Valuation: Lecture Note Packet 3
Real Options, Acquisition Valuation and Value Enhancement

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Real Options: Fact and Fantasy

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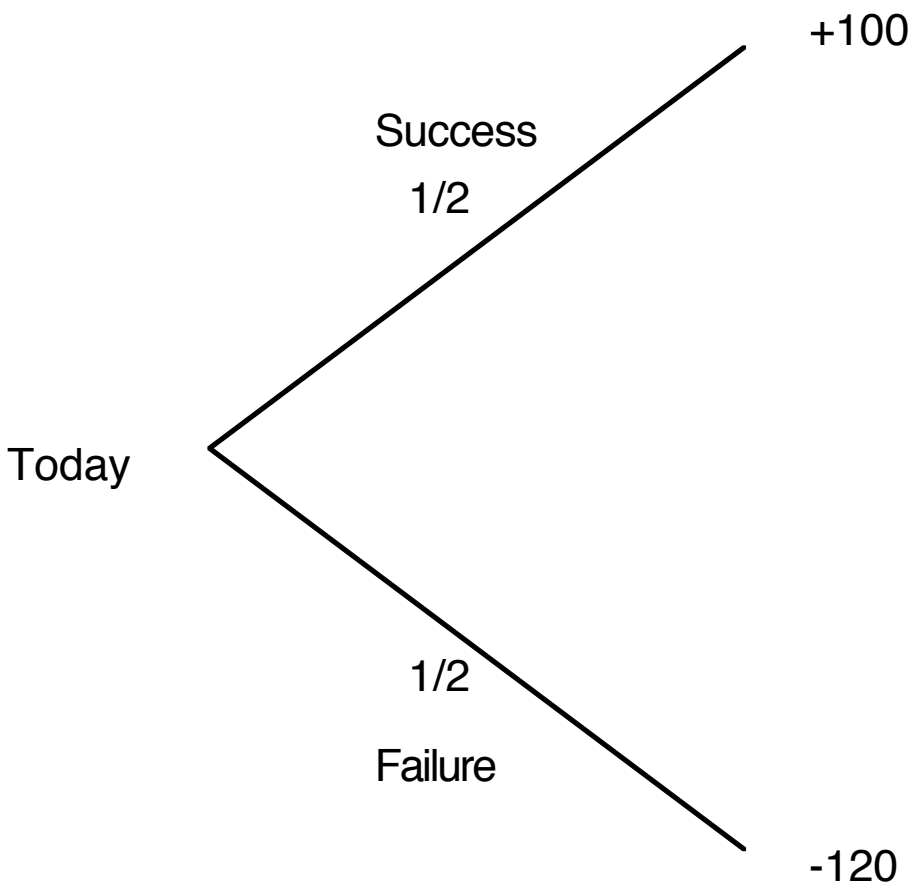
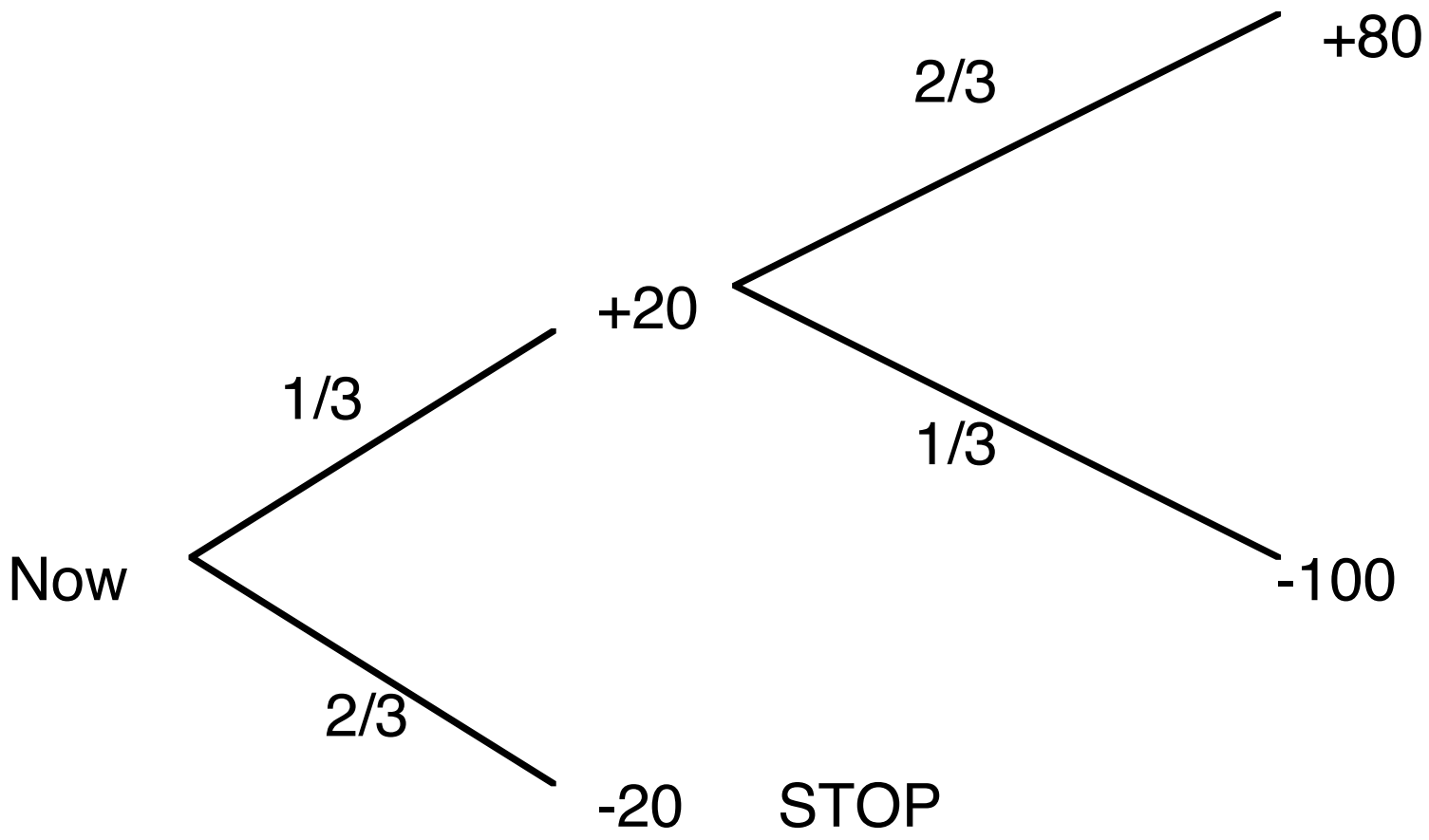
Underlying Theme: Searching for an Elusive Premium

- 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.

A bad investment…



Becomes a good one…



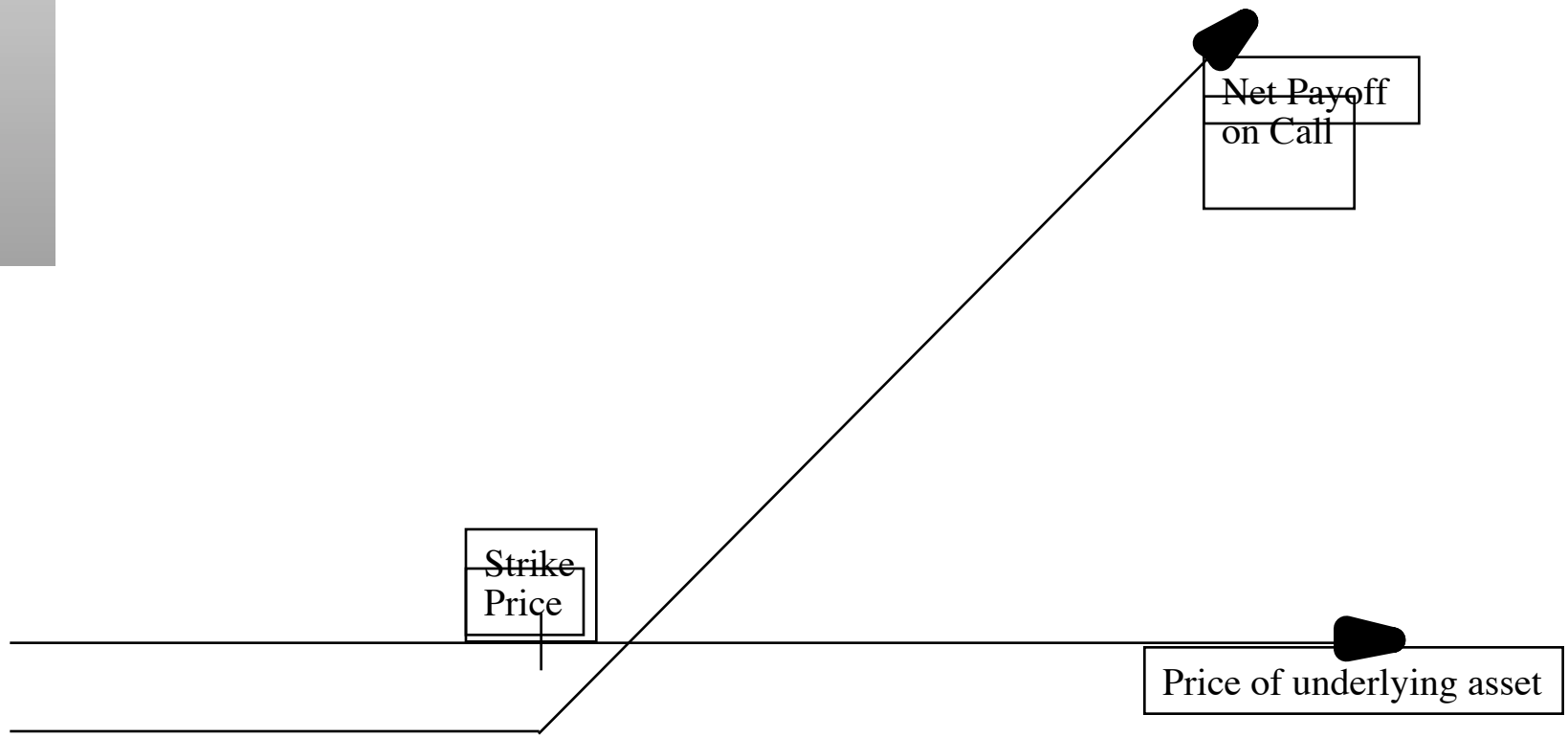
Three Basic Questions

- 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?

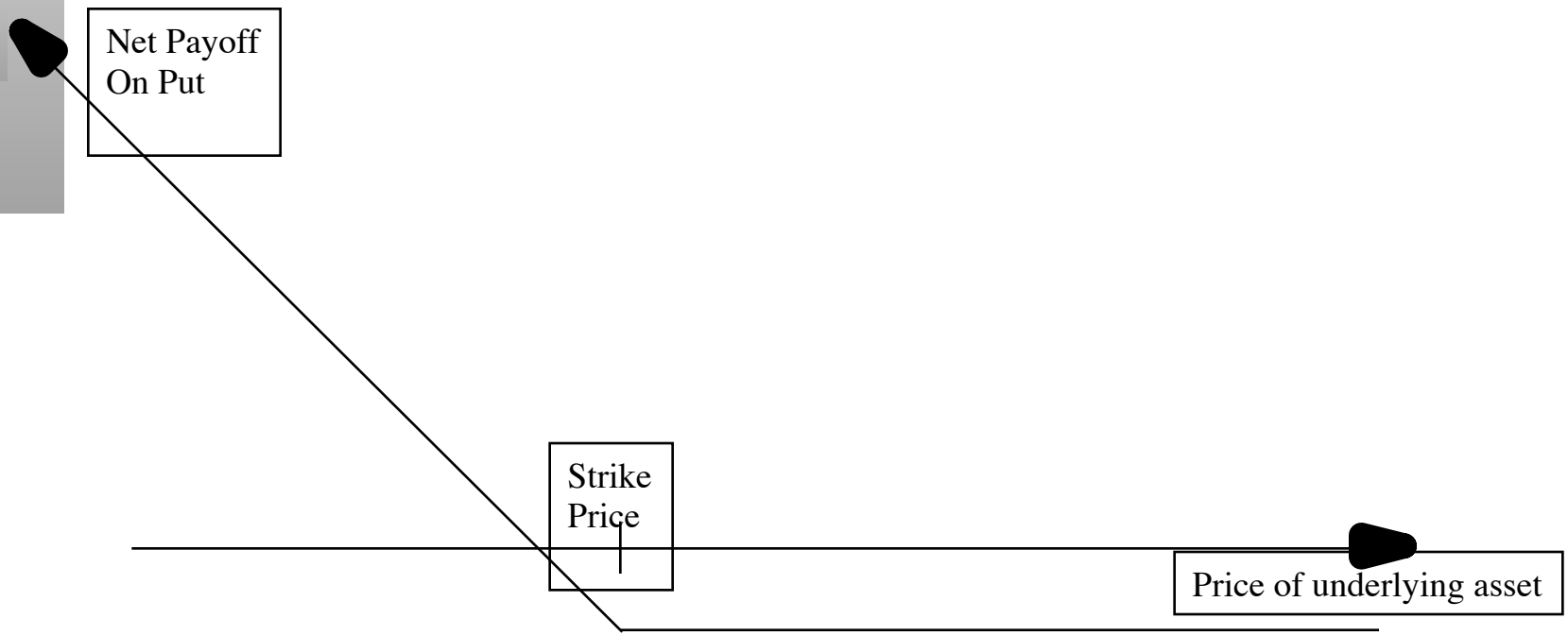
When is there an option embedded in an action?

- 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 clearly defined underlying asset whose value changes over time in unpredictable ways.
- The payoffs on this asset (real option) have to be contingent on an specified event occurring within a finite period.

Payoff Diagram on a Call



Payoff Diagram on Put Option



When does the option have significant economic value?

- For an option to have significant economic value, there has to be a restriction on competition in the event of the contingency. In a perfectly competitive product market, no contingency, no matter how positive, will generate positive net present value.
- At the limit, real options are most valuable when you have exclusivity - you and only you can take advantage of the contingency. They become less valuable as the barriers to competition become less steep.

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.

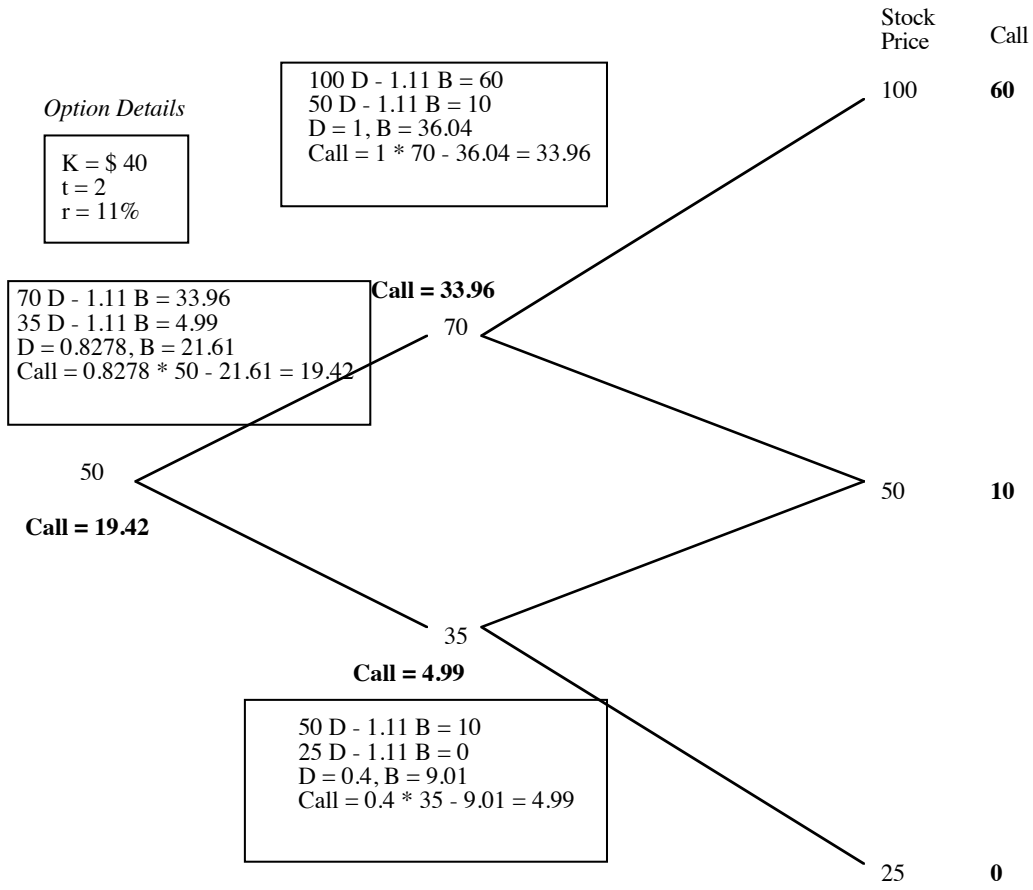
When can you use option pricing models to value real options?

- The notion of a replicating portfolio that drives option pricing models makes them most suited for valuing real options where
  - 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.
  - The cost of exercising the option is known with some degree of certainty.
- When option pricing models are used to value real assets, 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.

Creating a replicating portfolio

- The objective in creating a replicating portfolio is to use a combination of riskfree borrowing/lending and the underlying asset to create the same cashflows as the option being valued.
  - Call = Borrowing + Buying Δ of the Underlying Stock
  - Put = Selling Short Δ on Underlying Asset + Lending
  - The number of shares bought or sold is called the **option delta**.
- The principles of arbitrage then apply, and the value of the option has to be equal to the value of the replicating portfolio.

The Binomial Option Pricing Model



The Limiting Distributions….

- As the time interval is shortened, the limiting distribution, as t -> 0, can take one of two forms.
  - If as t -> 0, **price changes become smaller**, the limiting distribution is the normal distribution and the **price process is a continuous one**.
  - If as t->0, **price changes remain large**, the limiting distribution is the poisson distribution, i.e., a **distribution that allows for price jumps**.
- **The Black-Scholes model** applies when the **limiting distribution is the normal distribution** , and explicitly assumes that the price process is continuous and that there are no jumps in asset prices.

Black and Scholes…

- The version of the model presented by Black and Scholes was designed to value European options, which were dividend-protected.
- The value of a call option in the Black-Scholes model can be written as a function of the following variables:

  S = Current value of the underlying asset

  K = Strike price of the option

  t = Life to expiration of the option

  r = Riskless interest rate corresponding to the life of the option

  σ^2 = Variance in the ln(value) of the underlying asset

The Black Scholes Model

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

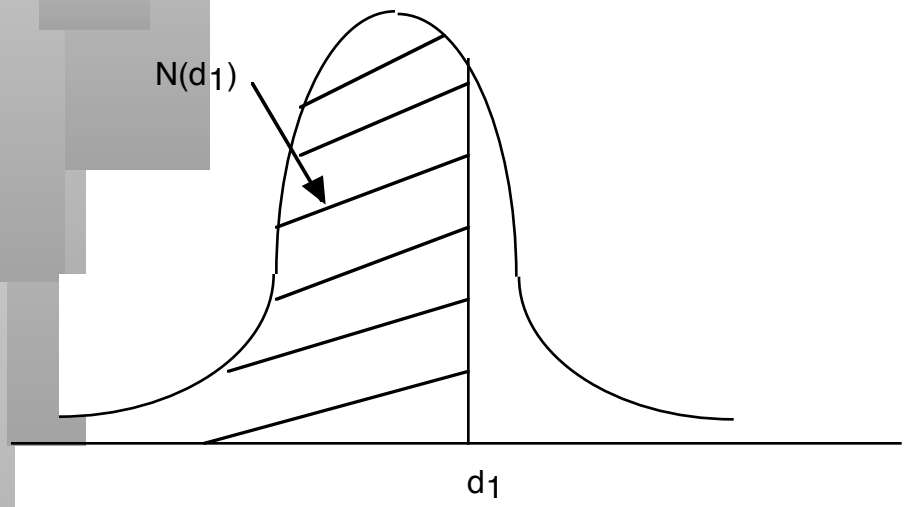
where,

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

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

- 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		

Adjusting for Dividends

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

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

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

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

- The value of a put can also be derived:

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

Choice of Option Pricing Models

- Most practitioners who use option pricing models to value real options argue for the binomial model over the Black-Scholes and justify this choice by noting that
  - Early exercise is the rule rather than the exception with real options
  - Underlying asset values are generally discontinous.
- If you can develop a binomial tree with outcomes at each node, it looks a great deal like a decision tree from capital budgeting. The question then becomes when and why the two approaches yield different estimates of value.

The Decision Tree Alternative

- Traditional decision tree analysis tends to use
  - One cost of capital to discount cashflows in each branch to the present
  - Probabilities to compute an expected value
    - **These values will generally be different from option pricing model values**
- If you modified decision tree analysis to
  - Use different discount rates at each node to reflect where you are in the decision tree (This is the Copeland solution) (or)
  - Use the riskfree rate to discount cashflows in each branch, estimate the probabilities to estimate an expected value and adjust the expected value for the market risk in the investment

Decision Trees could yield the same values as option pricing models

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?

