Acquisition Valuation

Aswath Damodaran

Issues in Acquisition Valuation

- Acquisition valuations are complex, because the valuation often involved issues like synergy and control, which go beyond just valuing a target firm. It is important on the right sequence, including
  - When should you consider synergy?
  - Where does the method of payment enter the process.
- Can synergy be valued, and if so, how?
- What is the value of control? How can you estimate the value?

Steps involved in an Acquisition Valuation

- *Step 1*: Establish a **motive** for the acquisition
- *Step 2:* Choose a **target**
- *Step 3:* **Value** the target with the **acquisition motive** built in.
- *Step 4*: Decide on the **mode of payment** - cash or stock, and if cash, arrange for financing - debt or equity.
- *Step 5:* Choose the **accounting method** for the merger/acquisition - purchase or pooling.

Step 1: Motives behind acquisitions

(1) Simplest rationale is **undervaluation**, i.e., that firms that are undervalued by financial markets, relative to true value, will be targeted for acquisition by those who recognize this anomaly.

(2) A more controversial reason is **diversification**, with the intent of stabilizing earnings and reducing risk.

(3) **Synergy** refers to the potential additional value from combining two firms, either from operational or financial sources.

- Operating Synergy can come from ***higher growth*** or ***lower costs***
- Financial Synergy can come from ***tax savings***, ***increased debt capacity*** or ***cash slack.***

(4) **Poorly managed firms are taken over and restructured** by the new owners, who lay claim to the additional value.

(5) **Managerial self-interest** and hubris are the primary, though unstated, reasons for many takeovers.

Step 2: Choose a target firm for the acquisition

If motive is	*Target firm*
Undervaluation	trades at a price below the estimated value
Diversification	is in a business which is different from the acquiring firm's business
Operating Synergy	have the characteristics that create the operating synergy
	Cost Savings: in same business to create economies of scale.
	Higher growth: should have potential for higher growth.
Financial Synergy	*Tax Savings*: provides a tax benefit to acquirer
	Debt Capacity: is unable to borrow money or pay high rates
	Cash slack: has great projects/ no funds
Control	badly managed firm whose stock has underperformed the market.
Manager's Interests	has characteristics that best meet CEO's ego and power needs.

Step 3: Value Target Firm with motive built in

If motive is	*Target firm*
Undervaluation	Value target firm as stand-alone entity: No extra premium
Diversification	Value target firm as stand-alone entity: No extra premium
Operating Synergy	Value the firms independently.
	Value the combined firm with the operating synergy
	Synergy is the difference between the latter and former
	Target Firm Value = Independent Value + Synergy
Financial Synergy	Tax Benefits: Value of Target Firm + PV of Tax Benefits
	Debt Capacity: Value of Target Firm + Increase in Value from Debt
	Cash Slack: Value of Target Firm + NPV of Projects/ Target
Control	Value of Target Firm run optimally
Manager's Interest	Value of Target Firm: No additional premium

The Valuation Process

VALUING AN ACQUISITION

Component	Valuation Guidelines	Should you pay?
Synergy	*Value the combined firm with synergy built in* . This may include a. a higher growth rate in revenues: *growth synergy* b. higher margins, because of *economies of scale* c. lower taxes, because of tax benefits: *tax synergy* d. lower cost of debt: *financing synergy* e. higher debt ratio because of lower risk: *debt capacity* *Subtract the value of the target firm (with control premium) + value of the bidding firm (pre-acquisition). This is the value of the synergy.*	Which firm is indispensable for the synergy? If it is the target, you should be willing to pay up to the synergy. If it is the bidder, you should not.
Control Premium	Value the company as if optimally managed. This will usually mean that investment, financing and dividend policy will be altered: Investment Policy: Higher returns on projects and divesting unproductive projects. Financing Policy: Move to a better financing structure; eg. optimal capital structure Dividend Policy: Return unused cash Practically, 1. Look at industry averages for optimal (if lazy) 2. Do a full-fledged corporate financial analysis	If motive is control or in a stand-alone valuation, this is the maximium you should pay.
Status Quo Valuation	Value the company as is, with existing inputs for investment, financing and dividend policy.	If motive is undervaluation, this is the maximum you should pay.

