value of firm	= $ 18,372 million
Less Outstanding Debt	= $ 9,900 million
Value of Equity	= $ 8,472 million
Value per share	= $ 8,472/165.3 = $51.25

3. An Example of an Expansion Option

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

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

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

Valuing the Expansion Option

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

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

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

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

Call Value= $ 234 Million

Opportunities and not Options…

Is the first investment necessary for the second investment?

Not necessary   Pre-Requisit

A Zero competitive
advantage on Second Investment

An Exclusive Right to
Second Investment

No option value

Option has no value

100% of option value

Option has high value

Second Investment has
zero excess returns

Second investment
has large sustainable
excess return

First-
Mover   Technological
Edge   Brand
Name   Telecom
Licenses   Pharmaceutical
patents

Increasing competitive advantage/ barriers to entry

Key Tests for Real Options

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