Option Pricing Applications in Investment/Strategic Analysis

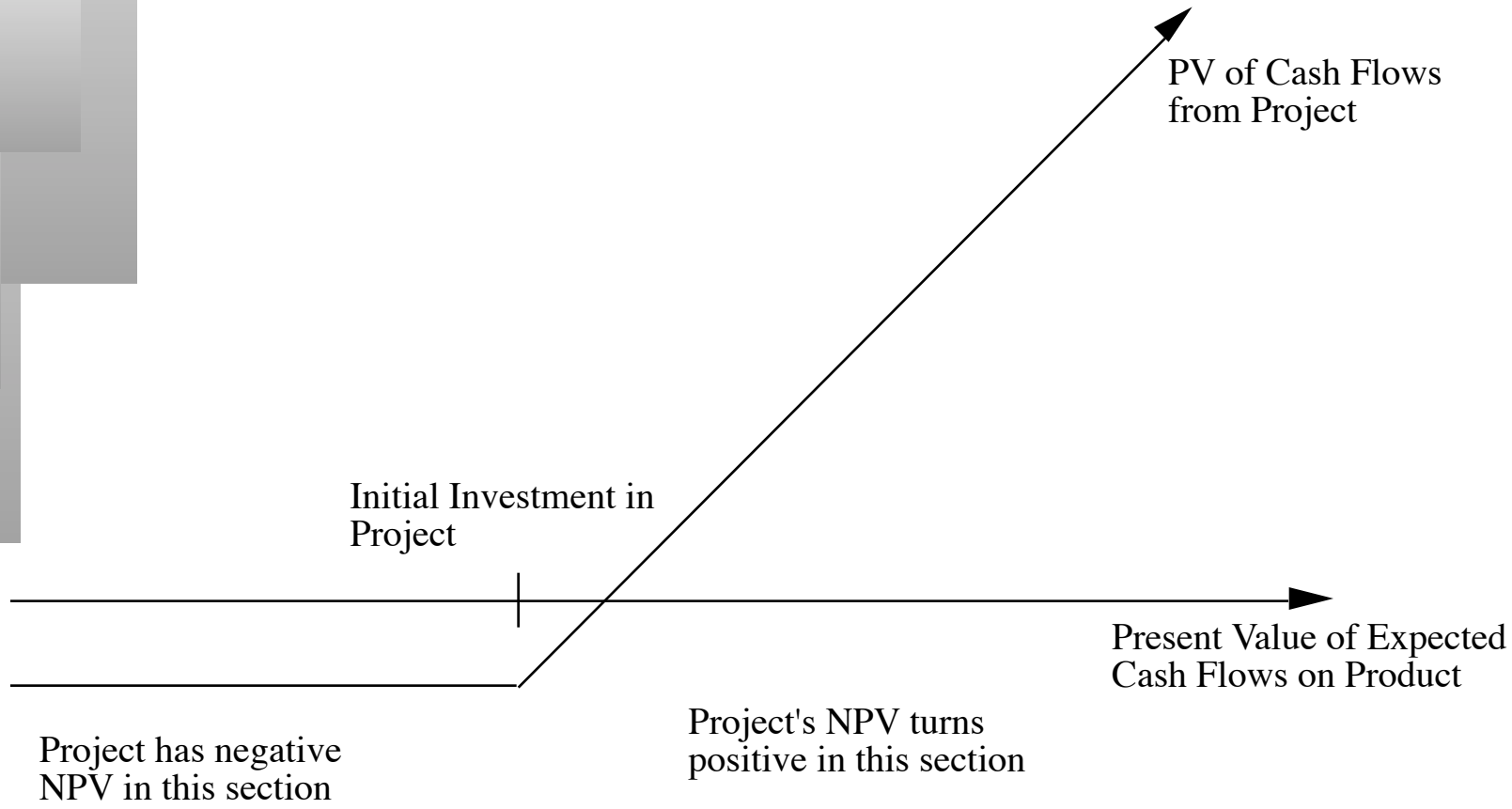
Options in Projects/Investments/Acquisitions

- One of the limitations of traditional investment analysis is that it is static and does not do a good job of capturing the options embedded in investment.
  - The first of these options is the option to delay taking a investment, when a firm has exclusive rights to it, until a later date.
  - The second of these options is taking one investment may allow us to take advantage of other opportunities (investments) in the future
  - The last option that is embedded in projects is the option to abandon a investment, if the cash flows do not measure up.
- These options all add value to projects and may make a "bad" investment (from traditional analysis) into a good one.

The Option to Delay

- When a firm has exclusive rights to a project or product for a specific period, it can delay taking this project or product until a later date.
- A traditional investment analysis just answers the question of whether the project is a "good" one if taken today.
- Thus, the fact that a project does not pass muster today (because its NPV is negative, or its IRR is less than its hurdle rate) does not mean that the rights to this project are not valuable.

Valuing the Option to Delay a Project

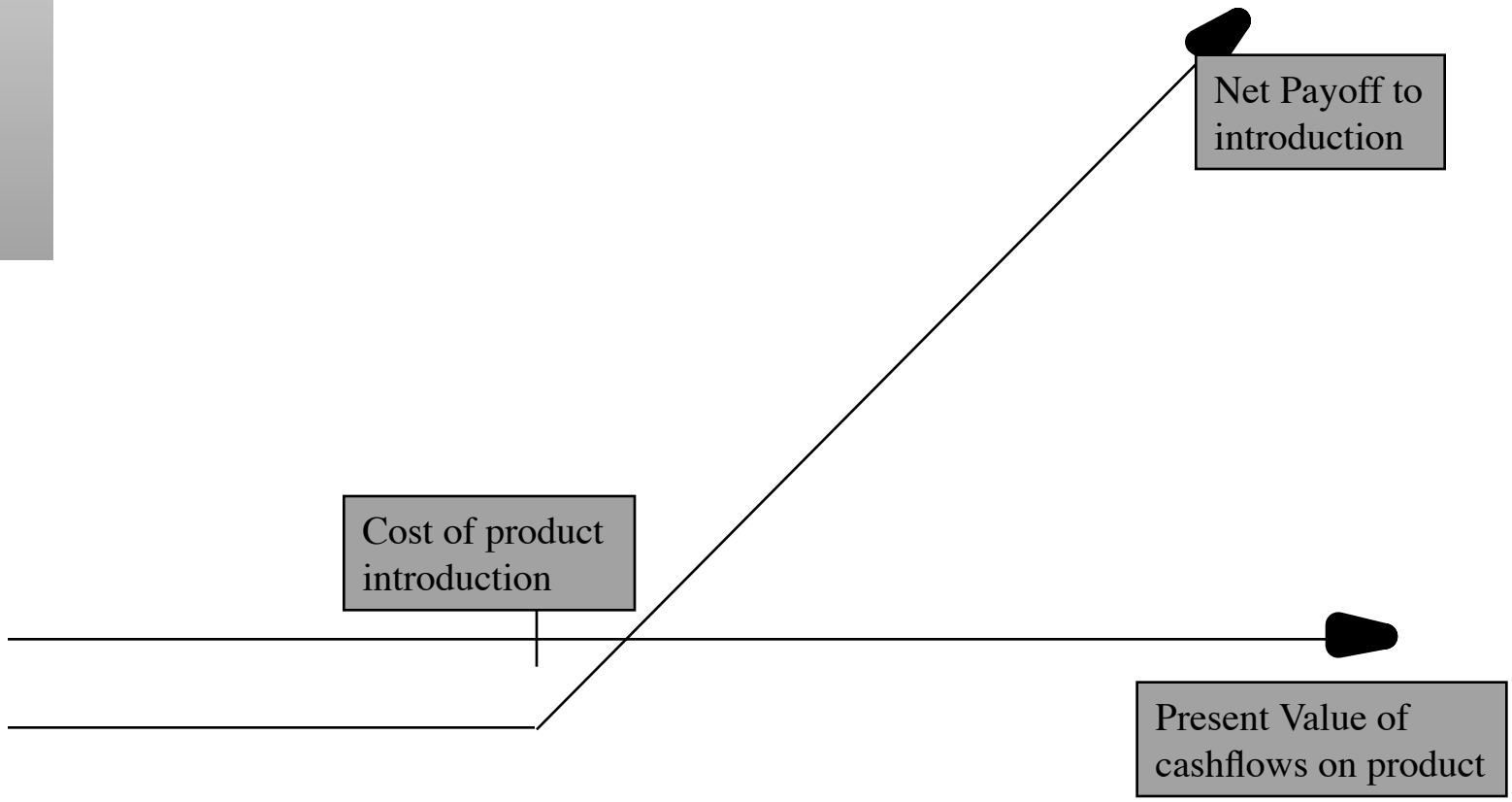


Example 1: Valuing product patents as options

- A product patent provides the firm with the right to develop the product and market it.
- It will do so only if the present value of the expected cash flows from the product sales exceed the cost of development.
- If this does not occur, the firm can shelve the patent and not incur any further costs.
- If I is the present value of the costs of developing the product, and V is the present value of the expected cashflows from development, the payoffs from owning a product patent can be written as:

Payoff from owning a product patent	= V - I	if V> I
	= 0	if V ≤ I

Payoff on Product Option



Obtaining Inputs for Patent Valuation

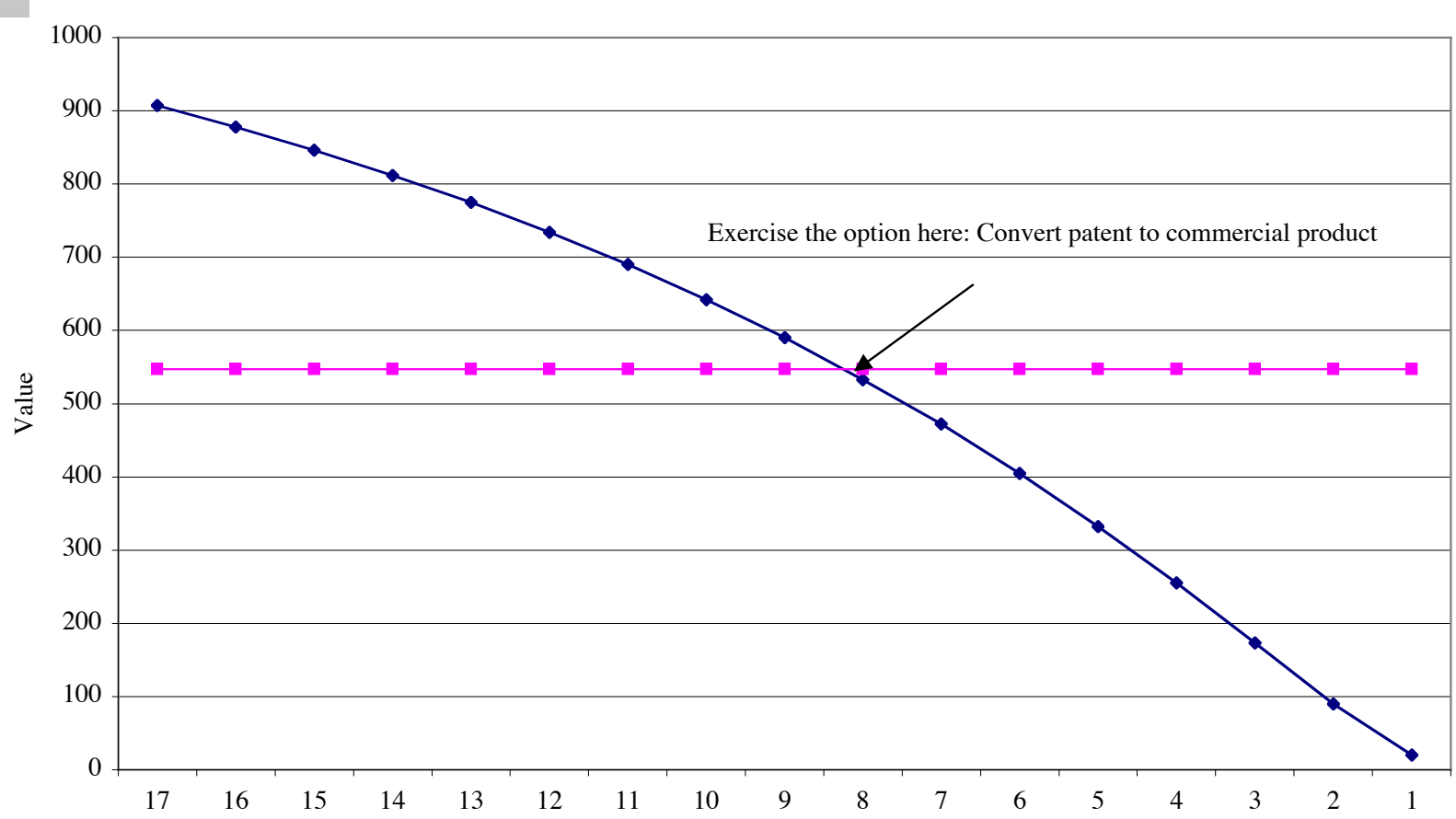
Input	Estimation Process
1. Value of the Underlying Asset	• Present Value of Cash Inflows from taking project now • This will be noisy, but that adds value.
2. Variance in value of underlying asset	• Variance in cash flows of similar assets or firms • Variance in present value from capital budgeting 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 $\text{Annual cost of delay} = \frac{1}{n}$

Valuing a Product Patent: 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 = σ^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

The Optimal Time to Exercise



Valuing a firm with patents

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

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

+ Value of existing patents (using option pricing)

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

- The last input measures the efficiency of the firm in converting its R&D into commercial products. If we assume that a firm earns its cost of capital from research, this term will become zero.
- If we use this approach, we should be careful not to double count and allow for a high growth rate in cash flows (in the DCF valuation).

Value of Biogen's existing products

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

Present Value of License Fees = $ 50 million $(1 - (1.07)^{-12})/.07$

= $ 397.13 million

Value of Biogen's Future R&D

- Biogen continued to fund research into new products, spending about $ 100 million on R&D in the most recent year. These R&D expenses were expected to grow 20% a year for the next 10 years, and 5% thereafter.
- It was assumed that every dollar invested in research would create $ 1.25 in value in patents (valued using the option pricing model described above) for the next 10 years, and break even after that (i.e., generate $ 1 in patent value for every $ 1 invested in R&D).
- There was a significant amount of risk associated with this component and the cost of capital was estimated to be 15%.

Value of Future R&D

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

Value of Biogen

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

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

= $ 397.13 million + $ 907 million + $ 318.30 million

= $1622.43 million

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

Value per share = $ 1,622.43 million / 35.5 = $ 45.70

The Real Options Test: Patents and Technology

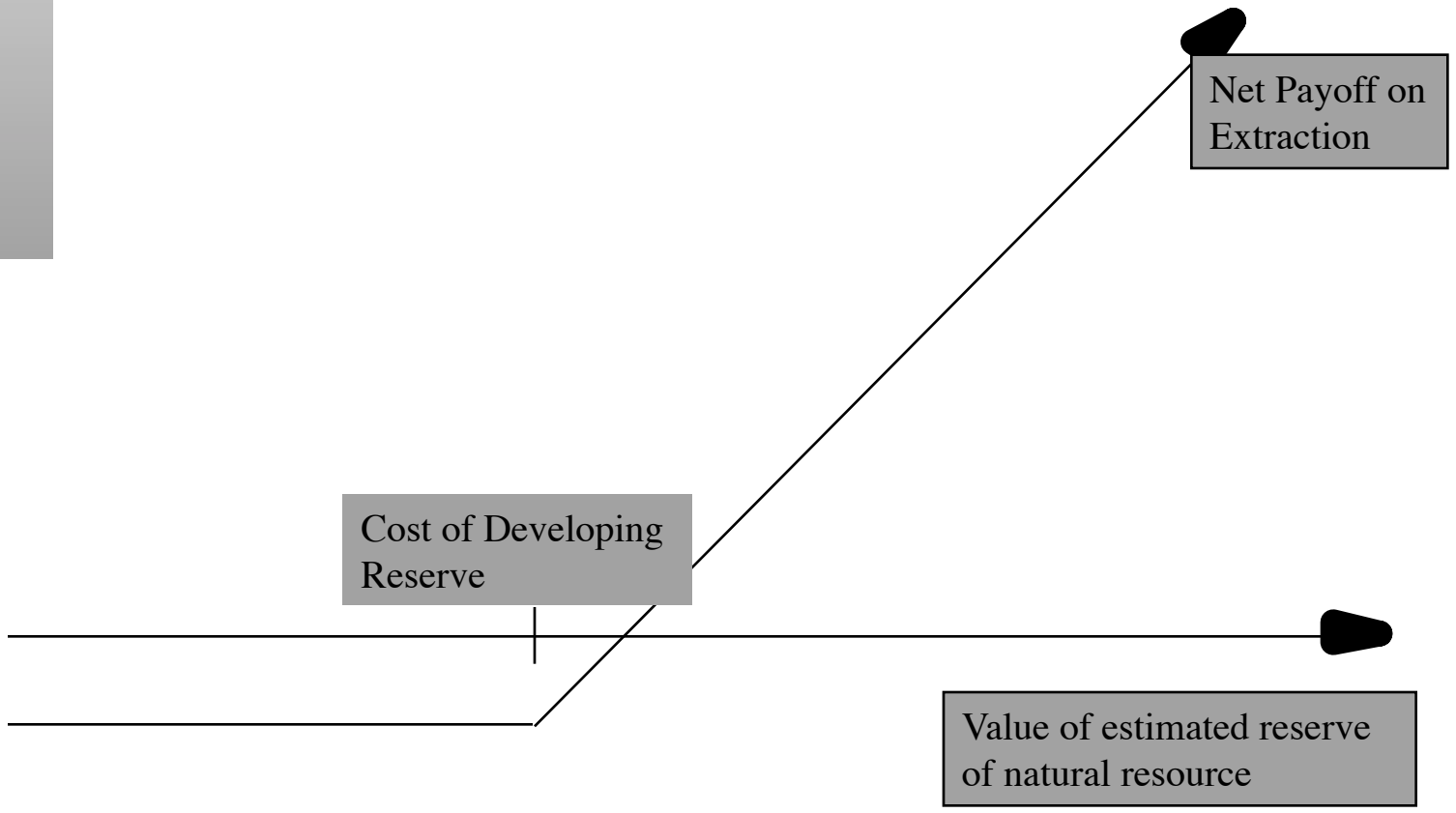
- The Option Test:
  - Underlying Asset: Product that would be generated by the patent
  - Contingency:
    - If PV of CFs from development > Cost of development: PV - Cost
    - If PV of CFs from development < Cost of development: 0
- The Exclusivity Test:
  - Patents restrict competitors from developing similar products
  - Patents do not restrict competitors from developing other products to treat the same disease.
- The Pricing Test
  - Underlying Asset: Patents are not traded. Not only do you therefore have to estimate the present values and volatilities yourself, you cannot construct replicating positions or do arbitrage.
  - Option: Patents are bought and sold, though not as frequently as oil reserves or mines.
  - Cost of Exercising the Option: This is the cost of converting the patent for commercial production. Here, experience does help and drug firms can make fairly precise estimates of the cost.
- Conclusion: You can estimate the value of the real option but the quality of your estimate will be a direct function of the quality of your capital budgeting. It works best if you are valuing a publicly traded firm that generates most of its value from one or a few patents - you can use the market value of the firm and the variance in that value then in your option pricing model.

Example 2: Valuing Natural Resource Options

- In a natural resource investment, the underlying asset is the resource and the value of the asset is based upon two variables - the quantity of the resource that is available in the investment and the price of the resource.
- In most such investments, there is a cost associated with developing the resource, and the difference between the value of the asset extracted and the cost of the development is the profit to the owner of the resource.
- Defining the cost of development as X, and the estimated value of the resource as V, the potential payoffs on a natural resource option can be written as follows:

Payoff on natural resource investment	= V - X	if V > X
	= 0	if V≤ X

Payoff Diagram on Natural Resource Firms



Estimating Inputs for Natural Resource Options

Input	Estimation Process
1. Value of Available Reserves of the Resource	• Expert estimates (Geologists for oil..); The present value of the after-tax cash flows from the resource are then estimated.
2. Cost of Developing Reserve (Strike Price)	• Past costs and the specifics of the investment
3. Time to Expiration	• Relinqushment Period: if asset has to be relinquished at a point in time. • Time to exhaust inventory - based upon inventory and capacity output.
4. Variance in value of underlying asset	• based upon variability of the price of the resources and variability of available reserves.
5. Net Production Revenue (Dividend Yield)	• Net production revenue every year as percent of market value.
6. Development Lag	• Calculate present value of reserve based upon the lag.

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.

Inputs to Option Pricing Model

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

  (If development is started today, the oil will not be available for sale until two years from now. The estimated opportunity cost of this delay is the lost production revenue over the delay period. Hence, the discounting of the reserve back at the dividend yield)
- Exercise Price = Present Value of development cost = $\$12 * 50 = \$600$ million
- Time to expiration on the option = 20 years
- Variance in the value of the underlying asset = 0.03
- Riskless rate =8%
- Dividend Yield = Net production revenue / Value of reserve = 5%

Valuing the Option

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

  d1 = 1.0359 N(d1) = 0.8498

  d2 = 0.2613 N(d2) = 0.6030

- Call Value= 544 .22 $\exp^{(-0.05)(20)}$ (0.8498) -600 ($\exp^{(-0.08)(20)}$ (0.6030)= $ 97.08 million
- This oil reserve, though not viable at current prices, still is a valuable property because of its potential to create value if oil prices go up.

Extending the option pricing approach to value natural resource firms

- Since the assets owned by a natural resource firm can be viewed primarily as options, **the firm itself can be valued using option pricing** models.
- The preferred approach would be to **consider each option separately**, value it and cumulate the values of the options to get the firm value.
- Since this information is likely to be **difficult to obtain** for large natural resource firms, such as oil companies, which own hundreds of such assets, a variant is to value the entire firm as one option.
- A purist would probably disagree, arguing that **valuing an option on a portfolio of assets (as in this approach) will provide a lower value than valuing a portfolio of options** (which is what the natural resource firm really own). Nevertheless, the value obtained from the model still provides an interesting perspective on the determinants of the value of natural resource firms.