Valuing NCR for AT & T

VALUING NCR for AT & T

Component	Valuation Guidelines	Value
Synergy	*Value the combined firm with synergy built in* . This may include a. a higher growth rate in revenues: *growth synergy* b. higher margins, because of *economies of scale* c. lower taxes, because of tax benefits: *tax synergy* d. lower cost of debt: *financing synergy* e. higher debt ratio because of lower risk: *debt capacity* *Subtract the value of the target firm (with control premium) + value of the bidding firm (pre-acquisition). This is the value of the synergy.*	$ 11,278 million - $ 6,723 million = $ 4,552 million
Control Premium	Value the company as if optimally managed. This will usually mean that investment, financing and dividend policy will be altered: Investment Policy: Higher returns on projects and divesting unproductive projects. Financing Policy: Move to a better financing structure; eg. optimal capital structure Dividend Policy: Return unused cash Practically, 1. Look at industry averages for optimal (if lazy) 2. Do a full-fledged corporate financial analysis	$ 6,723 million - $ 5,949 million = $ 774 million
Status Quo Valuation	Value the company as is, with existing inputs for investment, financing and dividend policy.	$ 5,949 million

Step 4: Decide on payment mechanism: Cash versus Stock

- Generally speaking, firms which **believe that their stock is under valued** will not use stock to do acquisitions.
- Conversely, firms which believe that their stock is **over or correctly valued will use stock** to do acquisitions.
- Not surprisingly, the **premium paid is larger** when an acquisition is **financed with stock** rather than cash.
- There might be an **accounting rationale** for using **stock** as opposed to cash. You are allowed to use pooling instead of purchase.
- There might also be a **tax rationale** for using stock. Cash acquisitions create tax liabilities to the selling firm's stockholders.

The Exchange Ratio in a Stock for Stock Exchange

- **Correct Exchange Ratio** to use in a Valuation = Value per Share of Target Firm (with control premium and target-controlled synergies) / Value per Share of Bidding Firm
- If the exchange ratio is set **too high**, there will be a **transfer of wealth from the bidding firm's stockholders** to the target firm's stockholders.
- If the exchange ratio is set **too low**, there will be **transfer of wealth from the target firm** to the bidding firm's stockholders.

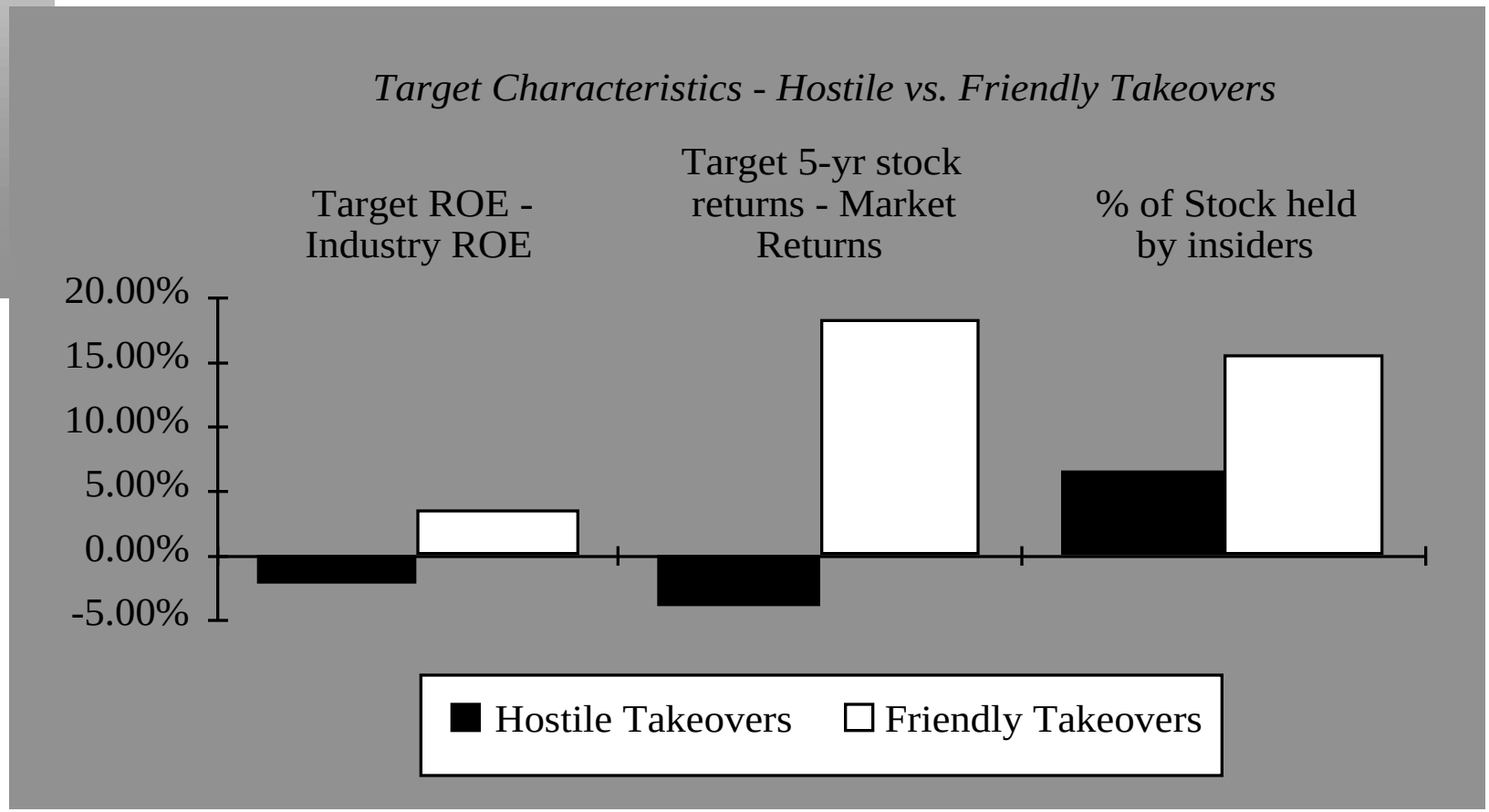
Step 5: Choose an accounting method for the merger