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

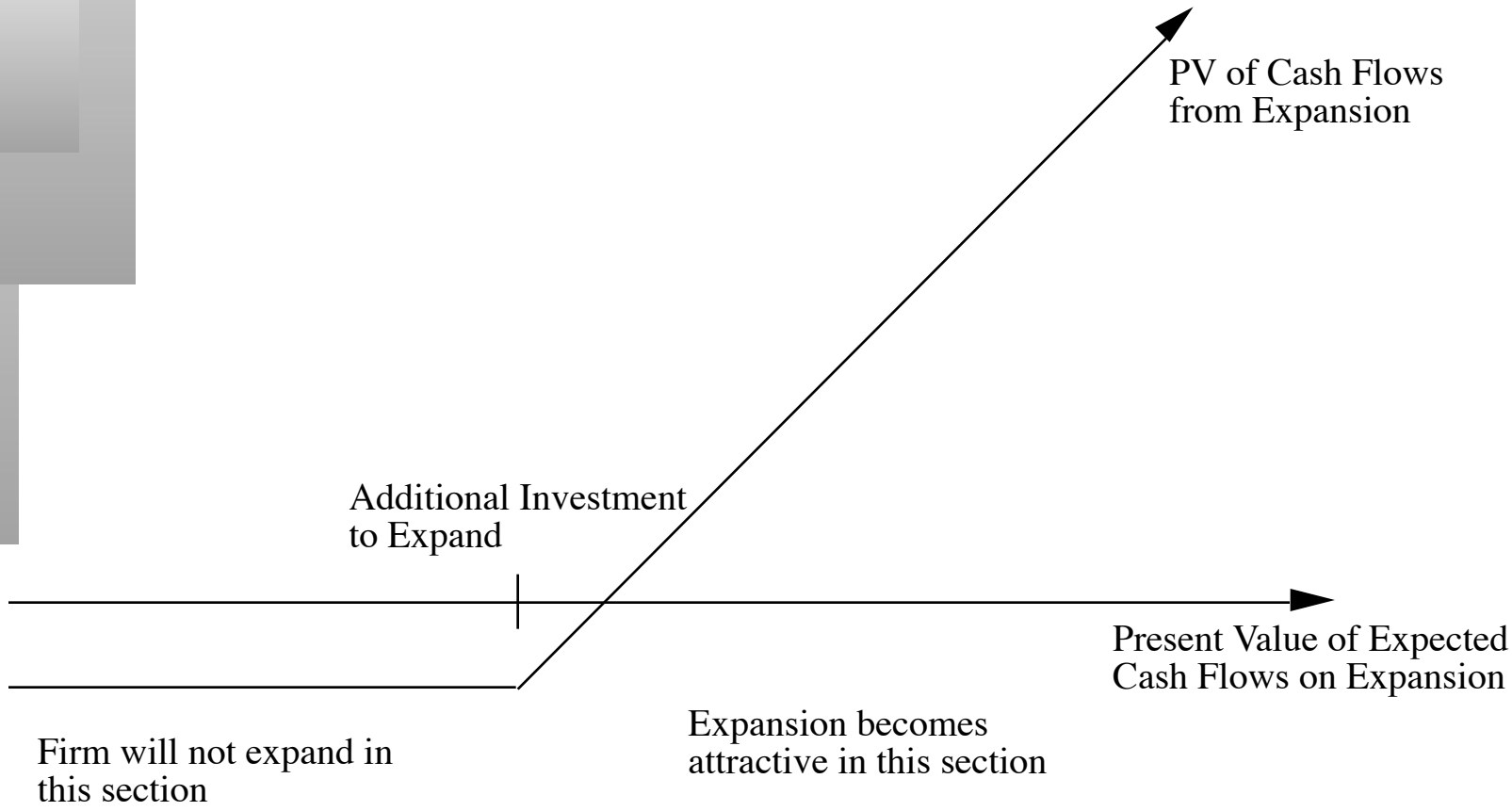
Putting Natural Resource Options to the Test

- The Option Test:
  - Underlying Asset: Oil or gold in reserve
  - Contingency: If value > Cost of development: Value - Dev Cost
    If value < Cost of development: 0
- The Exclusivity Test:
  - Natural resource reserves are limited (at least for the short term)
  - It takes time and resources to develop new reserves
- The Option Pricing Test
  - Underlying Asset: While the reserve or mine may not be traded, the commodity is. If we assume that we know the quantity with a fair degree of certainty, you can trade the underlying asset
  - Option: Oil companies buy and sell reserves from each other regularly.
  - Cost of Exercising the Option: This is the cost of developing a reserve. Given the experience that commodity companies have with this, they can estimate this cost with a fair degree of precision.
- Real option pricing models work well with natural resource options.

The Option to Expand/Take Other Projects

- Taking a project today may allow a firm to consider and take other valuable projects in the future.
- Thus, even though a project may have a negative NPV, it may be a project worth taking if the option it provides the firm (to take other projects in the future) provides a more-than-compensating value.
- These are the options that firms often call "strategic options" and use as a rationale for taking on "negative NPV" or even "negative return" projects.

The Option to Expand



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

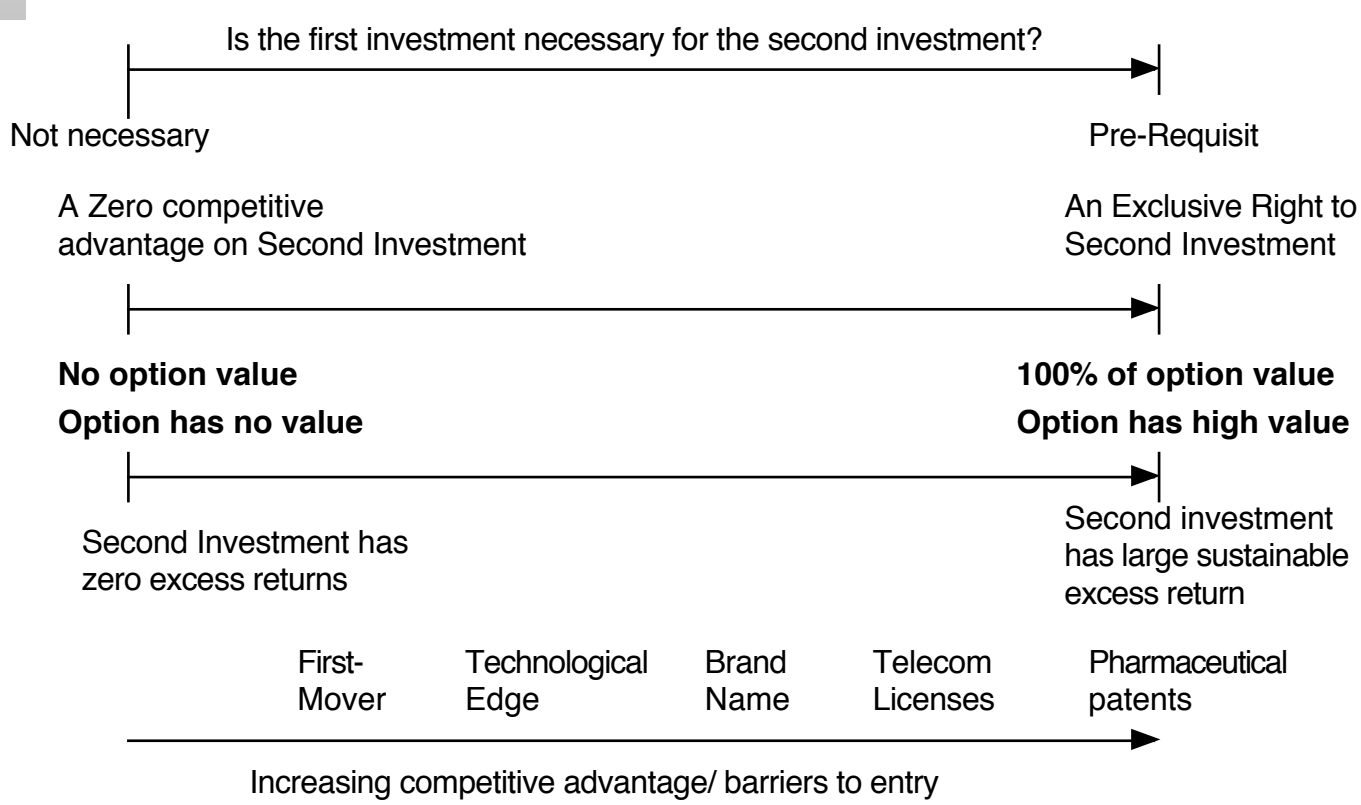
- Value of the Underlying Asset (S) = PV of Cash Flows from Expansion to entire U.S. market, if done now =$ 750 Million
- Strike Price (K) = Cost of Expansion into entire U.S market = $ 1000 Million
- We estimate the standard deviation in the estimate of the project value by using the annualized standard 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

Considering the Project with Expansion Option

- NPV of Limited Introduction = $ 400 Million - $ 500 Million
  = - $ 100 Million
- Value of Option to Expand to full market= $ 234 Million
- NPV of Project with option to expand
  = - $ 100 million + $ 234 million
  = $ 134 million
- **Invest in the project**

Opportunities are not Options…



The Real Options Test for Expansion Options

- The Options Test
  - Underlying Asset: Expansion Project
  - Contingency

  If PV of CF from expansion > Expansion Cost: PV - Expansion Cost

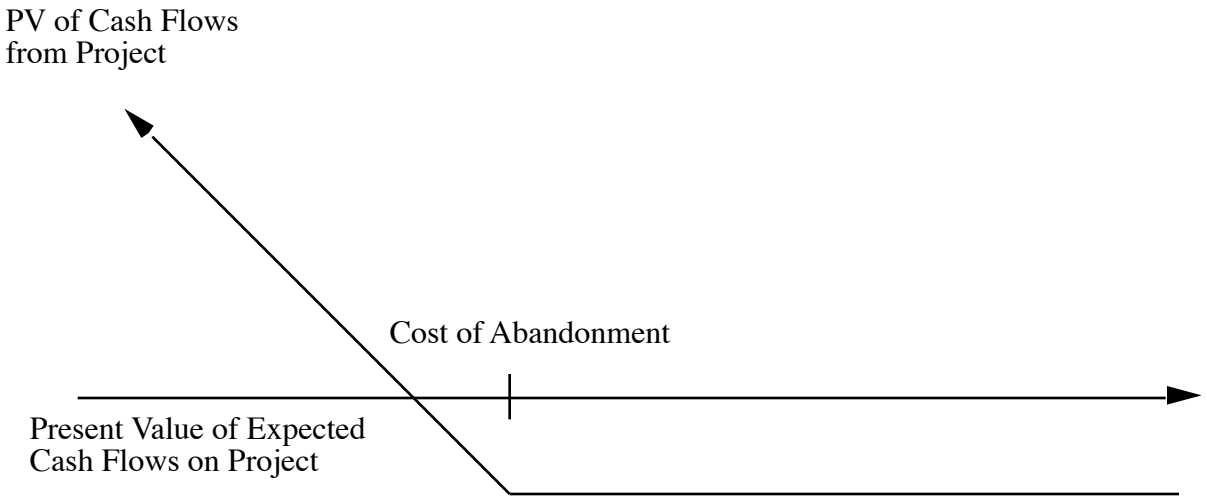
  If PV of CF from expansion < Expansion Cost: 0
- The Exclusivity Test
  - Barriers may range from strong (exclusive licenses granted by the government) to weaker (brand name, knowledge of the market) to weakest (first mover).
- The Pricing Test
  - Underlying Asset: As with patents, there is no trading in the underlying asset and you have to estimate value and volatility.
  - Option: Licenses are sometimes bought and sold, but more diffuse expansion options are not.
  - Cost of Exercising the Option: Not known with any precision and may itself evolve over time as the market evolves.
- Using option pricing models to value expansion options will not only yield extremely noisy estimates, but may attach inappropriate premiums to discounted cashflow estimates.

Internet Firms as Options

- Some analysts have justified the valuation of internet firms on the basis that you are buying the option to expand into a very large market. What do you think of this argument?
  - Is there an option to expand embedded in these firms?
  - Is it a valuable option?

The Option to Abandon

- A firm may sometimes have the option to abandon a project, if the cash flows do not measure up to expectations.
- If abandoning the project allows the firm to save itself from further losses, this option can make a project more valuable.



Valuing the Option to Abandon

- Airbus is considering a joint venture with Lear Aircraft to produce a small commercial airplane (capable of carrying 40-50 passengers on short haul flights)
  - Airbus will have to invest $ 500 million for a 50% share of the venture
  - Its share of the present value of expected cash flows is 480 million.
- Lear Aircraft, which is eager to enter into the deal, offers to buy Airbus's 50% share of the investment anytime over the next five years for $ 400 million, if Airbus decides to get out of the venture.
- A simulation of the cash flows on this time share investment yields a variance in the present value of the cash flows from being in the partnership is 0.16.
- The project has a life of 30 years.

Project with Option to Abandon

- Value of the Underlying Asset (S) = PV of Cash Flows from Project = $ 480 million
- Strike Price (K) = Salvage Value from Abandonment = $ 400 million
- Variance in Underlying Asset's Value = 0.16
- Time to expiration = Life of the Project =5 years
- Dividend Yield = 1/Life of the Project = 1/30 = 0.033 (We are assuming that the project's present value will drop by roughly 1/n each year into the project)
- Assume that the five-year riskless rate is 6%. The value of the put option can be estimated as follows:

Should Airbus enter into the joint venture?

- Value of Put $= Ke^{-rt} (1-N(d2)) - Se^{-yt} (1-N(d1))$
  $= 400 (\exp^{(-0.06)(5)} (1-0.4624) - 480 \exp^{(-0.033)(5)} (1-0.7882)$
  = $ 73.23 million
- The value of this abandonment option has to be added on to the net present value of the project of -$ 20 million, yielding a total net present value with the abandonment option of $ 53.23 million.

Implications for Investment Analysis/ Valuation

- Having a option to abandon a project can make otherwise unacceptable projects acceptable.
- Other things remaining equal, you would attach more value to companies with
  - More cost flexibility, that is, making more of the costs of the projects into variable costs as opposed to fixed costs.
  - Fewer long-term contracts/obligations with employees and customers, since these add to the cost of abandoning a project.
- These actions will undoubtedly cost the firm some value, but this has to be weighed off against the increase in the value of the abandonment option.

Option Pricing Applications in the Capital Structure Decision

Options in Capital Structure

- The most direct applications of option pricing in capital structure decisions is in the design of securities. In fact, most complex financial instruments can be broken down into some combination of a simple bond/common stock and a variety of options.
  - If these securities are to be issued to the public, and traded, the options have to be priced.
  - If these are non-traded instruments (bank loans, for instance), they still have to be priced into the interest rate on the instrument.
- The other application of option pricing is in valuing flexibility. Often, firms preserve debt capacity or hold back on issuing debt because they want to maintain flexibility.

The Value of Flexibility

- Firms maintain excess debt capacity or larger cash balances than are warranted by current needs, to meet unexpected future requirements.
- While maintaining this financing flexibility has value to firms, it also has a cost; the excess debt capacity implies that the firm is giving up some value and has a higher cost of capital.
- The value of flexibility can be analyzed using the option pricing framework; a firm maintains large cash balances and excess debt capacity in order to have the option to take projects that might arise in the future.

Value of Flexibility as an Option

- Consider a firm that has expected reinvestment needs of X each year, with a standard deviation in that value of σ_X. These external reinvestments include both internal projects and acquisitions.
- Assume that the firm is limited in its capacity to raise capital, for internal or external reasons and that it can raise L from internal cash flows and its normal access to capital markets.
- Excess debt capacity becomes useful if external reinvestment needs exceed the firm's internal funds.

  If X > L: Excess debt capacity can be used to cover the difference and invest in projects

  If X<L: Excess debt capacity remains unused (with an associated cost)

What happens when you make the investment?

- If the investment earns excess returns, the firm's value will increase by the present value of these excess returns over time. If we assume that the excess return each year is constant and perpetual, the present value of the excess returns that would be earned can be written as:

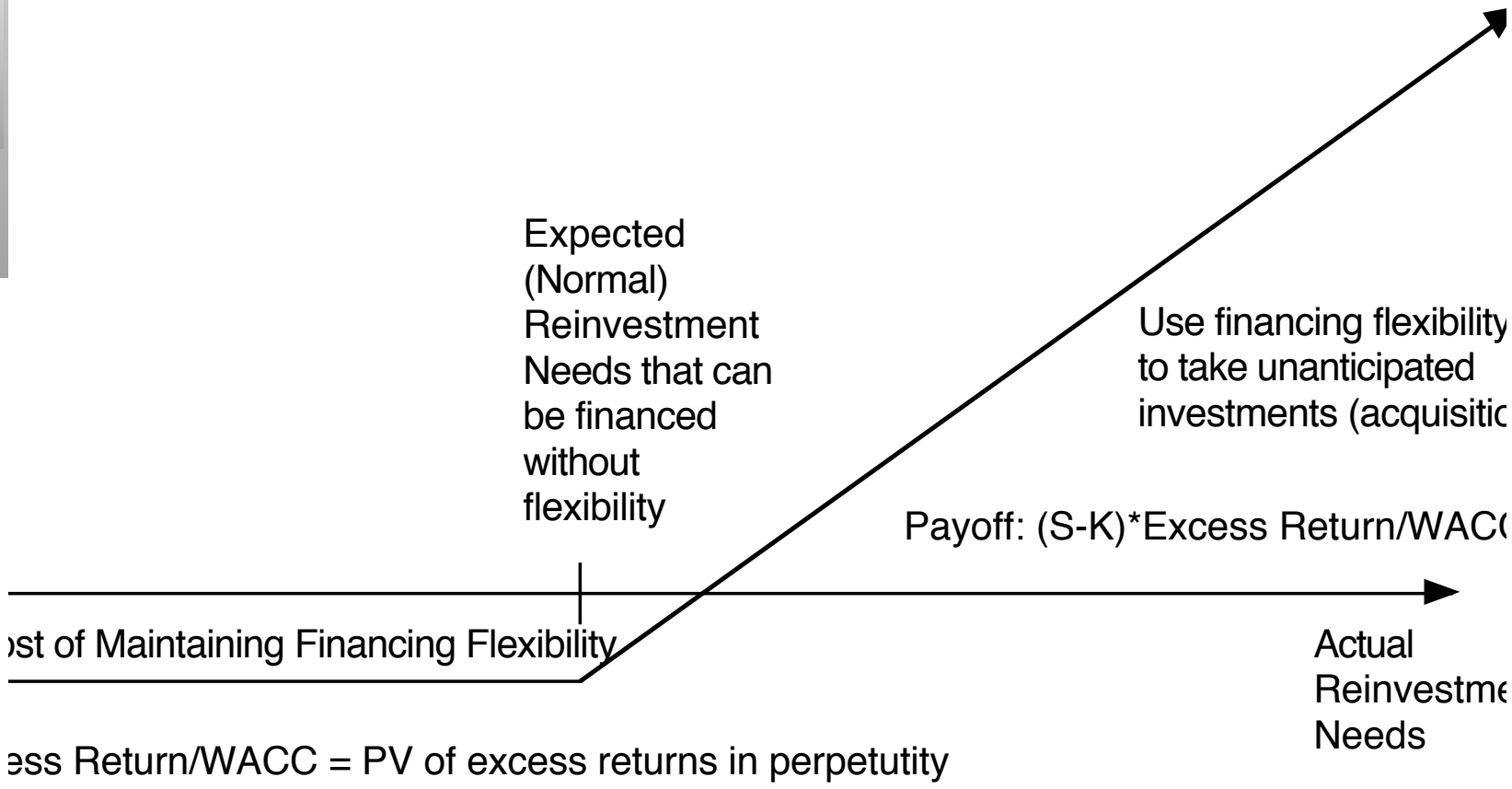
  Value of investment = (ROC - Cost of capital)/ Cost of capital

- The value of the investments that you can take because you have excess debt capacity becomes the payoff to maintaining excess debt capacity.

If X > L: [(ROC - Cost of capital)/ Cost of capital] New investments

If X<L: 0

The Value of Flexibility



Disney's Optimal Debt Ratio

Debt Ratio	Cost of Equity	Cost of Debt	Cost of Capital
0.00%	13.00%	4.61%	13.00%
10.00%	13.43%	4.61%	12.55%
Current:18%	**13.85%**	**4.80%**	**12.22%**
20.00%	13.96%	4.99%	12.17%
30.00%	14.65%	5.28%	11.84%
40.00%	*15.56%*	*5.76%*	*11.64%*
50.00%	16.85%	6.56%	11.70%
60.00%	18.77%	7.68%	12.11%
70.00%	21.97%	7.68%	11.97%
80.00%	28.95%	7.97%	12.17%
90.00%	52.14%	9.42%	13.69%

Inputs to Option Valuation Model- Disney

Model input	Estimated as	In general…	For Disney
S	Expected annual reinvestment needs (as % of firm value)	Measures magnitude of reinvestment needs	Average of Reinvestment/ Value over last 5 years = 5.3%
σ^2	Variance in annual reinvestment needs	Measures how much volatility there is in investment needs.	Variance over last 5 years in ln(Reinvestment /Value) =0.375
K	(Internal + Normal access to external funds)/ Value	Measures the capital constraint	Average over last 5 years = 4.8%
T	1 year	Measures an annual value for flexibility	T =1

Valuing Flexibility at Disney

The value of an option with these characteristics is 1.6092%. You can consider this the value of the option to take a project, but the overall value of flexibility will still depend upon the quality of the projects taken. In other words, the value of the option to take a project is zero if the project has zero net present value.

- Disney earns 18.69% on its projects has a cost of capital of 12.22%. *The excess return (annually) is 6.47%. Assuming that they can continue to generate these excess returns in perpetuity:*

Value of Flexibility (annual)= 1.6092%(.0647/.1222) = 0.85 % of value

- Disney's cost of capital at its optimal debt ratio is 11.64%. The cost it incurs to maintain flexibility is therefore 0.58% annually (12.22%-11.64%). It therefore pays to maintain flexibility.

Determinants of the Value of Flexibility

- Capital Constraints (External and Internal): The greater the capacity to raise funds, either internally or externally, the less the value of flexibility.
  - 1.1: Firms with significant internal operating cash flows should value flexibility less than firms with small or negative operating cash flows.
  - 1.2: Firms with easy access to financial markets should have a lower value for flexibility than firms without that access.
- Unpredictability of reinvestment needs: The more unpredictable the reinvestment needs of a firm, the greater the value of flexibility.
- Capacity to earn excess returns: The greater the capacity to earn excess returns, the greater the value of flexibility.
  - 1.3: Firms that do not have the capacity to earn or sustain excess returns get no value from flexibility.

Option Pricing Applications in Valuation

Equity Value in Deeply Troubled Firms

Value of Undeveloped Reserves for Natural Resource Firm

Value of Patent/License

Option Pricing Applications in Equity Valuation

- Equity in a troubled firm (i.e. a firm with high leverage, negative earnings and a significant chance of bankruptcy) can be viewed as a call option, which is the option to liquidate the firm.
- Natural resource companies, where the undeveloped reserves can be viewed as options on the natural resource.
- Start-up firms or high growth firms which derive the bulk of their value from the rights to a product or a service (eg. a patent)

Valuing Equity as an option

- The equity in a firm is a **residual claim**, i.e., equity holders lay claim to all cashflows left over after other financial claim-holders (debt, preferred stock etc.) have been satisfied.
- If a firm is liquidated, the same principle applies, with equity investors **receiving whatever is left over in the firm** after all outstanding debts and other financial claims are paid off.
- The **principle of limited liability**, however, protects equity investors in publicly traded firms if the value of the firm is less than the value of the outstanding debt, and they cannot lose more than their investment in the firm.

Equity as a call option

- The payoff to equity investors, on liquidation, can therefore be written as:

Payoff to equity on liquidation	= V - D	if V > D
	= 0	if V ≤ D

where,

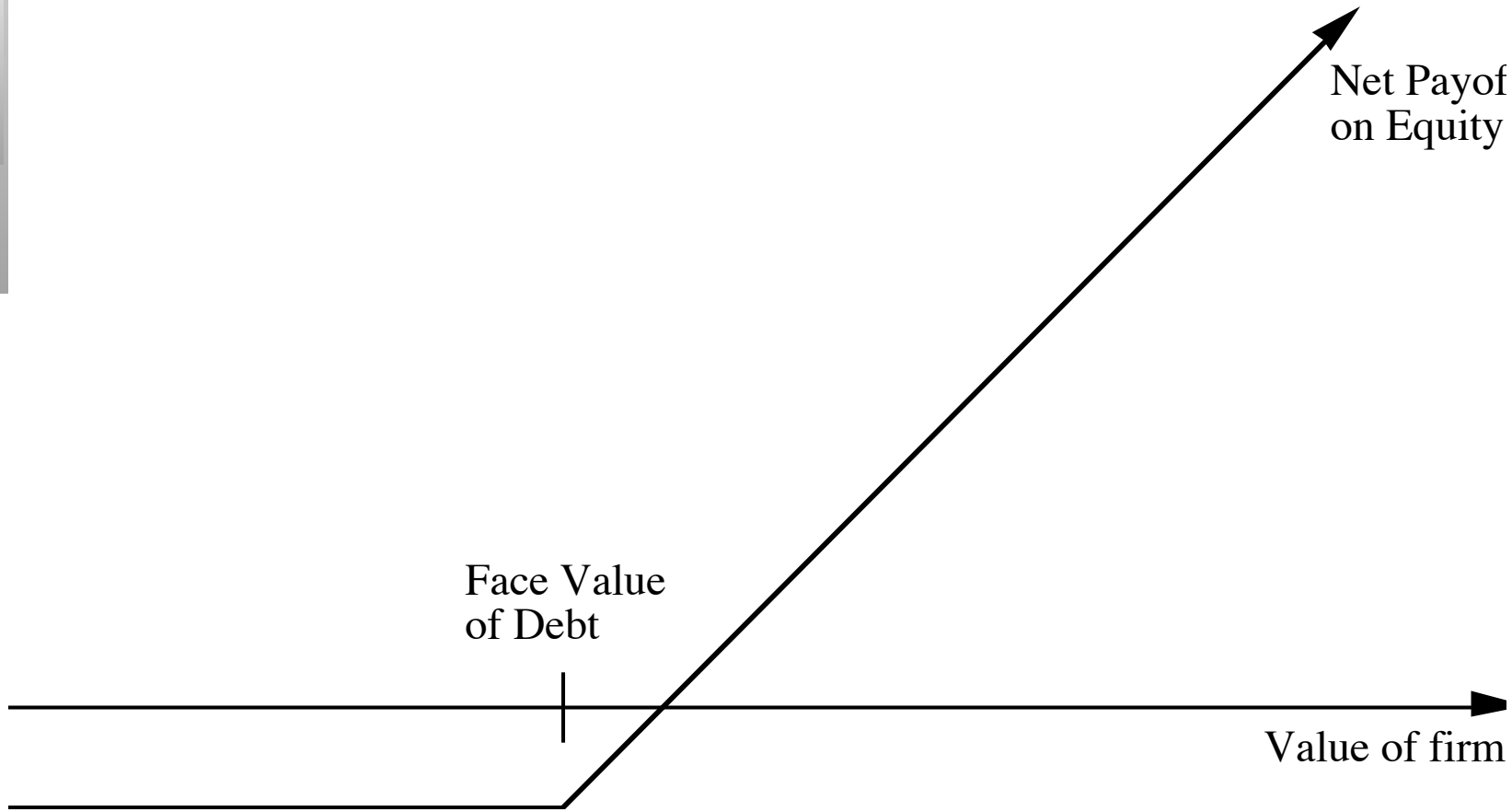
V = Value of the firm

D = Face Value of the outstanding debt and other external claims

- A call option, with a strike price of K, on an asset with a current value of S, has the following payoffs:

Payoff on exercise	= S - K	if S > K
	= 0	if S ≤ K

Payoff Diagram for Liquidation Option



Application to valuation: A simple example

- Assume that you have a firm whose assets are currently valued at $100 million and that the standard deviation in this asset value is 40%.
- Further, assume that the face value of debt is $80 million (It is zero coupon debt with 10 years left to maturity).
- If the ten-year treasury bond rate is 10%,
  - how much is the equity worth?
  - What should the interest rate on debt be?

Model Parameters

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

Valuing Equity as a Call Option

- Based upon these inputs, the Black-Scholes model provides the following value for the call:
  - d1 = 1.5994 N(d1) = 0.9451
  - d2 = 0.3345 N(d2) = 0.6310
- Value of the call = 100 (0.9451) - 80 $\exp^{(-0.10)(10)}$ (0.6310) = $75.94 million
- Value of the outstanding debt = $100 - $75.94 = $24.06 million
- Interest rate on debt = ($ 80 / $24.06)$^{1/10}$ -1 = 12.77%

I. The Effect of Catastrophic Drops in Value

- Assume now that a catastrophe wipes out half the value of this firm (the value drops to $ 50 million), while the face value of the debt remains at $ 80 million. What will happen to the equity value of this firm?
  - It will drop in value to $ 25.94 million [$ 50 million - market value of debt from previous page]
  - It will be worth nothing since debt outstanding > Firm Value
  - It will be worth more than $ 25.94 million

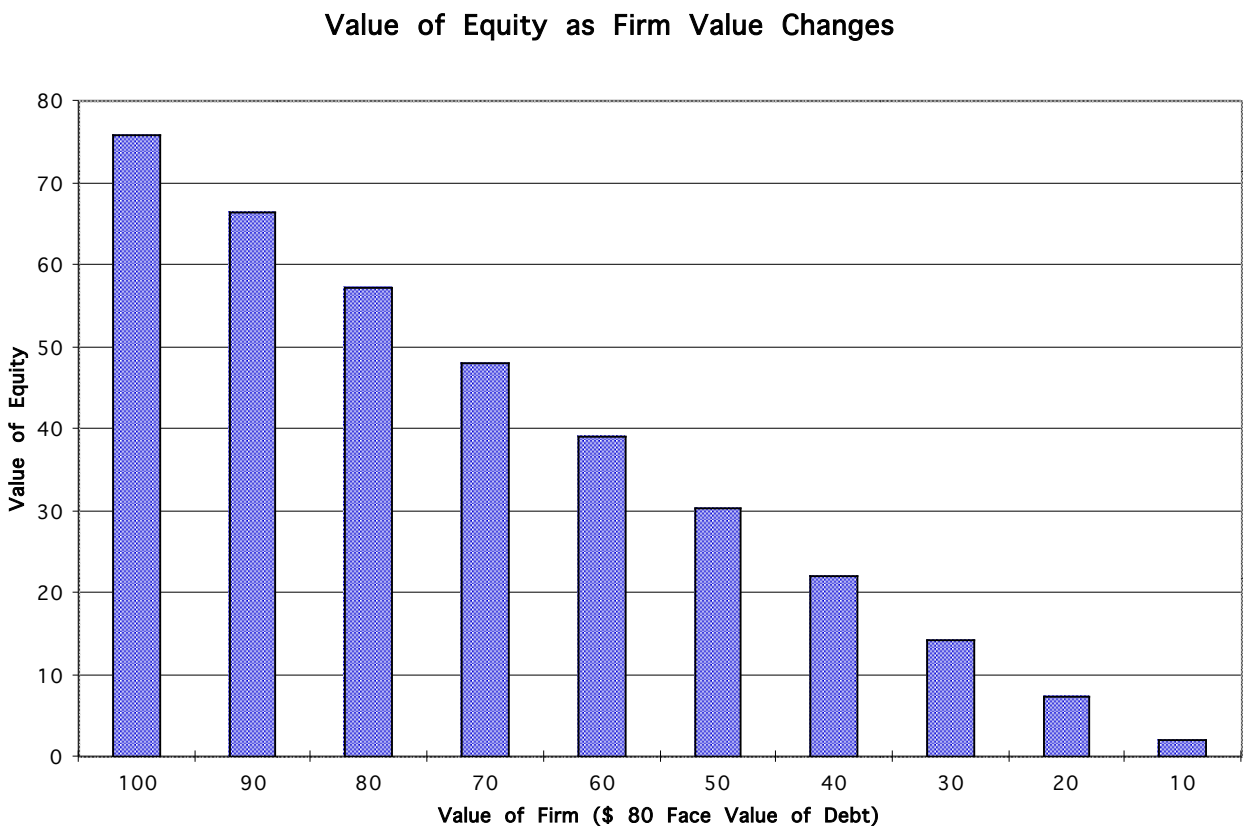
Valuing Equity in the Troubled Firm

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

The Value of Equity as an Option

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

Equity value persists ..



II. The conflict between stockholders and bondholders

- Consider again the firm described in the earlier example , with a value of assets of $100 million, a face value of zero-coupon ten-year debt of $80 million, a standard deviation in the value of the firm of 40%. The equity and debt in this firm were valued as follows:
  - Value of Equity = $75.94 million
  - Value of Debt = $24.06 million
  - Value of Firm == $100 million
- Now assume that the stockholders have the opportunity to take a project with a negative net present value of -$2 million, but assume that this project is a very risky project that will push up the standard deviation in firm value to 50%. Would you invest in this project?
  a) Yes
  b) No

Valuing Equity after the Project

- Value of the underlying asset = S = Value of the firm = $ 100 million - $2 million = $ 98 million (The value of the firm is lowered because of the negative net present value project)
- Exercise price = K = Face Value of outstanding debt = $ 80 million
- Life of the option = t = Life of zero-coupon debt = 10 years
- Variance in the value of the underlying asset = σ^2 = Variance in firm value = 0.25
- Riskless rate = r = Treasury bond rate corresponding to option life = 10%

Option Valuation

- Option Pricing Results for Equity and Debt Value
  - Value of Equity = $77.71
  - Value of Debt = $20.29
  - Value of Firm = $98.00
- The value of equity rises from $75.94 million to $ 77.71 million , even though the firm value declines by $2 million. The increase in equity value comes at the expense of bondholders, who find their wealth decline from $24.06 million to $20.19 million.

Effects of an Acquisition

- Assume that you are the manager of a firm and that you buy another firm, with a fair market value of $ 150 million, for exactly $ 150 million. In an efficient market, the stock price of your firm will
  - Increase
  - Decrease
  - Remain Unchanged

Effects on equity of a conglomerate merger

- You are provided information on two firms, which operate in unrelated businesses and hope to merge.

	Firm A	Firm B
Value of the firm	$100 million	$ 150 million
Face Value of Debt (10 yr zeros)	$ 80 million	$ 50 million
Maturity of debt	10 years	10 years
Std. Dev. in value	40 %	50 %
Correlation between cashflows	0.4	

The ten-year bond rate is 10%.

- The variance in the value of the firm after the acquisition can be calculated as follows:

Variance in combined firm value $= w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2 w_1 w_2 \rho_{12} \sigma_1 \sigma_2$

$= (0.4)^2 (0.16) + (0.6)^2 (0.25) + 2 (0.4) (0.6) (0.4) (0.4) (0.5)$

$= 0.154$

Valuing the Combined Firm

- The values of equity and debt in the individual firms and the combined firm can then be estimated using the option pricing model:

	Firm A	Firm B	Combined firm
Value of equity in the firm	$75.94	$134.47	$ 207.43
Value of debt in the firm	$24.06	$ 15.53	$ 42.57
Value of the firm	$100.00	$150.00	$ 250.00

- The combined value of the equity prior to the merger is $ 210.41 million and it declines to $207.43 million after.
- The wealth of the bondholders increases by an equal amount.
- There is a **transfer of wealth from stockholders to bondholders**, as a consequence of the merger. Thus, conglomerate mergers that are not followed by increases in leverage are likely to see this redistribution of wealth occur across claim holders in the firm.

Obtaining option pricing inputs - Some real world problems

- The examples that have been used to illustrate the use of option pricing theory to value equity have made some simplifying assumptions. Among them are the following:
  (1) There were only two claim holders in the firm - debt and equity.
  (2) There is only one issue of debt outstanding and it can be retired at face value.
  (3) The debt has a zero coupon and no special features (convertibility, put clauses etc.)
  (4) The value of the firm and the variance in that value can be estimated.

Real World Approaches to Valuing Equity in Troubled Firms: Getting Inputs

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

Valuing Equity as an option - Eurotunnel in early 1998

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

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

The Basic DCF Valuation

- The value of the firm estimated using projected cashflows to the firm, discounted at the weighted average cost of capital was £2,312 million.
- This was based upon the following assumptions –
  - Revenues will grow 5% a year in perpetuity.
  - The COGS which is currently 85% of revenues will drop to 65% of revenues in yr 5 and stay at that level.
  - Capital spending and depreciation will grow 5% a year in perpetuity.
  - There are no working capital requirements.
  - The debt ratio, which is currently 95.35%, will drop to 70% after year 5. The cost of debt is 10% in high growth period and 8% after that.
  - The beta for the stock will be 1.10 for the next five years, and drop to 0.8 after the next 5 years.
  - The long term bond rate is 6%.

Other Inputs

- The stock has been traded on the London Exchange, and the annualized std deviation based upon ln (prices) is 41%.
- There are Eurotunnel bonds, that have been traded; the annualized std deviation in ln(price) for the bonds is 17%.
  - The correlation between stock price and bond price changes has been 0.5. The proportion of debt in the capital structure during the period (1992-1996) was 85%.
  - Annualized variance in firm value

  $= (0.15)^2 (0.41)^2 + (0.85)^2 (0.17)^2 + 2 (0.15) (0.85)(0.5)(0.41)(0.17) = 0.0335$
- The 15-year bond rate is 6%. (I used a bond with a duration of roughly 11 years to match the life of my option)

Valuing Eurotunnel Equity and Debt

- Inputs to Model
  - Value of the underlying asset = S = Value of the firm = £2,312 million
  - Exercise price = K = Face Value of outstanding debt = £8,865 million
  - Life of the option = t = Weighted average duration of debt = 10.93 years
  - Variance in the value of the underlying asset = σ^2 = Variance in firm value = 0.0335
  - Riskless rate = r = Treasury bond rate corresponding to option life = 6%
- Based upon these inputs, the Black-Scholes model provides the following value for the call:

  d1 = -0.8337 N(d1) = 0.2023

  d2 = -1.4392 N(d2) = 0.0751
- Value of the call = 2312 (0.2023) - 8,865 $\exp^{(-0.06)(10.93)}$ (0.0751) = £122 million
- Appropriate interest rate on debt = $(8865/2190)^{(1/10.93)}$-1= 13.65%

In Closing…

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

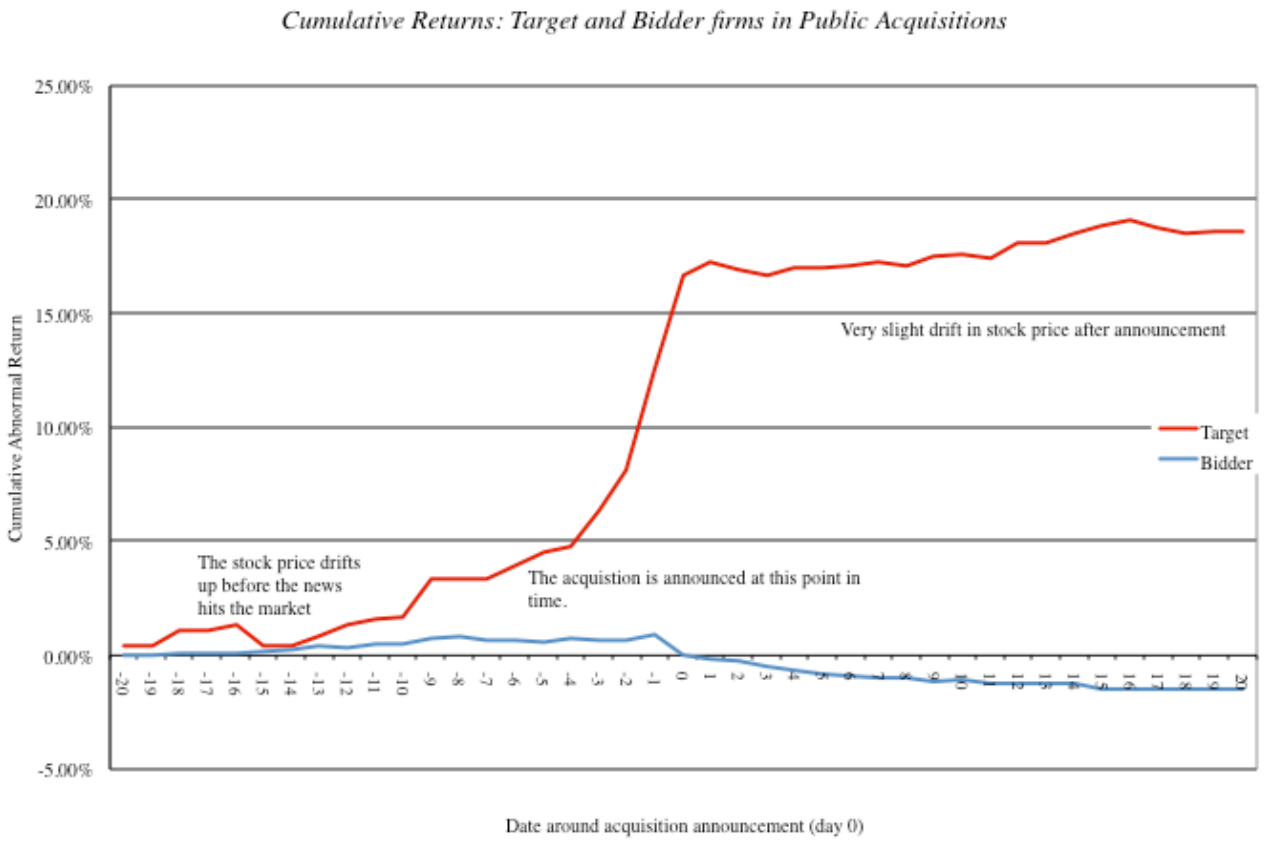
Industry Name	*Std Dev(Equity)*	*Std Dev(Firm)*	*Industry Name*	*Std Dev(Equity)*	*Std Dev(Firm)*
Advertising	35.48%	27.11%	Household Products	29.40%	24.91%
Aerospace/Defense	37.40%	33.13%	Industrial Services	43.95%	39.62%
Air Transport	44.52%	33.80%	Insurance (Diversified)	28.46%	26.99%
Aluminum	29.20%	22.05%	Insurance (Life)	30.61%	29.15%
Apparel	45.25%	37.34%	Insurance (Prop/Casualty)	26.98%	25.68%
Auto & Truck	31.01%	23.90%	Investment Co. (Domestic)	23.40%	22.28%
Auto Parts (OEM)	31.21%	26.63%	Investment Co. (Foreign)	28.01%	27.91%
Auto Parts (Replacement)	33.28%	25.71%	Investment Co. (Income)	10.95%	10.95%
Bank	24.44%	22.44%	Machinery	35.25%	30.94%
Bank (Canadian)	21.18%	19.12%	Manuf. Housing/Rec Veh	41.09%	36.00%
Bank (Foreign)	23.12%	22.39%	Maritime	33.85%	24.38%
Bank (Midwest)	20.13%	19.15%	Medical Services	63.58%	55.77%
Beverage (Alcoholic)	22.21%	20.24%	Medical Supplies	54.33%	50.44%
Beverage (Soft Drink)	37.59%	32.50%	Metal Fabricating	35.61%	32.85%
Building Materials	35.68%	31.08%	Metals & Mining (Div.)	55.48%	50.20%
Cable TV	41.41%	21.67%	Natural Gas (Distrib.)	19.35%	15.23%
Canadian Energy	25.24%	21.41%	Natural Gas (Diversified)	33.69%	28.21%
Cement & Aggregates	32.83%	29.86%	Newspaper	23.54%	19.99%
Chemical (Basic)	29.43%	25.16%	Office Equip & Supplies	34.40%	29.32%
Chemical (Diversified)	30.87%	27.01%	Oilfield Services/Equip.	43.25%	39.70%
Chemical (Specialty)	33.74%	29.34%	Packaging & Container	37.44%	30.32%
Coal/Alternate Energy	40.48%	34.85%	Paper & Forest Products	28.41%	17.50%
Computer & Peripherals	64.64%	59.54%	Petroleum (Integrated)	25.66%	20.98%
Computer Software & Svcs	52.88%	50.35%	Petroleum (Producing)	49.32%	42.47%
Copper	30.41%	12.62%	Precision Instrument	47.36%	44.21%
Diversified Co.	42.82%	35.20%	Publishing	35.89%	30.75%
Drug	59.77%	58.50%	R.E.I.T.	25.06%	24.52%
Drugstore	47.64%	36.63%	Railroad	23.73%	19.37%
Electric Util. (Central)	14.93%	11.38%	Recreation	50.25%	39.58%
Electric Utility (East)	16.56%	11.67%	Restaurant	40.12%	35.55%
Electric Utility (West)	18.18%	13.80%	Retail (Special Lines)	51.20%	39.98%
Electrical Equipment	43.70%	39.49%	Retail Building Supply	40.55%	33.95%
Electronics	53.39%	48.39%	Retail Store	40.14%	29.46%
Entertainment	36.01%	28.95%	Securities Brokerage	33.42%	22.74%
Environmental	53.98%	43.74%	Semiconductor	54.64%	52.72%
Financial Services	36.16%	27.68%	Semiconductor Cap Equip	53.41%	52.50%
Food Processing	33.13%	26.83%	Shoe	44.63%	40.08%
Food Wholesalers	27.60%	22.11%	Steel (General)	33.73%	28.96%
Foreign Diversified	91.01%	44.08%	Steel (Integrated)	40.34%	27.69%
Foreign Electron/Entertn	34.03%	29.17%	Telecom. Equipment	61.61%	56.72%
Foreign Telecom.	36.18%	32.99%	Telecom. Services	42.29%	35.05%
Furn./Home Furnishings	34.62%	30.90%	Textile	31.60%	24.12%
Gold/Silver Mining	49.57%	46.46%	Thrift	28.94%	26.42%
Grocery	31.64%	21.84%	Tire & Rubber	26.39%	23.60%
Healthcare Info Systems	57.80%	54.69%	Tobacco	33.85%	25.31%
Home Appliance	34.82%	29.48%	Toiletries/Cosmetics	42.97%	36.82%
Homebuilding	43.66%	27.13%	Trucking/Transp. Leasing	38.09%	29.21%
Hotel/Gaming	45.01%	29.76%	Utility (Foreign)	23.17%	18.34%
			Water Utility	18.53%	14.16%

Acquirers Anonymous: Seven Steps back to Sobriety…

Aswath Damodaran
Stern School of Business, New York University

www.damodaran.com

Acquisitions are great for target companies but not always for acquiring company stockholders…