- ***Purchase Method:***
  - The acquiring firm records the assets and liabilities of the acquired firm at market value, with *goodwill* capturing the difference between market value and the value of the assets acquired.
  - This goodwill will then be amortized, though the amortization is not tax deductible. If a firm pays cash on an acquisition, it has to use the purchase method to record the transaction.
- ***Pooling of Interests:***
  - The book values of the assets and liabilities of the merging firms are added to arrive at values for the combined firm. Since the market value of the transaction is not recognized, no goodwill is created or amortized.
  - This approach is allowed only if the acquiring firm exchanges its common stock for common stock of the acquired firm.
  - Since earnings are not affected by the amortization of goodwill, the reported earnings per share under this approach will be greater than the reported earnings per share in the purchase approach.

The Value of Control

- The value of control should be **inversely proportional to the perceived quality** of that management and its capacity to maximize firm value.
- **Value of control will be much greater for a poorly managed firm** that operates at below optimum capacity than it is for a well managed firm.
- Value of Control = Value of firm, with restructuring - Value of firm, without restructuring
- Negligible or firms which are operating at or close to their optimal value

Empirical Evidence on the Value of Control



After the hostile takeover..

- Many of the hostile takeovers were followed by an **increase in leverage**, which resulted in a downgrading of the debt. The leverage was quickly reduced, however, with proceeds from sale of assets.
- There was **no significant change in the amount of capital investment** in these firms, but investment was more focused on core business.
- Almost 60% of the takeovers were followed by **significant divestitures**, where half or more of the firm was divested. The overwhelming majority of the divestitures were of units which were in business areas **unrelated to the company's core business**, i.e., they constituted reversal of earlier corporate diversification.
- There were **significant management changes** in 17 of the 19 hostile takeovers, with the entire corporate management team replaced in 7 of the takeovers.

Stand Alone Valuation: Digital - Status Quo

- Digital had earning before interest and taxes of $391.38 million in 1997, which translated into a
  - A pre-tax operating margin of 3% on its revenues of $13,046 million
  - An after-tax return on capital of 8.51%
- Based upon its beta of 1.15, an after-tax cost of borrowing of 5% and a debt ratio of approximately 10%, the cost of capital for Digital in 1997 was
  - Cost of Equity = 6% + 1.15 (5.5%) = 12.33%
  - Cost of Capital = 12.33% (.9) + 5% (.1) = 11.59%
- Digital had capital expenditures of $475 million, depreciation of $ 461 million and working capital was 15% of revenues.
- Operating income, net cap ex and revenues are expected to grow 6% a year for the next 5 years, and 5% thereafter.