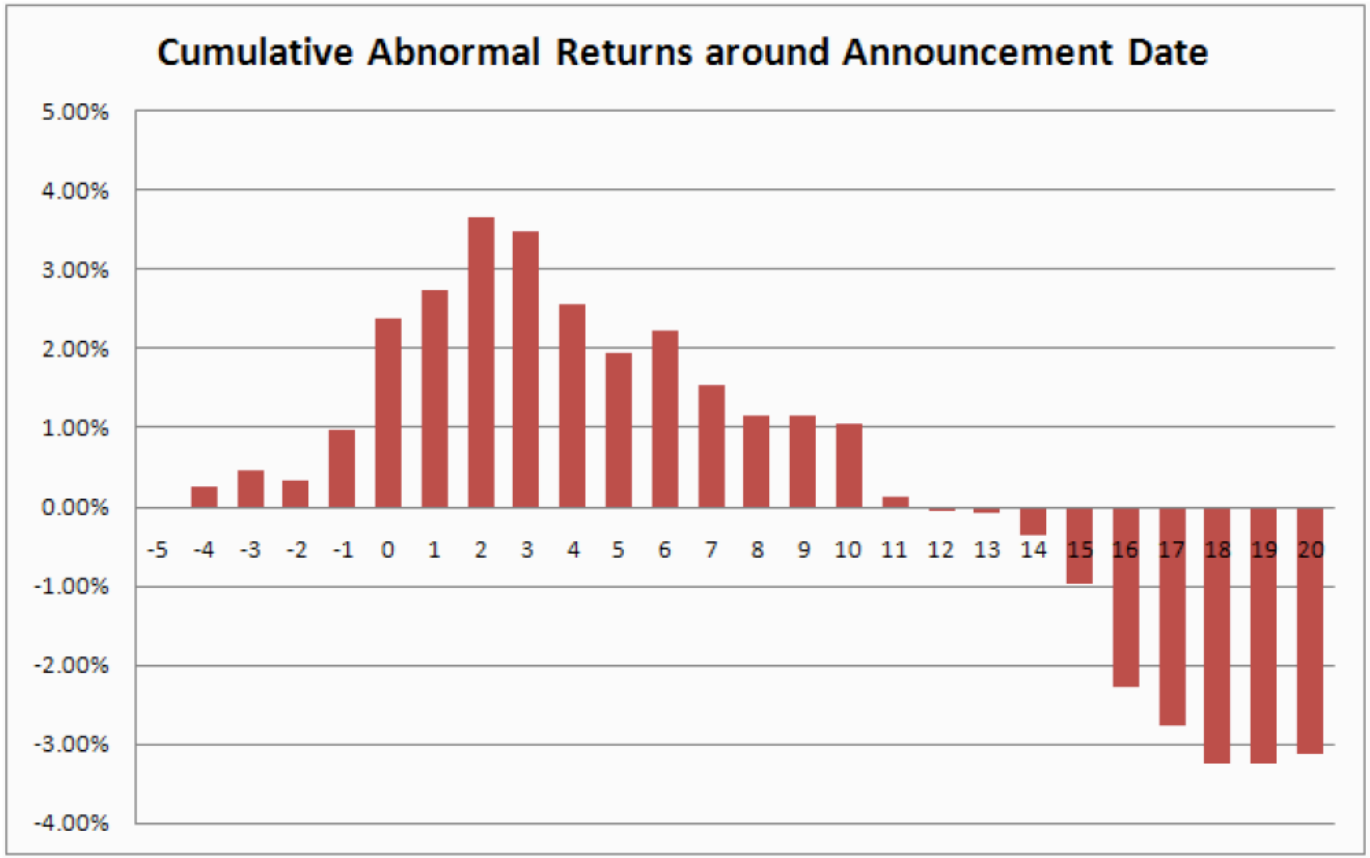
And the long-term follow up is not positive either..

- Managers often argue that the market is unable to see the long term benefits of mergers that they can see at the time of the deal. If they are right, mergers should create long term benefits to acquiring firms.
- The evidence does not support this hypothesis:
  - McKinsey and Co. has examined acquisition programs at companies on
    - Did the return on capital invested in acquisitions exceed the cost of capital?
    - Did the acquisitions help the parent companies outperform the competition?

    Half of all programs failed one test, and a quarter failed both.
  - Synergy is elusive. KPMG in a more recent study of global acquisitions concludes that most mergers (>80%) fail - the merged companies do worse than their peer group.
  - A large number of acquisitions that are reversed within fairly short time periods. About 20% 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%.

A scary thought… The disease is spreading… Indian firms acquiring US targets – 1999 - 2005

Indian Acquirers: Returns around acquisition announcements



Growing through acquisitions seems to be a "loser's game"

- Firms that grow through acquisitions have generally had far more trouble creating value than firms that grow through internal investments.
- In general, acquiring firms tend to
  - Pay too much for target firms
  - Over estimate the value of "synergy" and "control"
  - Have a difficult time delivering the promised benefits
- Worse still, there seems to be very little learning built into the process. The same mistakes are made over and over again, often by the same firms with the same advisors.
- Conclusion: There is something structurally wrong with the process for acquisitions which is feeding into the mistakes.

The seven sins in acquisitions…

1. Risk Transference: Attributing acquiring company risk characteristics to the target firm.
2. Debt subsidies: Subsiding target firm stockholders for the strengths of the acquiring firm.
3. Auto-pilot Control: The "20% control premium" and other myth…
4. Elusive Synergy: Misidentifying and mis-valuing synergy.
5. Its all relative: Transaction multiples, exit multiples…
6. Verdict first, trial afterwards: Price first, valuation to follow
7. It's not my fault: Holding no one responsible for delivering results.

Testing sheet

Test	Passed/Failed	Rationalization
Risk transference		
Debt subsidies		
Control premium		
The value of synergy		
Comparables and Exit Multiples		
Bias		
A successful acquisition strategy		

Lets start with a target firm

- The target firm has the following income statement:

	Revenues	100
-	Operating Expenses	80
=	Operating Income	20
-	Taxes	8
=	After-tax OI	12

- Assume that this firm will generate this operating income forever (with no growth) and that the cost of equity for this firm is 20%. The firm has no debt outstanding. What is the value of this firm?

Test 1: Risk Transference…

- Assume that as an acquiring firm, you are in a much safer business and have a cost of equity of 10%. What is the value of the target firm to you?

Lesson 1: Don't transfer your risk characteristics to the target firm

- The cost of equity used for an investment should reflect the risk of the investment and not the risk characteristics of the investor who raised the funds.
- Risky businesses cannot become safe just because the buyer of these businesses is in a safe business.

Test 2: Cheap debt?

- Assume as an acquirer that you have access to cheap debt (at 4%) and that you plan to fund half the acquisition with debt. How much would you be willing to pay for the target firm?

Lesson 2: Render unto the target firm that which is the target firm's but not a penny more..

- As an acquiring firm, it is entirely possible that you can borrow much more than the target firm can on its own and at a much lower rate. If you build these characteristics into the valuation of the target firm, you are essentially transferring wealth from your firm's stockholder to the target firm's stockholders.
- When valuing a target firm, use a cost of capital that reflects the debt capacity and the cost of debt that would apply to the firm.

Test 3: Control Premiums

- Assume that you are now told that it is conventional to pay a 20% premium for control in acquisitions (backed up by Mergerstat). How much would you be willing to pay for the target firm?

- Would your answer change if I told you that you can run the target firm better and that if you do, you will be able to generate a 30% pre-tax operating margin (rather than the 20% margin that is currently being earned).

- What if the target firm were perfectly run?

Lesson 3: Beware of rules of thumb…

- Valuation is cluttered with rules of thumb. After painstakingly valuing a target firm, using your best estimates, you will be often be told that
  - It is common practice to add arbitrary premiums for brand name, quality of management, control etc…
  - These premiums will be often be backed up by data, studies and services. What they will not reveal is the enormous sampling bias in the studies and the standard errors in the estimates.
  - If you have done your valuation right, those premiums should already be incorporated in your estimated value. Paying a premium will be double counting.

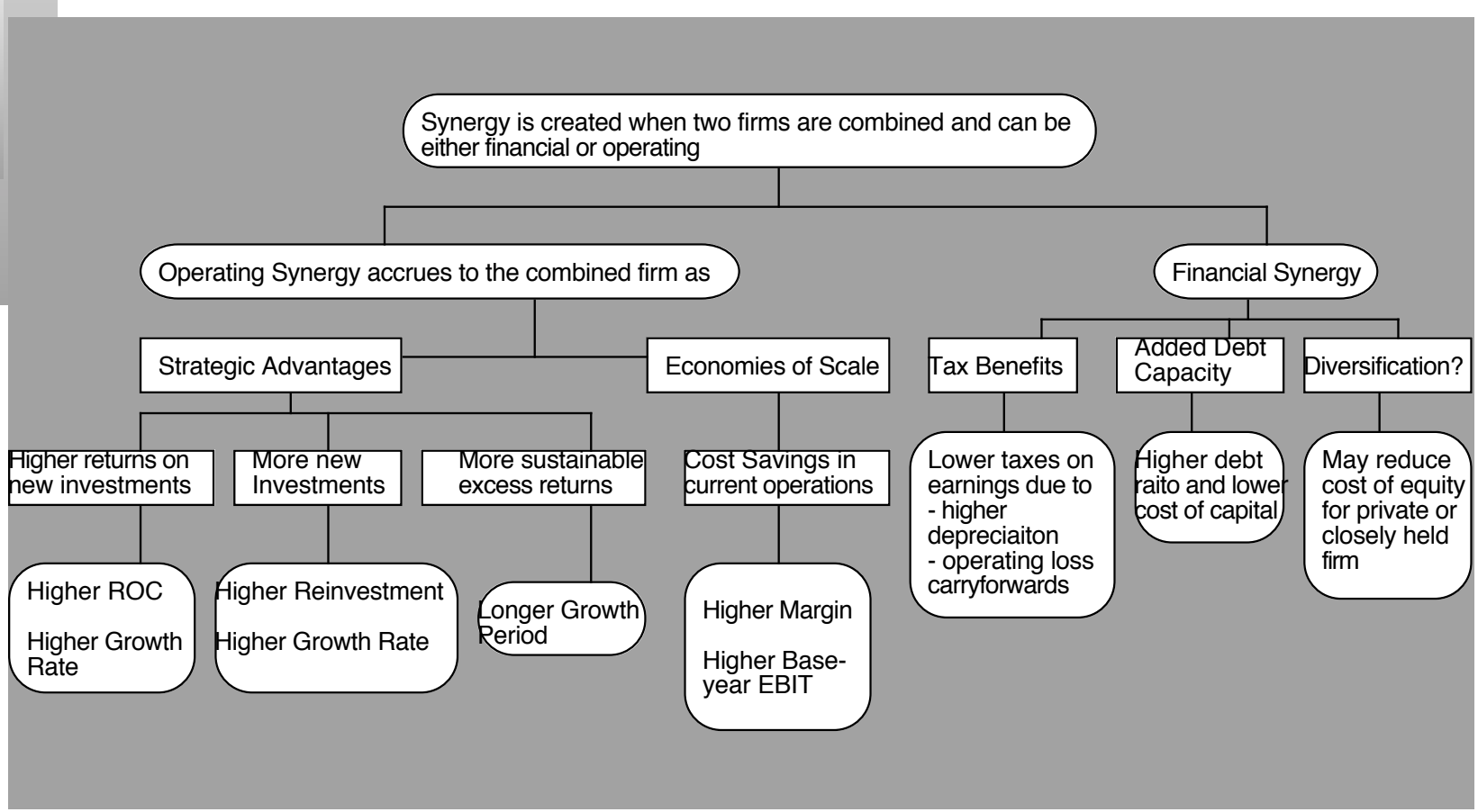
Test 4: Synergy….

- Assume that you are told that the combined firm will be less risky than the two individual firms and that it should have a lower cost of capital (and a higher value). Is this likely?

- Assume now that you are told that there are potential growth and cost savings synergies in the acquisition. Would that increase the value of the target firm?

- Should you pay this as a premium?

The Value of Synergy



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: Example 1
The illusion of "lower risk"

- When we estimate the cost of equity for a publicly traded firm, we focus only on the risk that cannot be diversified away in that firm (which is the rationale for using beta or betas to estimate the cost of equity).
- When two firms merge, it is true that the combined firm may be less risky than the two firms individually, but the risk that is reduced is 'firm specified risk'. By definition, market risk is risk that cannot be diversified away and the beta of the combined firm will always be a weighted average of the betas of the two firms in the merger.
- When does it make sense to "merge" to reduce total risk?

Synergy - Example 2
Higher growth and cost savings

	P&G	Gillette	Piglet: No Synergy	Piglet: Synergy	
Free Cashflow to Equity	$5,864.74	$1,547.50	$7,412.24	$7,569.73	Annual operating expenses reduced by $250 million
Growth rate for first 5 years	12%	10%	11.58%	12.50%	Slighly higher growth rate
Growth rate after five years	4%	4%	4.00%	4.00%	
Beta	0.90	0.80	0.88	0.88	
Cost of Equity	7.90%	7.50%	7.81%	7.81%	Value of synergy
Value of Equity	$221,292	$59,878	$281,170	$298,355	**$17,185**

Synergy: Example 3
Tax Benefits?

- Assume that you are Best Buys, the electronics retailer, and that you would like to enter the hardware component of the market. You have been approached by investment bankers for Zenith, which while still a recognized brand name, is on its last legs financially. The firm has net operating losses of $ 2 billion. If your tax rate is 36%, estimate the tax benefits from this acquisition.

- If Best Buys had only $500 million in taxable income, how would you compute the tax benefits?

- If the market value of Zenith is $800 million, would you pay this tax benefit as a premium on the market value?

Synergy: Example 4
Asset Write-up

- One of the earliest leveraged buyouts was done on Congoleum Inc., a diversified firm in ship building, flooring and automotive accessories, in 1979 by the firm's own management.
  - After the takeover, estimated to cost $400 million, the firm would be allowed to write up its assets to reflect their new market values, and claim depreciation on the new values.
  - The estimated change in depreciation and the present value effect of this depreciation, discounted at the firm's cost of capital of 14.5% is shown below:

Congoleum's Tax Benefits

Year	*Deprec'n*	*Deprec'n before*	*Change in after*	*Tax Savings Deprec'n*	*PV*
1980	$8.00	$35.51	$27.51	$13.20	$11.53
1981	$8.80	$36.26	$27.46	$13.18	$10.05
1982	$9.68	$37.07	$27.39	$13.15	$8.76
1983	$10.65	$37.95	$27.30	$13.10	$7.62
1984	$11.71	$21.23	$9.52	$4.57	$2.32
1985	$12.65	$17.50	$4.85	$2.33	$1.03
1986	$13.66	$16.00	$2.34	$1.12	$0.43
1987	$14.75	$14.75	$0.00	$0.00	$0.00
1988	$15.94	$15.94	$0.00	$0.00	$0.00
1989	$17.21	$17.21	$0.00	$0.00	$0.00
1980-89	*$123.05*	*$249.42*	*$126.37*	*$60.66*	*$41.76*

Lesson 4: Don't pay for buzz words

- Through time, acquirers have always found ways of justifying paying for premiums over estimated value by using buzz words - synergy in the 1980s, strategic considerations in the 1990s and real options in this decade.
- While all of these can have value, the onus should be on those pushing for the acquisitions to show that they do and not on those pushing against them to show that they do not.

Test 5: Comparables and Exit Multiples

- Now assume that you are told that an analysis of other acquisitions reveals that acquirers have been willing to pay 5 times EBIT.. Given that your target firm has EBIT of $ 20 million, would you be willing to pay $ 100 million for the acquisition?

- What if I estimate the terminal value using an exit multiple of 5 times EBIT?

- As an additional input, your investment banker tells you that the acquisition is accretive. (Your PE ratio is 20 whereas the PE ratio of the target is only 10… Therefore, you will get a jump in earnings per share after the acquisition…)

Biased samples = Poor results

- Biased samples yield biased results. Basing what you pay on what other acquirers have paid is a recipe for disaster. After all, we know that acquirer, on average, pay too much for acquisitions. By matching their prices, we risk replicating their mistakes.
- Even when we use the pricing metrics of other firms in the sector, we may be basing the prices we pay on firms that are not truly comparable.
- When we use exit multiples, we are assuming that what the market is paying for comparable companies today is what it will continue to pay in the future.

Lesson 5: Don't be a lemming…

- All too often, acquisitions are justified by using one of the following two arguments:
  - Every one else in your sector is doing acquisitions. You have to do the same to survive.
  - The value of a target firm is based upon what others have paid on acquisitions, which may be much higher than what your estimate of value for the firm is.
- With the right set of comparable firms (selected to back up your story), you can justify almost any price.
- And EPS accretion is a meaningless measure. After all, buying an company with a PE lower than yours will lead mathematically to EPS accretion.

Test 6: The CEO really wants to do this…

- Now assume that you know that the CEO of the acquiring firm really, really wants to do this acquisition and that the investment bankers on both sides have produced fairness opinions that indicate that the firm is worth $ 100 million. Would you be willing to go along?

Lesson 6: Don't let egos or investment bankers get the better of common sense…

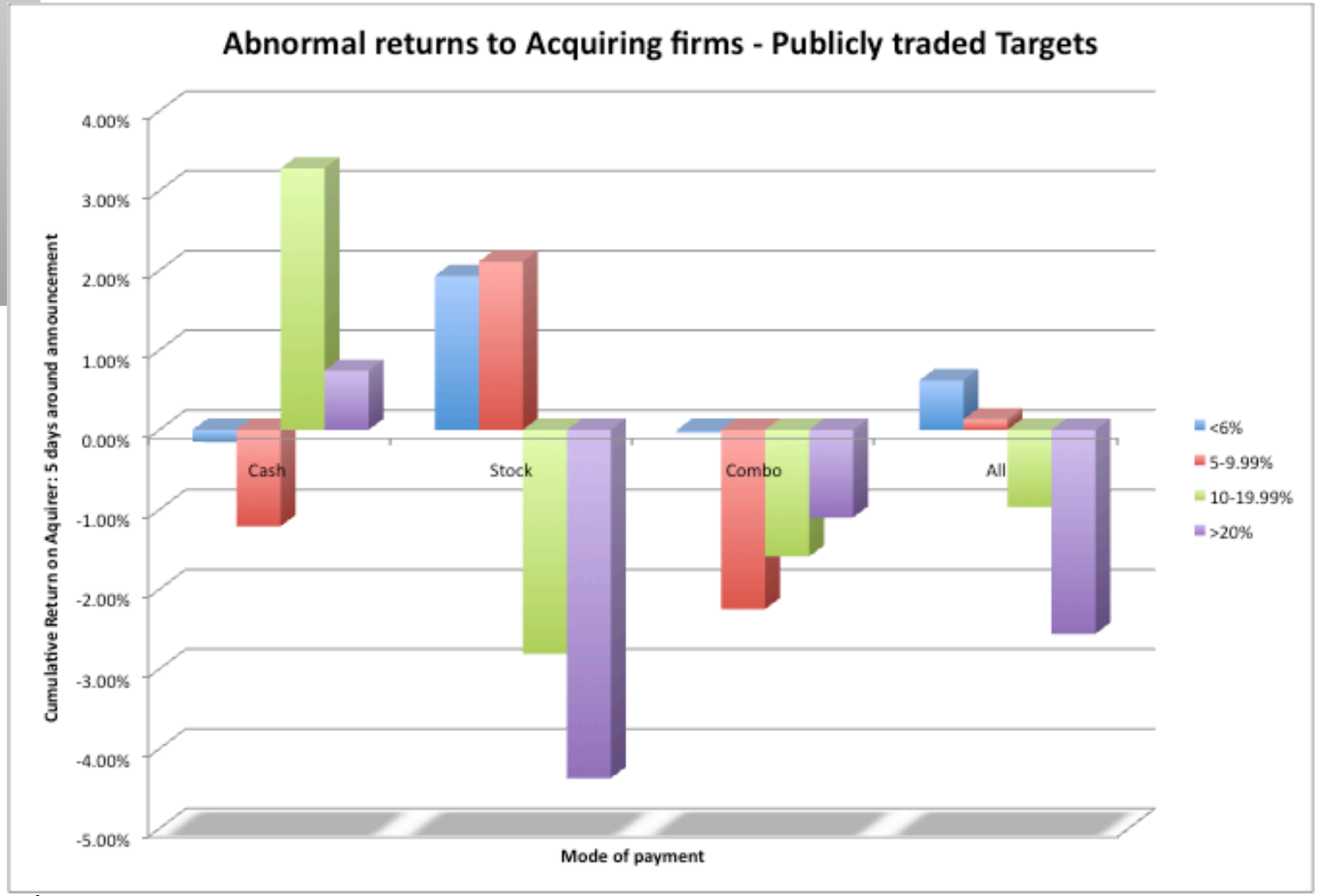
- If you define your objective in a bidding war as winning the auction at any cost, you will win. But beware the winner's curse!
- The premiums paid on acquisitions often have nothing to do with synergy, control or strategic considerations (though they may be provided as the reasons). They may just reflect the egos of the CEOs of the acquiring firms.

Test 7: Is it hopeless?

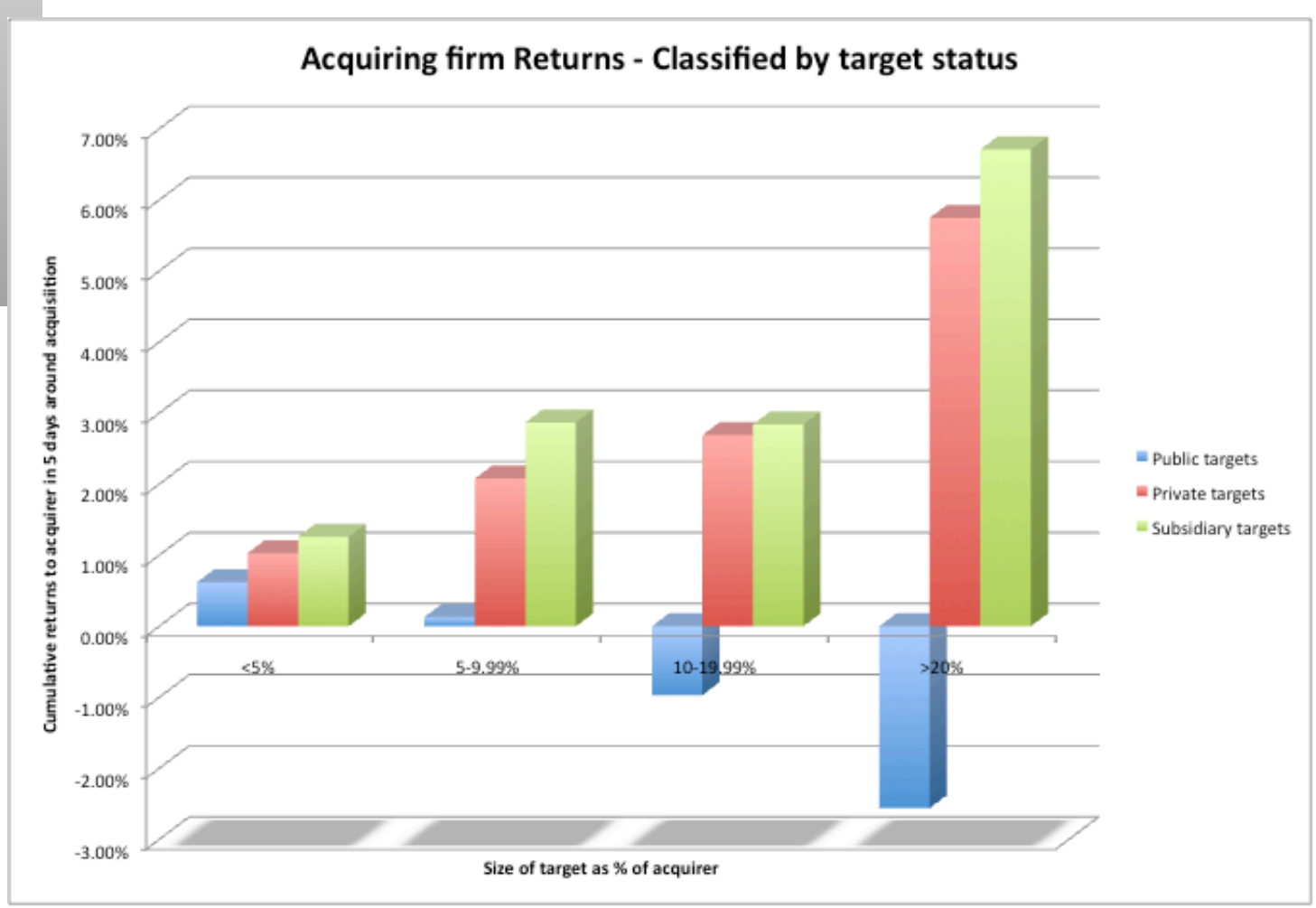
- The odds seem to be clearly weighted against success in acquisitions. If you were to create a strategy to grow, based upon acquisitions, which of the following offers your best chance of success?

This	Or this
Public target	Private target
Pay with cash	Pay with stock
Small target	Large target
Cost synergies	Growth synergies

You are better off buying small rather than large targets… with cash rather than stock



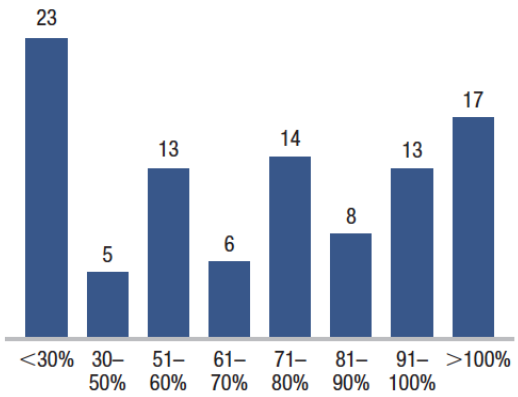
And focusing on private firms and subsidiaries, rather than public firms…



Growth vs Cost Synergies

Top-line trouble: 70 percent of mergers failed to achieve expected revenue synergies

Mergers achieving stated percentage of expected revenue synergies, percent $N = 77$



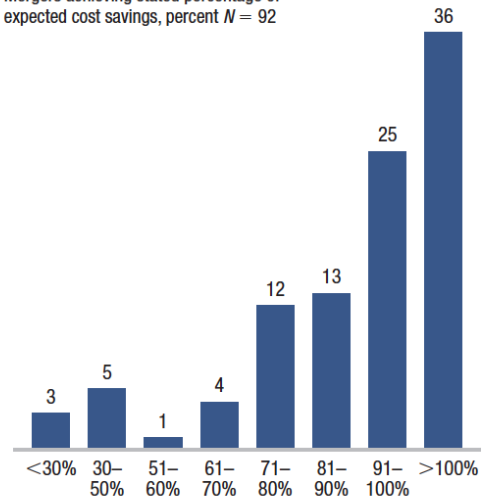
Typical sources of estimation error

- Ignoring or underestimating customer losses (typically 2% to 5%) that result from the integration
- Assuming growth or share targets out of line with overall market growth and competitive dynamics (no "outside view" calibration)

Source: McKinsey (2002) Postmerger Management Practice client survey; client case studies

Cost-synergy estimation is better, but there are patterns emerging in the errors

Mergers achieving stated percentage of expected cost savings, percent $N = 92$



Typical sources of estimation error

- Underestimating one-time costs
- Using benchmarks from noncomparable situations
- Not sanity-checking management estimates against precedent transactions
- Failing to ground estimates in bottom-up analysis (e.g., location-by-location review of overlaps

Source: McKinsey (2002) Postmerger Management Practice client survey; client case studies

Synergy: Odds of success

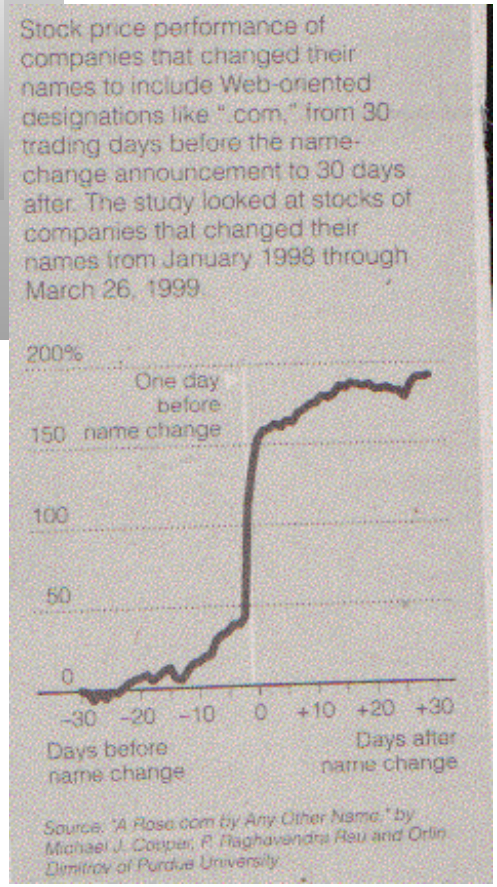
- Studies that have focused on synergies have concluded that you are far more likely to deliver cost synergies than growth synergies.
- Synergies that are concrete and planned for at the time of the merger are more likely to be delivered than fuzzy synergies.
- Synergy is much more likely to show up when someone is held responsible for delivering the synergy.
- You are more likely to get a share of the synergy gains in an acquisition when you are a single bidder than if you are one of multiple bidders.

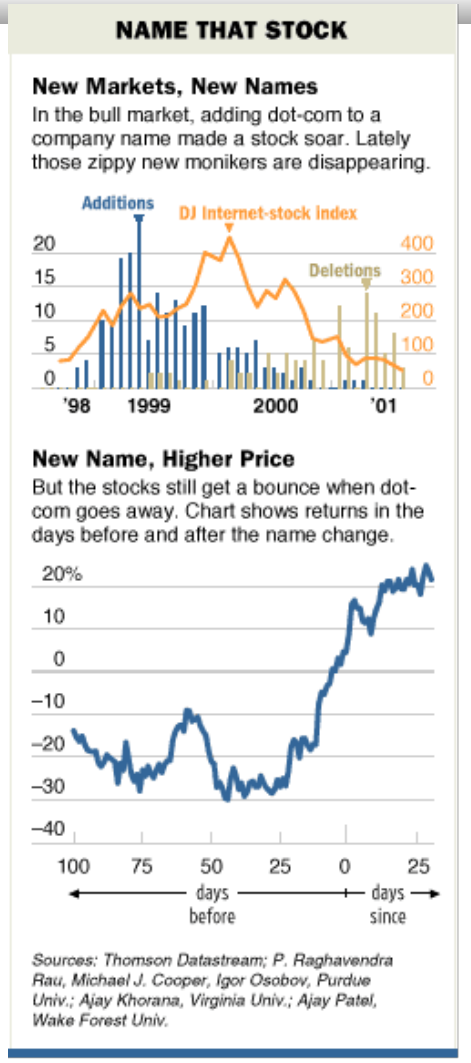
Lesson 7: For acquisitions to create value, you have to stay disciplined..

- If you have a successful acquisition strategy, stay focused on that strategy. Don't let size or hubris drive you to "expand" the strategy.
- Realistic plans for delivering synergy and control have to be put in place before the merger is completed. By realistic, we have to mean that the magnitude of the benefits have to be reachable and not pipe dreams and that the time frame should reflect the reality that it takes a while for two organizations to work as one.
- The best thing to do in a bidding war is to drop out.
- Someone (preferably the person pushing hardest for the merger) should be held to account for delivering the benefits.
- The compensation for investment bankers and others involved in the deal should be tied to how well the deal works rather than for getting the deal done.

Value Enhancement and the Expected Value of Control: Back to Basics

Price Enhancement versus Value Enhancement

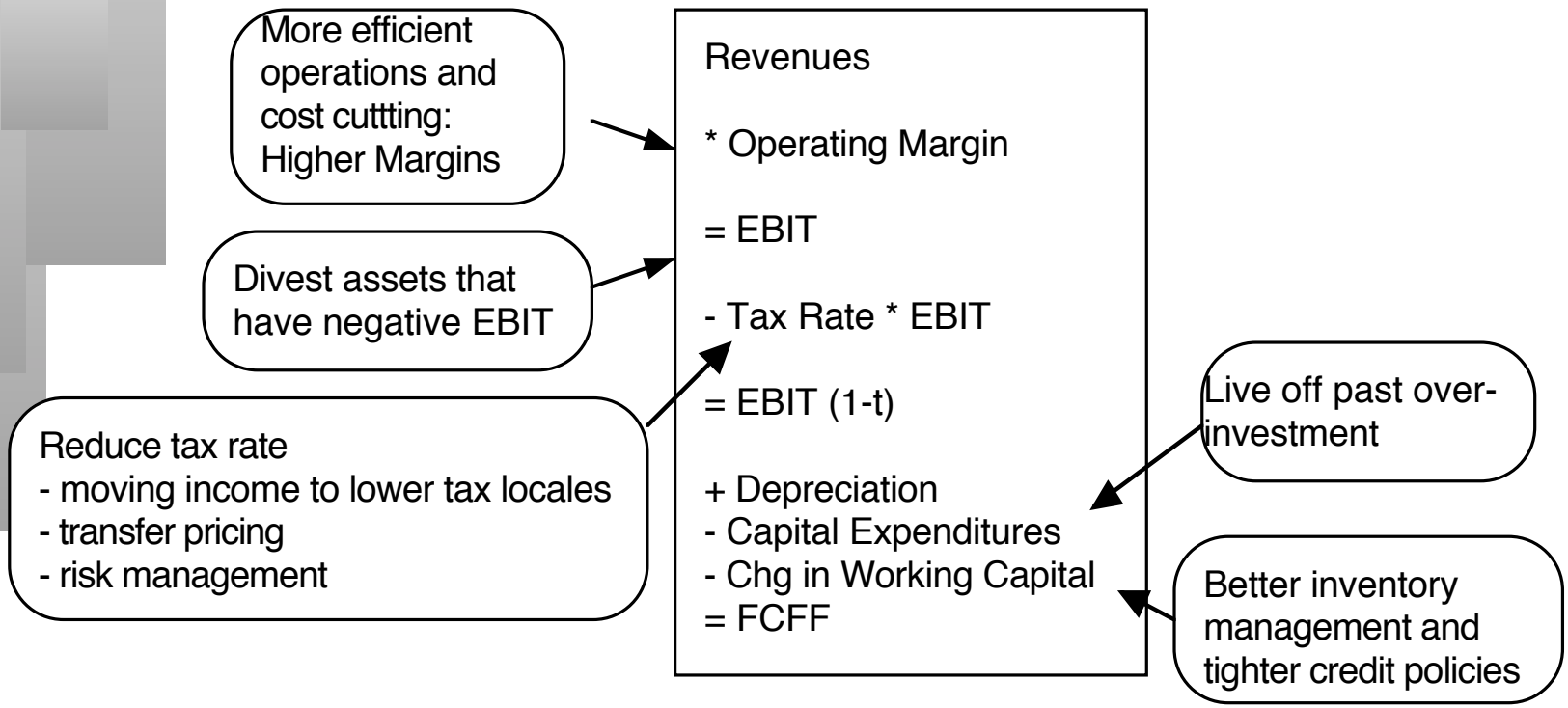




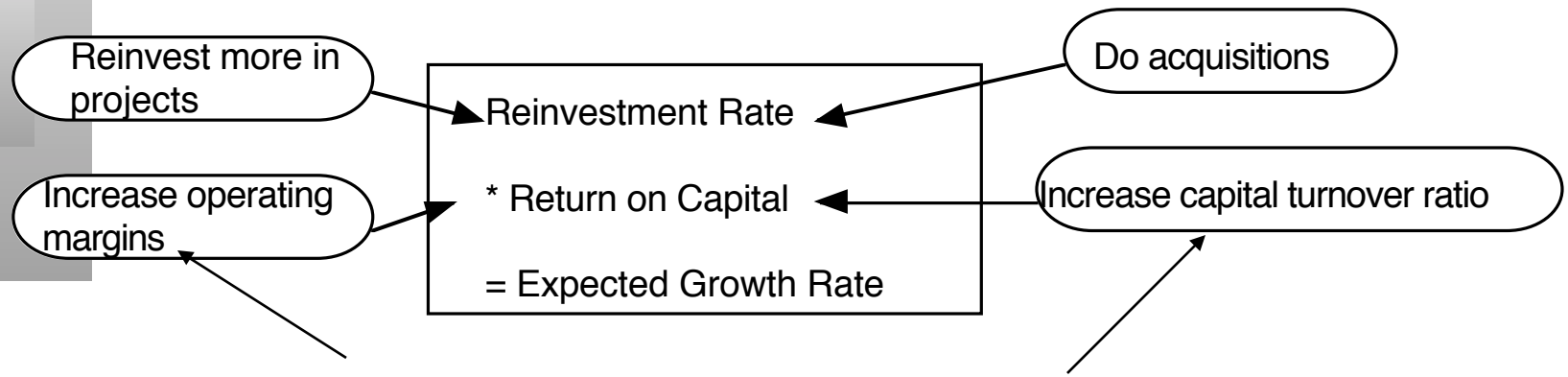
The Paths to Value Creation

- 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

Value Creation 1: Increase Cash Flows from Assets in Place



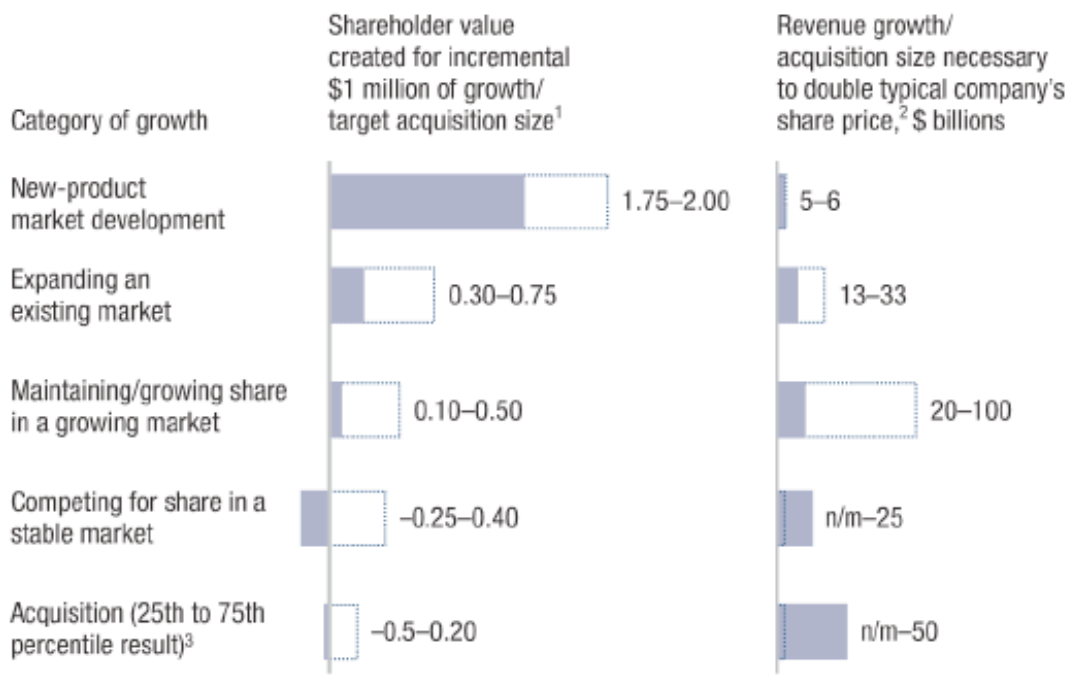
Value Creation 2: Increase Expected Growth



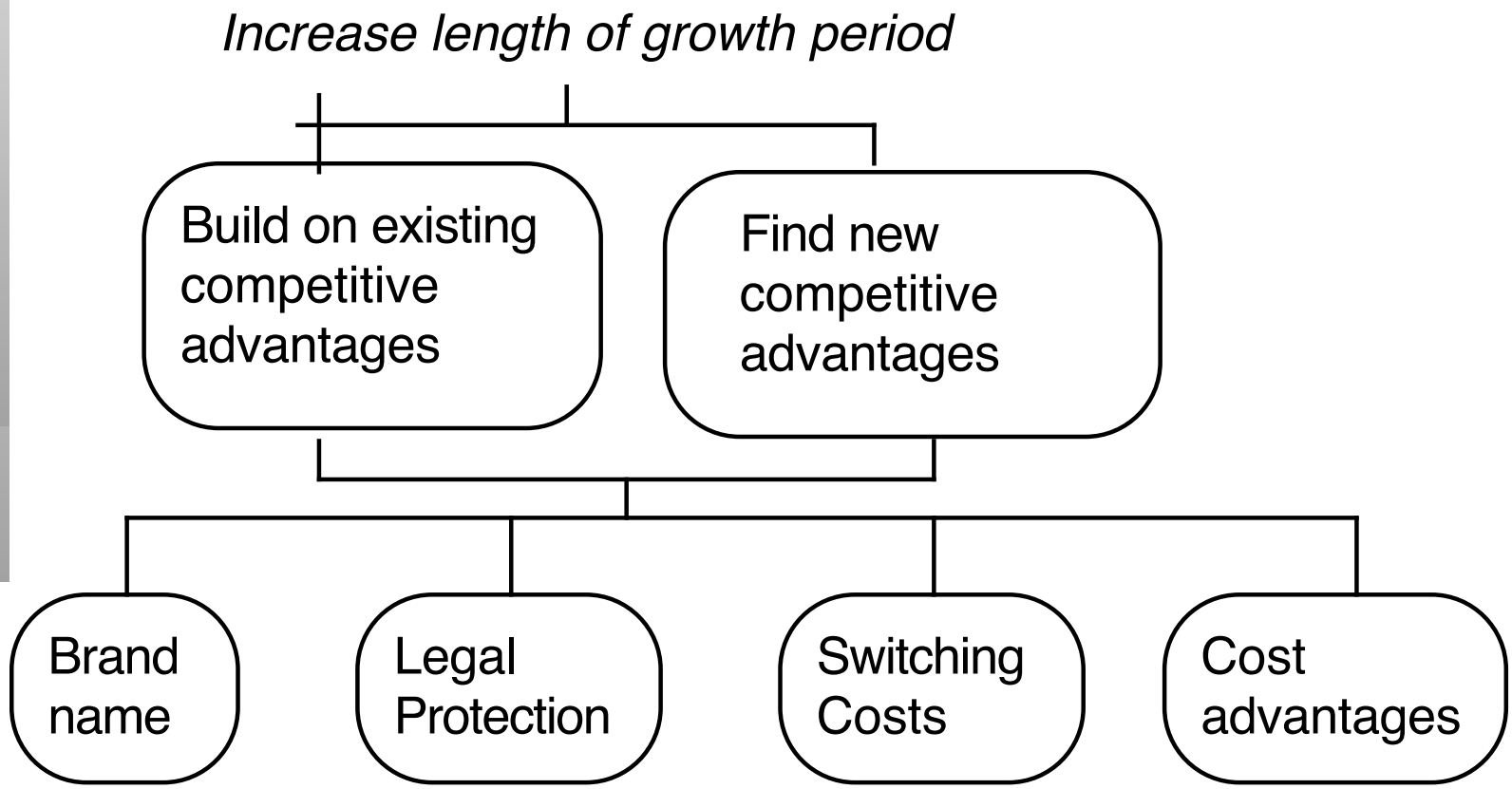
Price Leader versus Volume Leader Strategies
*Return on Capital = Operating Margin * Capital Turnover Ratio*

Value Creating Growth… Evaluating the Alternatives..