Digital: Status Quo Valuation

Year	FCFF	Terminal Value	PV
1	$133.26		$119.42
2	$141.25		$113.43
3	$149.73		$107.75
4	$158.71		$102.35
5	$168.24	$2,717.35	$1,667.47
Terminal Year	$156.25		

Firm Value = **$2,110.41**

- The capital expenditures are assumed to be 110% of revenues in stable growth; working capital remains 15%;
- Debt ratio remains at 10%, but after-tax cost of debt drops to 4%. Beta declines to 1.

Digital: Change in Control

- Digital will raise its debt ratio to 20%. The beta will increase, but the cost of capital will decrease.
  - New Beta = 1.25 (Unlevered Beta = 1.07; Debt/Equity Ratio = 25%)
  - Cost of Equity = 6% + 1.25 (5.5%) = 12.88%
  - New After-tax Cost of Debt = 5.25%
  - Cost of Capital = 12.88% (0.8) + 5.25% (0.2) = 11.35%
- Digital will raise its return on capital to 11.35%, which is its cost of capital. (Pre-tax Operating margin will go up to 4%)
- The reinvestment rate remains unchanged, but the increase in the return on capital will increase the expected growth rate in the next 5 years to 10%.
- After year 5, the beta will drop to 1, and the after-tax cost of debt will decline to 4%.

Digital Valuation: Change in Control

Year	FCFF	Terminal Value	PV
1	$156.29		$140.36
2	$171.91		$138.65
3	$189.11		$136.97
4	$208.02		$135.31
5	$228.82	$6,584.62	$3,980.29
Terminal Year	$329.23		
Value of the Firm: with Control Change			= **$ 4,531 million**
Value of the Firm: Status Quo			= **$ 2,110 million**
Value of Control			= **$2,421 million**

Valuing Synergy

- The key to the existence of synergy is that the **target firm controls a specialized resource** that becomes more valuable if combined with the bidding firm's resources. The specialized resource will vary depending upon the merger:
  - *In horizontal mergers:* economies of scale, which reduce costs, or from increased market power, which increases profit margins and sales. (Examples: Bank of America and Security Pacific, Chase and Chemical)
  - *In vertical integration:* Primary source of synergy here comes from controlling the chain of production much more completely.
  - *In functional integration*: When a firm with strengths in one functional area acquires another firm with strengths in a different functional area, the potential synergy gains arise from exploiting the strengths in these areas.

Valuing operating synergy

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

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

A procedure for valuing synergy

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

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

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

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

Synergy Effects in Valuation Inputs

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

Valuing Synergy: Compaq and Digital

- In 1997, Compaq acquired Digital for $ 30 per share + 0.945 Compaq shares for every Digital share. ($ 53-60 per share) The acquisition was motivated by the belief that the combined firm would be able to find investment opportunities and compete better than the firms individually could.

Background Data

	Compaq	*Digital: Opt Mgd*
Current EBIT	$ 2,987 million	$ 522 million
Current Revenues	$25,484 mil	$13,046 mil
Capital Expenditures - Depreciation	$ 184 million	$ 14 (offset)
Expected growth rate -next 5 years	10%	10%
Expected growth rate after year 5	5%	5%
Debt /(Debt + Equity)	10%	20%
After-tax cost of debt	5%	5.25%
Beta for equity - next 5 years	1.25	1.25
Beta for equity - after year 5	1.00	1.0
Working Capital/Revenues	15%	15%
Tax rate is 36% for both companies		

Valuing Compaq

Year	FCFF	Terminal Value	PV
1	$1,518.19		$1,354.47
2	$1,670.01		$1,329.24
3	$1,837.01		$1,304.49
4	$2,020.71		$1,280.19
5	$2,222.78	$56,654.81	$33,278.53
Terminal Year	$2,832.74		$38,546.91

- Value of Compaq = $ 38,547 million
- After year 5, capital expenditures will be 110% of depreciation.