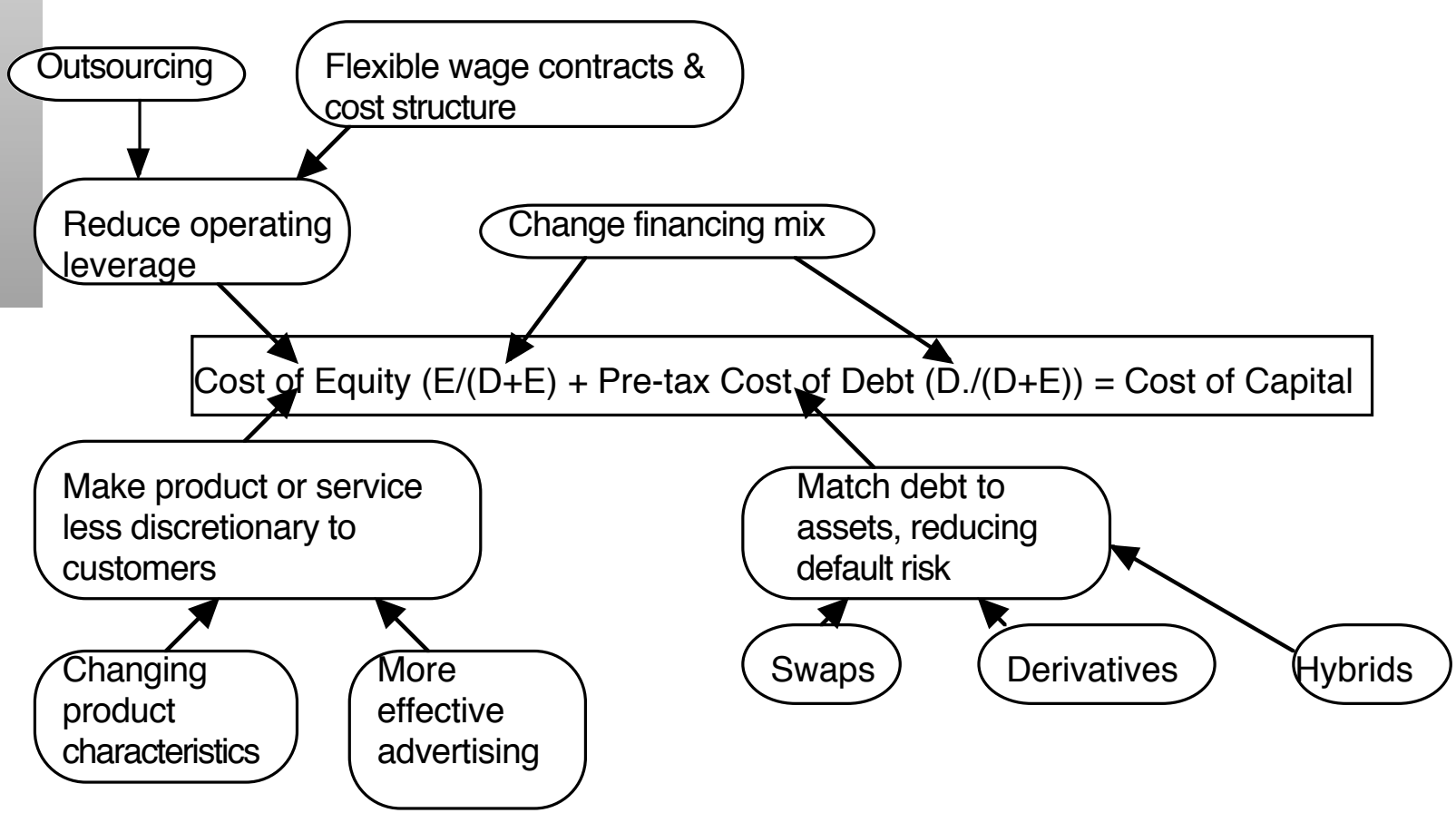
Modes of organic growth vary in value creation intensity—consumer goods industry



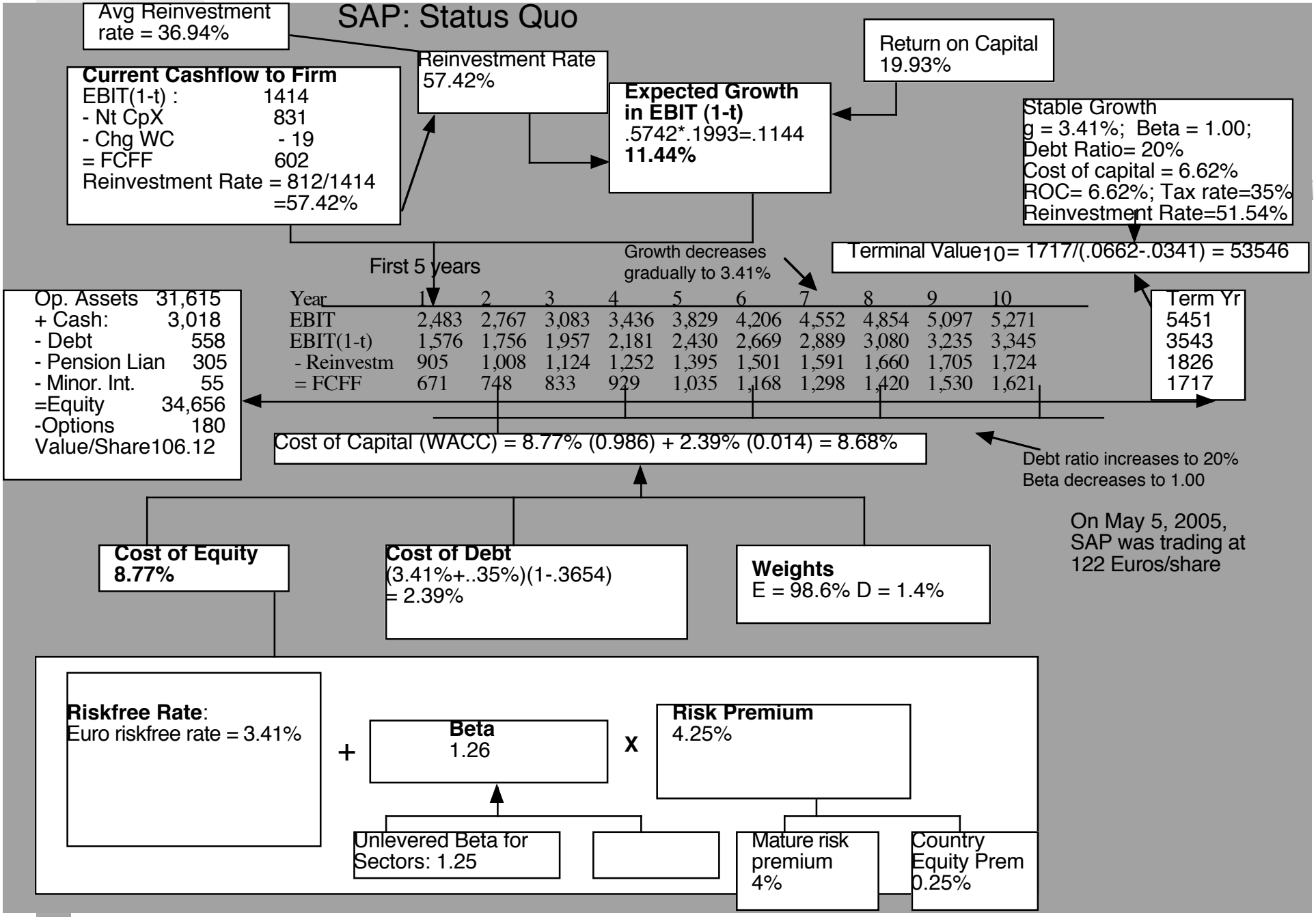
III. Building Competitive Advantages: Increase length of the growth period



Value Creation 4: Reduce Cost of Capital



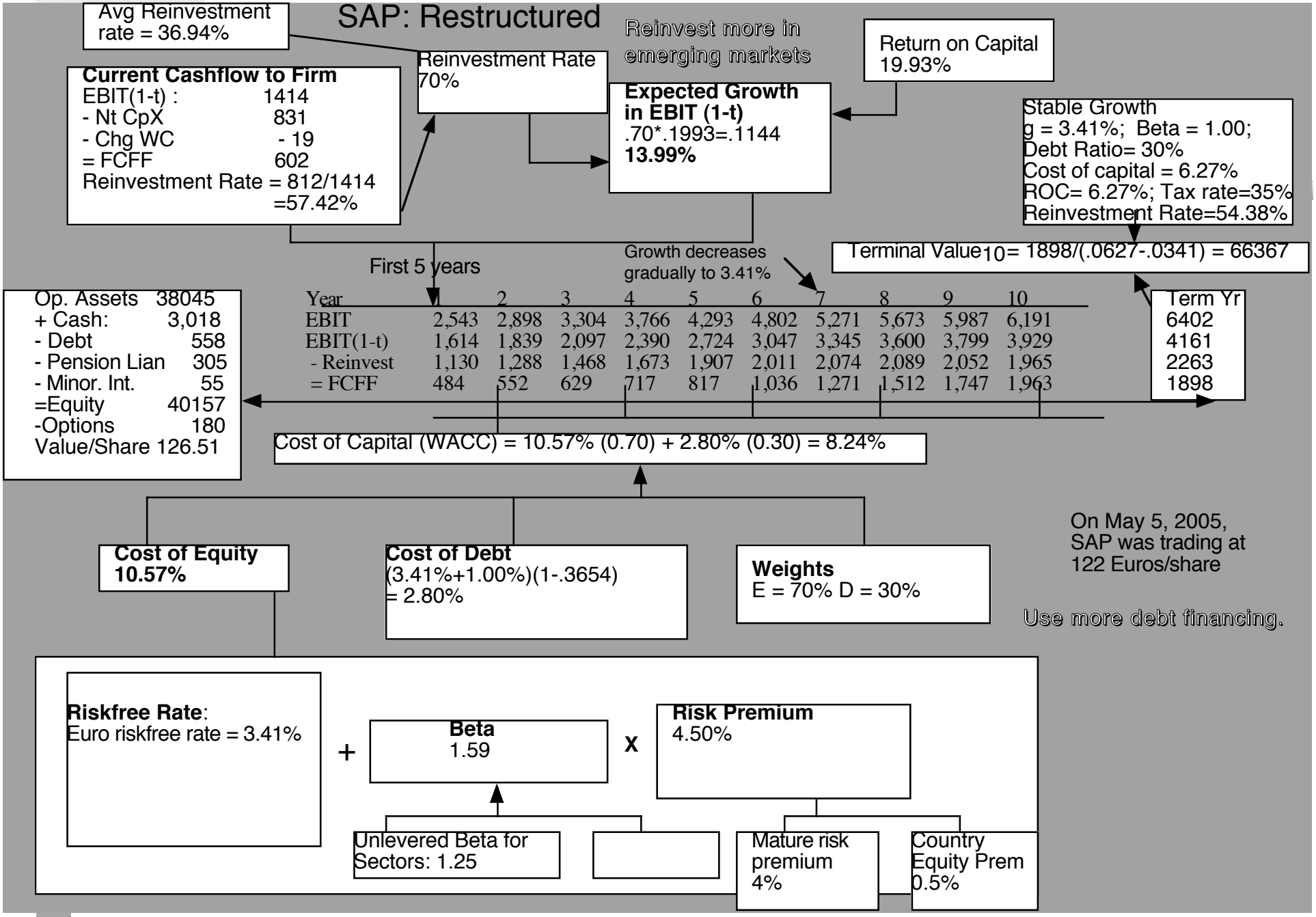
SAP: Status Quo

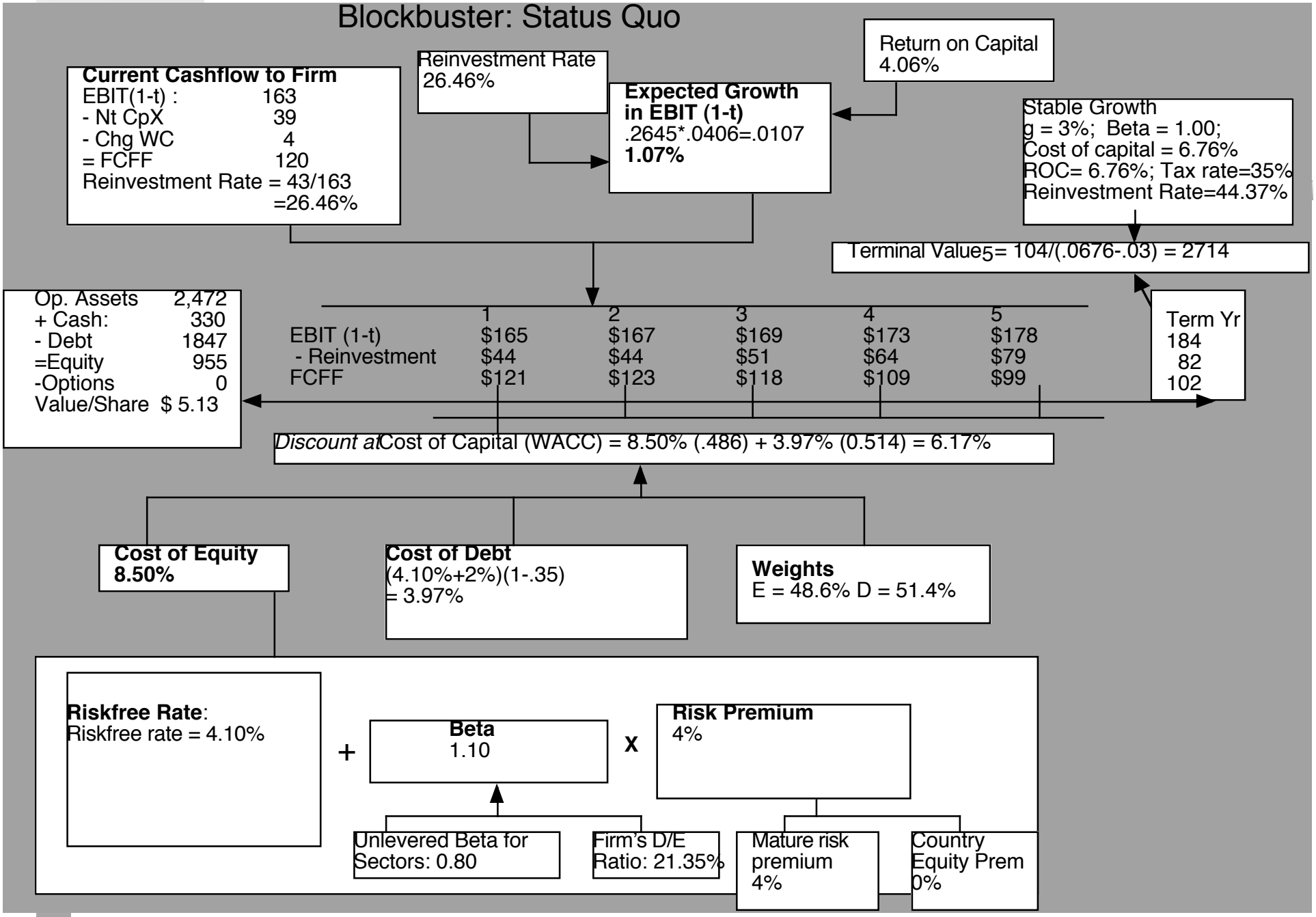


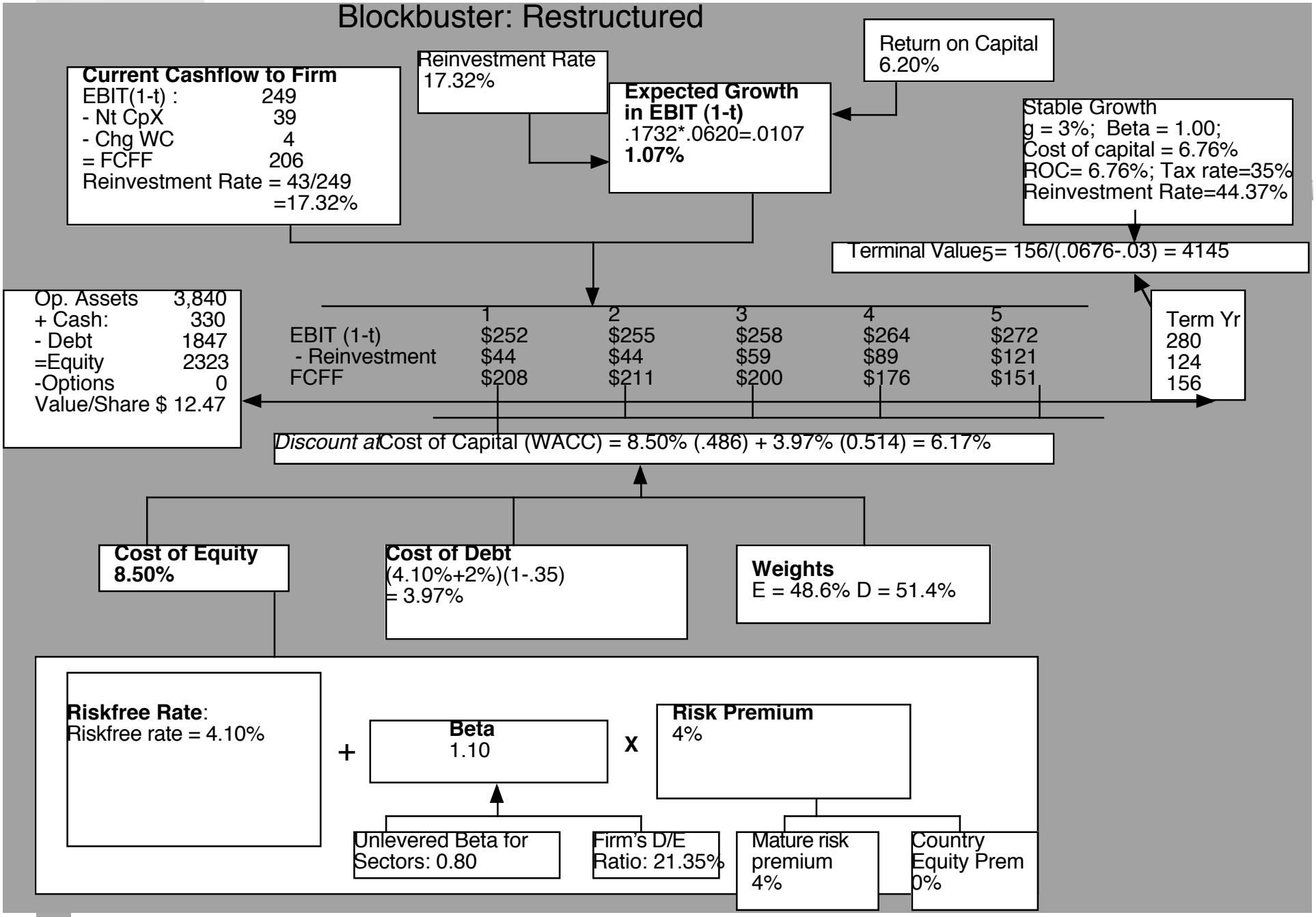
SAP : Optimal Capital Structure

Debt Ratio	Beta	Cost of Equity	Bond Rating	Interest rate on debt	Tax Rate	Cost of Debt (after-tax)	WACC	Firm Value (G)
0%	1.25	8.72%	AAA	3.76%	36.54%	2.39%	8.72%	$39,088
10%	1.34	9.09%	AAA	3.76%	36.54%	2.39%	8.42%	$41,480
20%	1.45	9.56%	A	4.26%	36.54%	2.70%	8.19%	$43,567
30%	1.59	10.16%	A-	4.41%	36.54%	2.80%	7.95%	$45,900
40%	1.78	10.96%	CCC	11.41%	36.54%	7.24%	9.47%	$34,043
50%	2.22	12.85%	C	15.41%	22.08%	12.01%	12.43%	$22,444
60%	2.78	15.21%	C	15.41%	18.40%	12.58%	13.63%	$19,650
70%	3.70	19.15%	C	15.41%	15.77%	12.98%	14.83%	$17,444
80%	5.55	27.01%	C	15.41%	13.80%	13.28%	16.03%	$15,658
90%	11.11	50.62%	C	15.41%	12.26%	13.52%	17.23%	$14,181

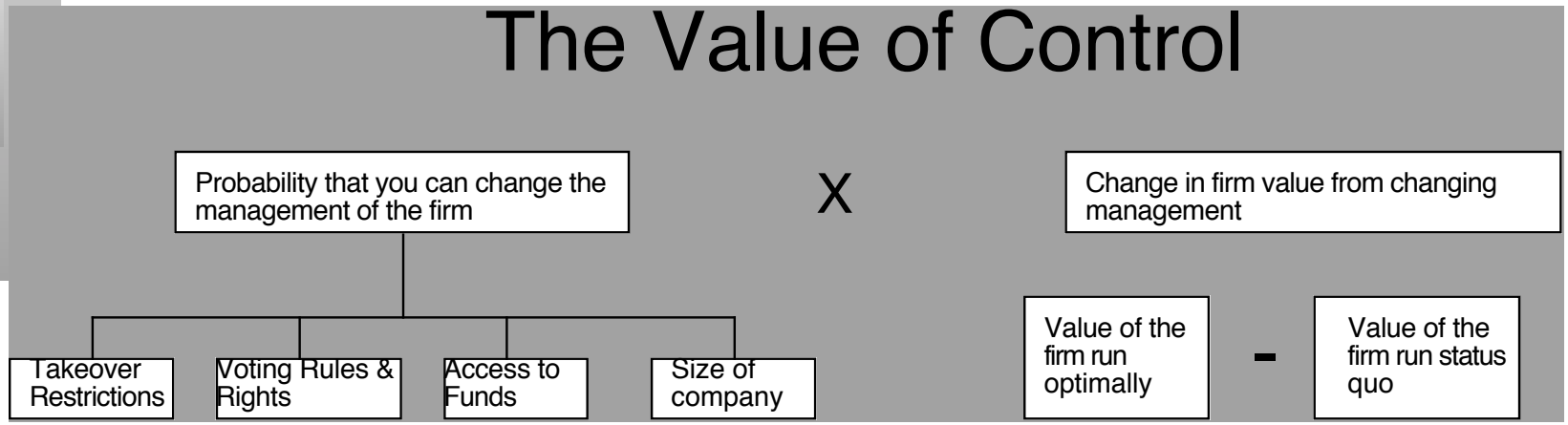
SAP: Restructured




Blockbuster: Status Quo
Current Cashflow to Firm
EBIT(1-t) : 163
- Nt CpX 39
- Chg WC 4
= FCFF 120
Reinvestment Rate = 43/163
=26.46%
Reinvestment Rate
26.46%
Return on Capital
4.06%
Expected Growth in EBIT (1-t)
.2645*.0406=.0107
1.07%
Stable Growth
g = 3%; Beta = 1.00;
Cost of capital = 6.76%
ROC= 6.76%; Tax rate=35%
Reinvestment Rate=44.37%
Terminal Value5= 104/(.0676-.03) = 2714
Op. Assets 2,472
+ Cash: 330
- Debt 1847
=Equity 955
-Options 0
Value/Share $ 5.13
1 2 3 4 5
EBIT (1-t) $165 $167 $169 $173 $178
- Reinvestment $44 $44 $51 $64 $79
FCFF $121 $123 $118 $109 $99
Term Yr
184
82
102
Discount at Cost of Capital (WACC) = 8.50% (.486) + 3.97% (0.514) = 6.17%
Cost of Equity
8.50%
Cost of Debt
(4.10%+2%)(1-.35)
= 3.97%
Weights
E = 48.6% D = 51.4%
Riskfree Rate:
Riskfree rate = 4.10%
+
Beta
1.10
X
Risk Premium
4%
Unlevered Beta for Sectors: 0.80
Firm's D/E Ratio: 21.35%
Mature risk premium
4%
Country Equity Prem
0%


Blockbuster: Restructured
Current Cashflow to Firm
EBIT(1-t) : 249
- Nt CpX 39
- Chg WC 4
= FCFF 206
Reinvestment Rate = 43/249
=17.32%
Reinvestment Rate
17.32%
Return on Capital
6.20%
Expected Growth in EBIT (1-t)
.1732*.0620=.0107
1.07%
Stable Growth
g = 3%; Beta = 1.00;
Cost of capital = 6.76%
ROC= 6.76%; Tax rate=35%
Reinvestment Rate=44.37%
Terminal Value5= 156/(.0676-.03) = 4145
Op. Assets 3,840
+ Cash: 330
- Debt 1847
=Equity 2323
-Options 0
Value/Share $ 12.47
1 2 3 4 5
EBIT (1-t) $252 $255 $258 $264 $272
- Reinvestment $44 $44 $59 $89 $121
FCFF $208 $211 $200 $176 $151
Term Yr
280
124
156
Discount at Cost of Capital (WACC) = 8.50% (.486) + 3.97% (0.514) = 6.17%
Cost of Equity
8.50%
Cost of Debt
(4.10%+2%)(1-.35)
= 3.97%
Weights
E = 48.6% D = 51.4%
Riskfree Rate:
Riskfree rate = 4.10%
+
Beta
1.10
X
Risk Premium
4%
Unlevered Beta for Sectors: 0.80
Firm's D/E Ratio: 21.35%
Mature risk premium
4%
Country Equity Prem
0%

The Expected Value of Control



The Probability of Changing Control – Factors to consider

- Institutional Factors
  - Capital restrictions: In markets where it is difficult to raise funding for hostile acquisitions, management change will be less likely.
  - State Restrictions: Some markets restrict hostile acquisitions for parochial, political, social (loss of jobs) and economic reasons (prevent monopolies).
  - Inertia and Conflicts of Interest: Institutions may tilt to incumbents.
  - Presence of activist investors, who are willing to challenge incumbents..
- Firm-specific factors
  - Anti-takeover amendments: They more difficult for a hostile acquirer to acquire the company or dissident stockholders to change management.
  - Voting Rights: Shares with disproportionate voting rights held by insiders.
  - Corporate Holding Structures: Cross holdings and Pyramid structures allow insiders with small holdings to control large numbers of firms.
  - Large Stockholders as managers: A large stockholder (usually the founder) is also the incumbent manager of the firm.

Why the probability of management changing shifts over time….

- Corporate governance rules can change over time, as new laws are passed. If the change gives stockholders more power, the likelihood of management changing will increase.
- Activist investing ebbs and flows with market movements (activist investors are more visible in down markets) and often in response to scandals.
- Events such as hostile acquisitions can make investors reassess the likelihood of change by reminding them of the power that they do possess.

Estimating the Probability of Change

- You can estimate the probability of management changes by using historical data (on companies where change has occurred) and statistical techniques such as probits or logits.
- Empirically, the following seem to be related to the probability of management change:
  - Stock price and earnings performance, with forced turnover more likely in firms that have performed poorly relative to their peer group and to expectations.
  - Structure of the board, with forced CEO changes more likely to occur when the board is small, is composed of outsiders and when the CEO is not also the chairman of the board of directors.
  - Ownership structure; forced CEO changes are more common in companies with high institutional and low insider holdings. They also seem to occur more frequently in firms that are more dependent upon equity markets for new capital.
  - Industry structure, with CEOs more likely to be replaced in competitive industries.

Manifestations of the Value of Control

- Hostile acquisitions: In hostile acquisitions which are motivated by control, the control premium should reflect the change in value that will come from changing management.
- Valuing publicly traded firms: The market price for every publicly traded firm should incorporate an expected value of control, as a function of the value of control and the probability of control changing.

  Market value = Status quo value + (Optimal value – Status quo value)* Probability of management changing
- Voting and non-voting shares: The premium (if any) that you would pay for a voting share should increase with the expected value of control.
- Minority Discounts in private companies: The minority discount (attached to buying less than a controlling stake) in a private business should be increase with the expected value of control.

1. Hostile Acquisition: Example

- In a hostile acquisition, you can ensure management change after you take over the firm. Consequently, you would be willing to pay up to the optimal value.
- As an example, Blockbuster was trading at $9.50 per share in July 2005. The optimal value per share that we estimated as $ 12.47 per share. Assuming that this is a reasonable estimate, you would be willing to pay up to $2.97 as a premium in acquiring the shares.
- Issues to ponder:
  - Would you automatically pay $2.97 as a premium per share? Why or why not?
  - What would your premium per share be if change will take three years to implement?

2. Market prices of Publicly Traded Companies: An example

- The market price per share at the time of the valuation (May 2005) was roughly $9.50.

  Expected value per share = Status Quo Value + Probability of control changing * (Optimal Value – Status Quo Value)

  $ 9.50 = $ 5.13 + Probability of control changing ($12.47 - $5.13)

- The market is attaching a probability of 59.5% that management policies can be changed. This was after Icahn's successful challenge of management. Prior to his arriving, the market price per share was $8.20, yielding a probability of only 41.8% of management changing.

	Value of Equity	Value per share
Status Quo	$ 955 million	$ 5.13 per share
Optimally managed	$2,323 million	$12.47 per share

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:

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

- 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:

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

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

3. Voting and Non-voting Shares: An Example

- To value voting and non-voting shares, we will consider Embraer, the Brazilian aerospace company. As is typical of most Brazilian companies, the company has common (voting) shares and preferred (non-voting shares).
  - Status Quo Value = 12.5 billion $R for the equity;
  - Optimal Value = 14.7 billion $R, assuming that the firm would be more aggressive both in its use of debt and in its reinvestment policy.
- There are 242.5 million voting shares and 476.7 non-voting shares in the company and the probability of management change is relatively low. Assuming a probability of 20% that management will change, we estimated the value per non-voting and voting share:
  - Value per non-voting share = Status Quo Value/ (# voting shares + # non-voting shares) = 12,500/(242.5+476.7) = 17.38 $R/ share
  - Value per voting share = Status Quo value/sh + Probability of management change * (Optimal value – Status Quo Value) = 17.38 + 0.2* (14,700-12,500)/242.5 = 19.19 $R/share
- With our assumptions, the voting shares should trade at a premium of 10.4% over the non-voting shares.

4. Minority Discount: An example

- Assume that you are valuing Kristin Kandy, a privately owned candy business for sale in a private transaction. You have estimated a value of $ 1.6 million for the equity in this firm, assuming that the existing management of the firm continues into the future and a value of $ 2 million for the equity with new and more creative management in place.
  - Value of 51% of the firm = 51% of optimal value = 0.51* $ 2 million = $1.02 million
  - Value of 49% of the firm = 49% of status quo value = 0.49 * $1.6 million = $784,000
- Note that a 2% difference in ownership translates into a large difference in value because one stake ensures control and the other does not.

To conclude…

- The value of control in a firm should lie in being able to run that firm differently and better. Consequently, the value of control should be greater in poorly performing firms, where the primary reason for the poor performance is the management.
- The market value of every firm reflects the expected value of control, which is the product of the probability of management changing and the effect on value of that change. This has far ranging implications. In acquisitions, the premiums paid should reflect how much the price already reflects the expected value of control; in a market that already reflects a high value for expected control, the premiums should be smaller.
- With companies with voting and non-voting shares, the premium on voting shares should reflect the expected value of control. If the probability of control changing is small and/or the value of changing management is small (because the company is well run), the expected value of control should be small and so should the voting stock premium.
- In private company valuation, the discount applied to minority blocks should be a reflection of the value of control.

Minority and Majority interests

- When you get a controlling interest in a private firm (generally >51%, but could be less…), you would be willing to pay the appropriate proportion of the optimal value of the firm.
- When you buy a minority interest in a firm, you will be willing to pay the appropriate fraction of the status quo value of the firm.
- For badly managed firms, there can be a significant difference in value between 51% of a firm and 49% of the same firm. This is the minority discount.
- If you own a private firm and you are trying to get a private equity or venture capital investor to invest in your firm, it may be in your best interests to offer them a share of control in the firm even though they may have well below 51%.

Alternative Approaches to Value Enhancement

- *Maximize a variable that is correlated with the value of the firm. There are several choices for such a variable. It could be*
  - an accounting variable, such as **earnings or return on investment**
  - a marketing variable, such as **market share**
  - a cash flow variable, such as cash flow return on investment (CFROI)
  - a risk-adjusted cash flow variable, such as Economic Value Added (EVA)
- **The advantages of using these variables are that they**
  - Are often simpler and easier to use than DCF value.
- **The disadvantage is that the**
  - Simplicity comes at a cost; these variables are not perfectly correlated with DCF value.

Economic Value Added (EVA) and CFROI

- The Economic Value Added (EVA) is a measure of surplus value created on an investment.
  - Define the return on capital (ROC) to be the "true" cash flow return on capital earned on an investment.
  - Define the cost of capital as the weighted average of the costs of the different financing instruments used to finance the investment.

EVA = (Return on Capital - Cost of Capital) (Capital Invested in Project)

- The CFROI is a measure of the cash flow return made on capital

CFROI = (Adjusted EBIT (1-t) + Depreciation & Other Non-cash Charges) / Capital Invested

The bottom line…

- The value of a firm is not going to change just because you use a different metric for value. All approaches that are discounted cash flow approaches should yield the same value for a business, if they make consistent assumptions.
- If there are differences in value from using different approaches, they must be attributable to differences in assumptions, either explicit or implicit, behind the valuation.

A Simple Illustration

- Assume that you have a firm with a book value value of capital of $ 100 million, on which it expects to generate a return on capital of 15% in perpetuity with a cost of capital of 10%.
- This firm is expected to make additional investments of $ 10 million at the beginning of each year for the next 5 years. These investments are also expected to generate 15% as return on capital in perpetuity, with a cost of capital of 10%.
- After year 5, assume that
  - The earnings will grow 5% a year in perpetuity.
  - The firm will keep reinvesting back into the business but the return on capital on these new investments will be equal to the cost of capital (10%).

Firm Value using EVA Approach

Capital Invested in Assets in Place	=$ 100
EVA from Assets in Place = (.15 – .10) (100)/.10	=$ 50
+ PV of EVA from New Investments in Year 1 = [(.15 -– .10)(10)/.10]	=$ 5
+ PV of EVA from New Investments in Year 2 = [(.15 -– .10)(10)/.10]/1.1	= $ 4.55
+ PV of EVA from New Investments in Year 3 = [(.15 -– .10)(10)/.10]/1.1^2	=$ 4.13
+ PV of EVA from New Investments in Year 4 = [(.15 -– .10)(10)/.10]/1.1^3	=$ 3.76
+ PV of EVA from New Investments in Year 5 = [(.15 -– .10)(10)/.10]/1.1^4	=$ 3.42
Value of Firm	**=$ 170.85**

Firm Value using DCF Valuation: Estimating FCFF

	Base Year	*1*	*2*	*3*	*4*	*5*	*Term. Year*
EBIT (1-t) : Assets in Place	$ 15.00	$ 15.00	$ 15.00	$ 15.00	$ 15.00	$ 15.00	
EBIT(1-t) :Investments- Yr 1		$ 1.50	$ 1.50	$ 1.50	$ 1.50	$ 1.50	
EBIT(1-t) :Investments- Yr 2			$ 1.50	$ 1.50	$ 1.50	$ 1.50	
EBIT(1-t): Investments -Yr 3				$ 1.50	$ 1.50	$ 1.50	
EBIT(1-t): Investments -Yr 4					$ 1.50	$ 1.50	
EBIT(1-t): Investments- Yr 5						$ 1.50	
Total EBIT(1-t)		$ 16.50	$ 18.00	$ 19.50	$ 21.00	$ 22.50	$ 23.63
- Net Capital Expenditures	$10.00	$ 10.00	$ 10.00	$ 10.00	$ 10.00	$ 11.25	$ 11.81
FCFF		$ 6.50	$ 8.00	$ 9.50	$ 11.00	$ 11.25	$ 11.81

After year 5, the reinvestment rate is 50% = g/ ROC

Firm Value: Present Value of FCFF

Year	0	1	2	3	4	5	Term Year
FCFF		$ 6.50	$ 8.00	$ 9.50	$ 11.00	$ 11.25	$ 11.81
PV of FCFF	($10)	$ 5.91	$ 6.61	$ 7.14	$ 7.51	$ 6.99	
Terminal Value						$ 236.25	
PV of Terminal Value						$ 146.69	
Value of Firm	$170.85						

Implications

- Growth, by itself, does not create value. It is growth, with investment in excess return projects, that creates value.
  - The growth of 5% a year after year 5 creates no additional value.
- The "market value added" (MVA), which is defined to be the excess of market value over capital invested is a function of tthe excess value created.
  - In the example above, the market value of $ 170.85 million exceeds the book value of $ 100 million, because the return on capital is 5% higher than the cost of capital.

Year-by-year EVA Changes

- Firms are often evaluated based upon year-to-year changes in EVA rather than the present value of EVA over time.
- The advantage of this comparison is that it is simple and does not require the making of forecasts about future earnings potential.
- Another advantage is that it can be broken down by any unit - person, division etc., as long as one is willing to assign capital and allocate earnings across these same units.
- While it is simpler than DCF valuation, using year-by-year EVA changes comes at a cost. In particular, it is entirely possible that a firm which focuses on increasing EVA on a year-to-year basis may end up being less valuable.

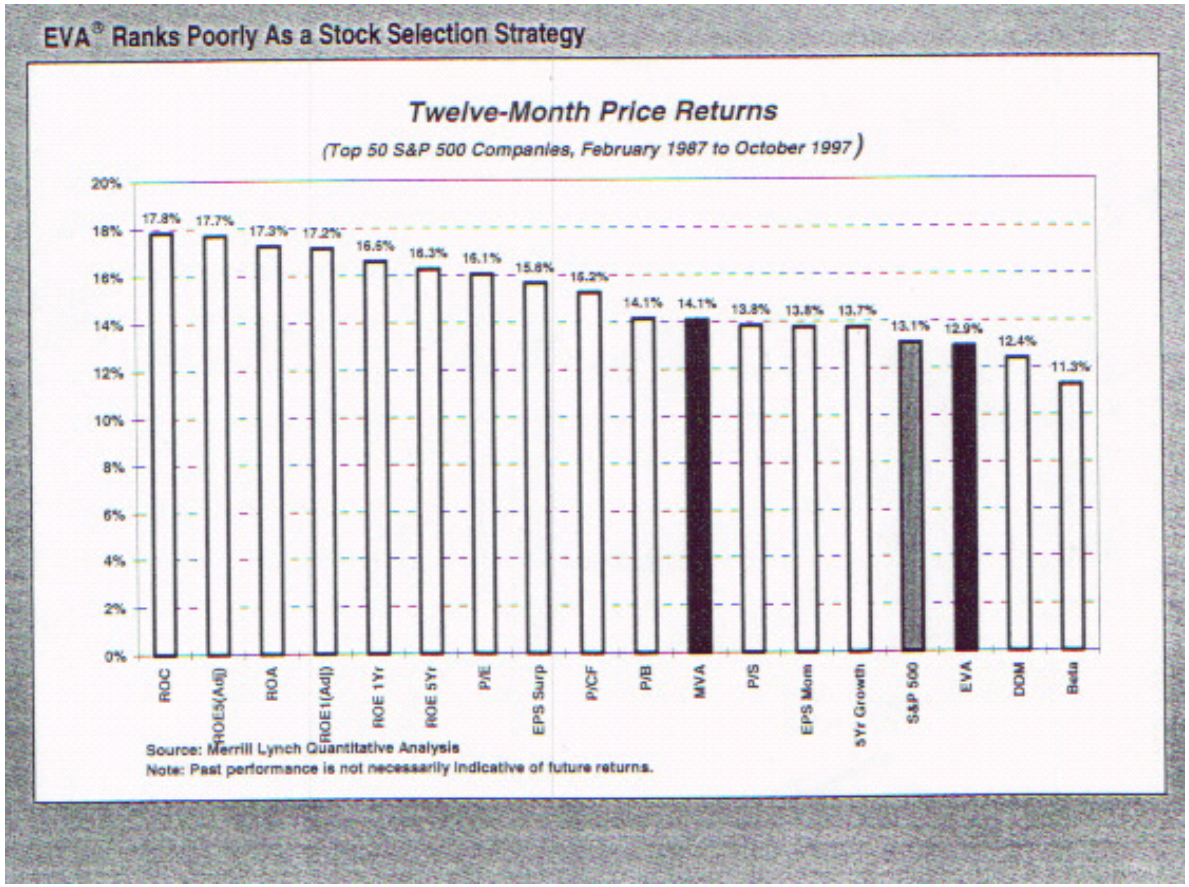
Gaming the system: Delivering high current EVA while destroying value…

- The Growth trade off game: Managers may give up valuable growth opportunities in the future to deliver higher EVA in the current year.
- The Risk game: Managers may be able to deliver a higher dollar EVA but in riskier businesses. The value of the business is the present value of EVA over time and the risk effect may dominate the increased EVA.
- The capital invested game: The key to delivering positive EVA is to make investments that do not show up as part of capital invested. That way, your operating income will increase while capital invested will decrease.

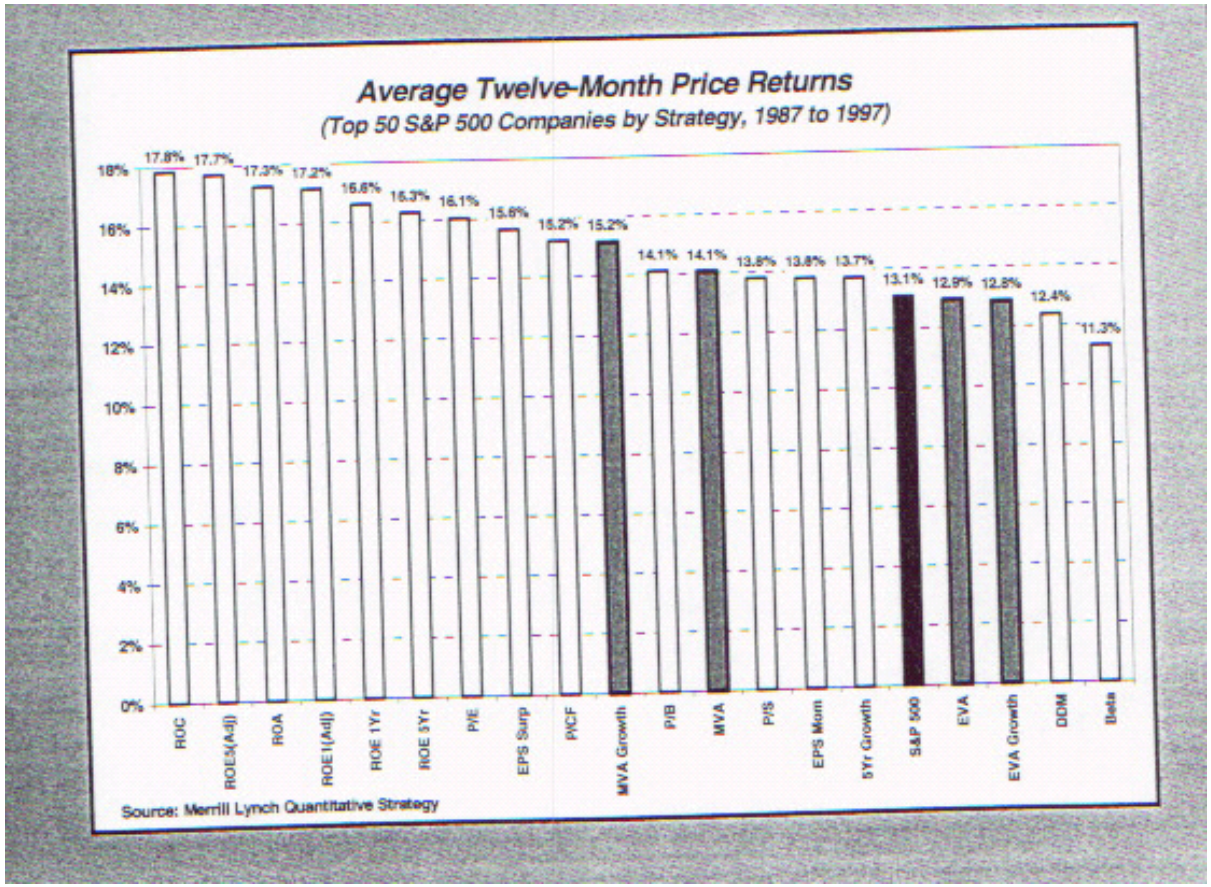
Delivering a high EVA may not translate into higher stock prices…

- The relationship between EVA and Market Value Changes is more complicated than the one between EVA and Firm Value.
- The market value of a firm reflects not only the Expected EVA of Assets in Place but also the Expected EVA from Future Projects
- To the extent that the actual economic value added is smaller than the expected EVA the market value can decrease even though the EVA is higher.

High EVA companies do not earn excess returns



Increases in EVA do not create excess returns



Implications of Findings

- This does not imply that increasing EVA is bad from a corporate finance standpoint. In fact, given a choice between delivering a "below-expectation" EVA and no EVA at all, the firm should deliver the "below-expectation" EVA.
- It does suggest that the correlation between increasing year-to-year EVA and market value will be weaker for firms with high anticipated growth (and excess returns) than for firms with low or no anticipated growth.
- It does suggest also that "investment strategies"based upon EVA have to be carefully constructed, especially for firms where there is an expectation built into prices of "high" surplus returns.

When focusing on year-to-year EVA changes has least side effects

1. Most or all of the assets of the firm are already in place; i.e, very little or none of the value of the firm is expected to come from future growth.
   - [This minimizes the risk that increases in current EVA come at the expense of future EVA]
2. The leverage is stable and the cost of capital cannot be altered easily by the investment decisions made by the firm.
   - [This minimizes the risk that the higher EVA is accompanied by an increase in the cost of capital]
3. The firm is in a sector where investors anticipate little or not surplus returns; i.e., firms in this sector are expected to earn their cost of capital.
   - [This minimizes the risk that the increase in EVA is less than what the market expected it to be, leading to a drop in the market price.]

When focusing on year-to-year EVA changes can be dangerous

1. High growth firms, where the bulk of the value can be attributed to future growth.
2. Firms where neither the leverage not the risk profile of the firm is stable, and can be changed by actions taken by the firm.
3. Firms where the current market value has imputed in it expectations of significant surplus value or excess return projects in the future.

Note that all of these problems can be avoided if we restate the objective as maximizing the present value of EVA over time. If we do so, however, some of the perceived advantages of EVA - its simplicity and observability - disappear.

The Bottom line…

- Value creation is hard work. There are no short cuts.
- Investment banks/Consultants/Experts who claim to have short cuts and metrics that allow for easy value creation are holding back on hard truths.
- Value creation does not happen in finance departments of businesses. Every employee has a role to play.