Combined Firm Valuation

- The Combined firm will have some economies of scale, allowing it to increase its current after-tax operating margin slightly. The dollar savings will be approximately $ 100 million.
  - Current Operating Margin = (2987+522)/(25484+13046) = 9.11%
  - New Operating Margin = (2987+522+100)/(25484+13046) = 9.36%
- The combined firm will also have a slightly higher growth rate of 10.50% over the next 5 years, because of operating synergies.
- The beta of the combined firm is computed in two steps:
  - Digital's Unlevered Beta = 1.07; Compaq's Unlevered Beta=1.17
  - Digital's Firm Value = 4.5; Compaq's Firm Value = 38.6
  - Unlevered Beta = 1.07 * (4.5/43.1) + 1.17 (38.6/43.1) = 1.16
  - Combined Firm's Debt/Equity Ratio = 13.64%
  - New Levered Beta = 1.16 (1+(1-0.36)(.1364)) = 1.26
  - Cost of Capital = 12.93% (.88) + 5% (.12) = 11.98%

Combined Firm Valuation

Year	FCFF	Terminal Value	PV
1	$1,726.65		$1,541.95
2	$1,907.95		$1,521.59
3	$2,108.28		$1,501.50
4	$2,329.65		$1,481.68
5	$2,574.26	$66,907.52	$39,463.87
Terminal Year	$3,345.38		
Value of Combined Firm			= **$ 45,511**

The Value of Synergy

- Value of Combined Firm wit Synergy = $45,511 million
- Value of Compaq + Value of Digital
  = 38,547 + 4532 = $ 43,079 million
- Total Value of Synergy = $ 2,432 million

Digital: Valuation Blocks

Value of Firm - Status Quo	**= $ 2,110 million**
+ Value of Control	= $ 2,521 million
Value of Firm - Change of Control	**= $ 4,531 million**
+ Value of Synergy	= $ 2,432 million
Total Value of Digital with Synergy	**= $ 6,963 million**

Estimating Offer Prices and Exchange Ratios

- There are 146.789 million Digital shares outstanding, and Digital had $1,006 million in debt outstanding. Estimate that maximum price you would be willing to offer on this deal.

- Assume that Compaq wanted to do an exchange offer, where it would exchange its shares for Digital shares. Assuming that Compaq stock is valued at $27 per share, what would be the exchange ratio?

Evaluating Compaq's Offer

Value of Digital with Synergy	=	$6,963 mil
- Value of Cash paid in deal = $ 30 * 146.789 mil shrs =		$4,403 mil
- Digitial's Outstanding Debt (assumed by Compaq)		$1,006 mil
Remaining Value		$ 1,554 mil
/ number of Shares outstanding		146.789
= Remaining Value per Share		$ 10.59
Compaq's value per share at time of Exchange Offer		$ 27

Appropriate Exchange Ratio = 10.59/27 = 0.39 Compaq shares for every Digital share

Actual Exchange Ratio = 0.945 Compaq shares/Digital Share

Citicorp + Travelers = ?

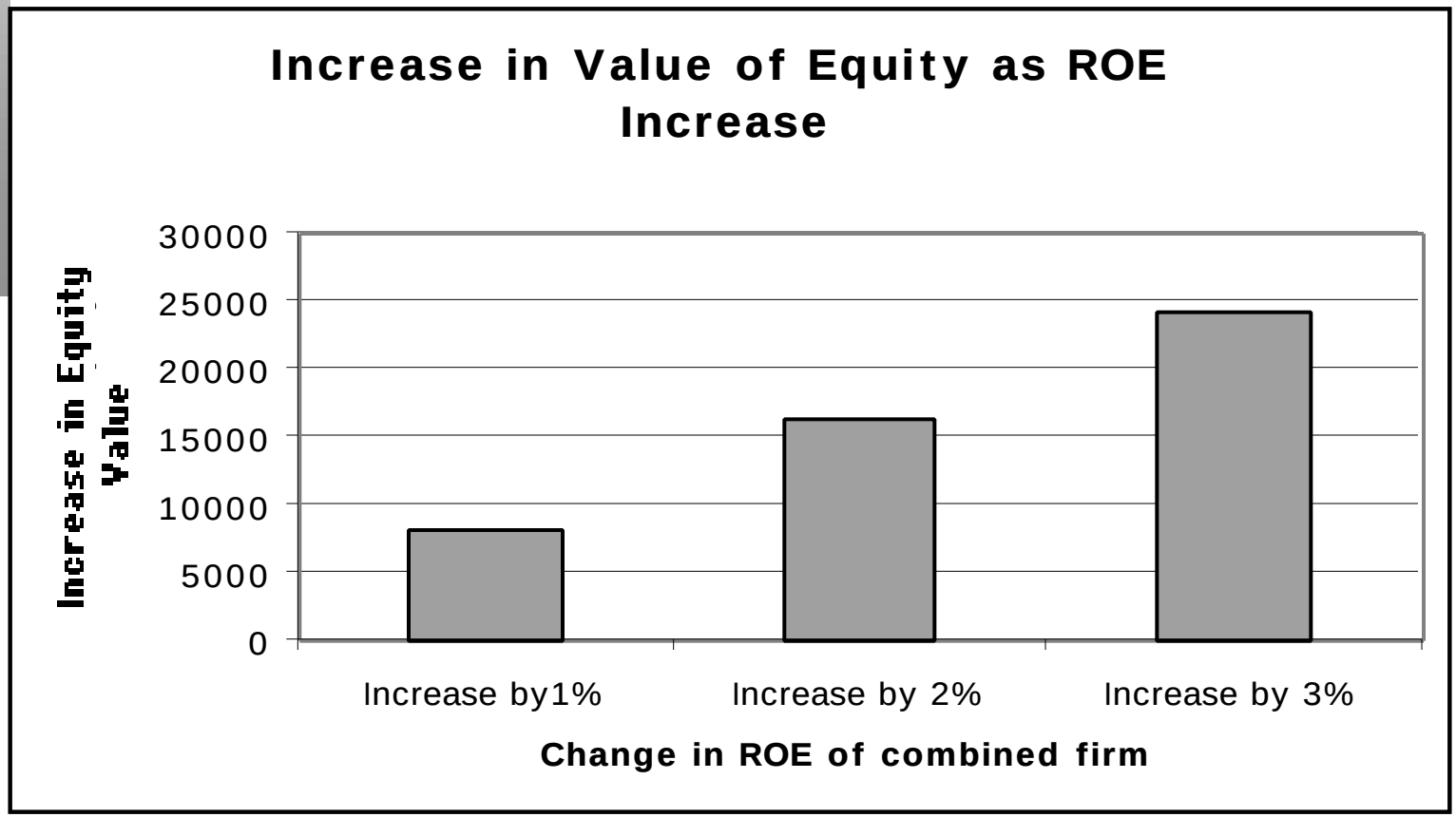
	Citicorp	Travelers	Citigroup
Net Income	$ 3,591	$ 3,104	$ 6,695
BV of Equity	$ 20,722	$ 20,736	$ 41,458
ROE	17.33%	14.97%	16.15%
Dividends	$ 1,104	$ 587	$ 1,691
Payout Ratio	30.74%	18.91%	25.27%
Retention Ratio	69.26%	81.09%	74.73%
Expected growth	12.00%	12.14%	12.07%
Growth Period	5	5	5
Beta	1.25	1.40	1.33
Risk Premium	4.00%	4.00%	4.00%
MV of Equity (bil)	81	84	165.00
Cost of Equity	11.00%	11.60%	11.31%
Beta - stable	1.00	1.00	1.00
Growth-stable	6.00%	6.00%	6.00%
Payout-stable	65.38%	59.92%	62.85%
DDM	$ 70,743	$ 53,464	$ 124,009
DDM/share	155.84	46.38	

The Right Exchange Ratio

- Based upon these numbers, what exchange ratio would you agree to as a Citicorp stockholder?

- The actual exchange ratio was 2.5 shares of Travelers for every share of Citicorp. As a Citicorp stockholder, do you think that this is a reasonable exchange ratio?

The Value of Synergy



Financial Synergy

- Sources of Financial Synergy
  - *Diversification*: Acquiring another firm as a way of reducing risk cannot create wealth for two publicly traded firms, with diversified stockholders, but it could create wealth for private firms or closely held publicly traded firms.
  - *Cash Slack*: When a firm with significant excess cash acquires a firm, with great projects but insufficient capital, the combination can create value.
  - *Tax Benefits*: The tax paid by two firms combined together may be lower than the taxes paid by them as individual firms.
  - *Debt Capacity*: By combining two firms, each of which has little or no capacity to carry debt, it is possible to create a firm that may have the capacity to borrow money and create value.

I. Diversification: No Value Creation?

- A takeover, motivated only by diversification considerations, has no effect on the combined value of the two firms involved in the takeover. The value of the combined firms will always be the sum of the values of the independent firms.
- In the case of private firms or closely held firms, where the owners may not be diversified personally, there might be a potential value gain from diversification.

II. Cash Slack

- Managers **may reject profitable investment opportunities** if they have to raise new capital to finance them.
- It may therefore make sense for a company with **excess cash and no investment opportunities** to take over a cash-poor firm with good investment opportunities, or vice versa.
- The **additional value** of combining these two firms lies in the **present value of the projects** that would not have been taken if they had stayed apart, but can now be taken because of the availability of cash.

Valuing Cash Slack

- Assume that Netscape has a severe capital rationing problem, that results in approximately $500 million of investments, with a cumulative net present value of $100 million, being rejected.
- IBM has far more cash than promising projects, and has accumulated $4 billion in cash that it is trying to invest. It is under pressure to return the cash to the owners.
- If IBM takes over Netscape Inc, it can be argued that the value of the combined firm will increase by the synergy benefit of $100 million, which is the net present value of the projects possessed by the latter that can now be taken with the excess cash from the former.

III. Tax Benefits

(1) If one of the firms has tax deductions that it cannot use because it is losing money, while the other firm has income on which it pays significant taxes, the combining of the two firms can lead to tax benefits that can be shared by the two firms. The value of this synergy is the present value of the tax savings that accrue because of this merger.

(2) The assets of the firm being taken over can be written up to reflect new market value, in some forms of mergers, leading to higher tax savings from depreciation in future years.

Valuing Tax Benefits: Tax Losses

- 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?

Valuing Tax Benefits: 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 before*	*Deprec'n after*	*Change in Deprec'n*	*Tax Savings*	*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*

IV. Debt Capacity

- Diversification will lead to an **increase in debt capacity** and an **increase in the value of the firm**.
- Has to be weighed against the immediate transfer of wealth that occurs to existing bondholders in both firms from the stockholders.

Valuing Debt Capacity

- When two firms in different businesses merge, the combined firm will have less variable earnings, and may be able to borrow more (have a higher debt ratio) than the individual firms.
- In the following example, we will combine two firms, with optimal debt ratios of 30% each, and end up with a firm with an optimal debt ratio of 40%.

Effect on Costs of Capital of Added debt

	Firm A	Firm B New Debt	AB -No Debt	AB - Added
Debt (%)	30%	30%	30%	40%
Cost of debt	6.00%	5.40%	5.65%	5.65%
Equity(%)	70%	70%	70%	60%
Cost of equity	13.60%	12.50%	12.95%	13.65%
WACC - Year 1	11.32%	10.37%	10.76%	10.45%
WACC- Year 2	11.32%	10.37%	10.76%	10.45%
WACC- Year 3	11.32%	10.37%	10.77%	10.45%
WACC-Year 4	11.32%	10.37%	10.77%	10.45%
WACC-Year 5	11.32%	10.37%	10.77%	10.45%
WACC-after year 5	10.55%	10.37%	10.45%	9.76%

Effect on Value of Added Debt

	Firm A	Firm B Debt	AB -No new Debt	AB - Added
FCFF in year 1	$120.00	$220.00	$340.00	$340.00
FCFF in year 2	$144.00	$242.00	$386.00	$386.00
FCFF in year 3	$172.80	$266.20	$439.00	$439.00
FCFF in year 4	$207.36	$292.82	$500.18	$500.18
FCFF in year 5	$248.83	$322.10	$570.93	$570.93
Terminal Value	$5,796.97	$7,813.00	$13,609.97	$16,101.22
Present Value	**$4,020.91**	**$5,760.47**	**$9,781.38**	**$11,429.35**

- The value of the firm, as a consequence of the added debt, will increase from $9,781.38 million to $11,429.35 million.

Empirical Evidence on Synergy

- If synergy is perceived to exist in a takeover, the value of the combined firm should be greater than the sum of the values of the bidding and target firms, operating independently.

  V(AB) > V(A) + V(B)

- Bradley, Desai and Kim (1988) use a sample of 236 inter-firm tender offers between 1963 and 1984 and report that the **combined value of the target and bidder firms increases 7.48%** ($117 million in 1984 dollars), on average, on the announcement of the merger.
- **Operating synergy** was the primary motive in **one-third of hostile takeovers**. (Bhide)

Operational Evidence on Synergy

- A stronger test of synergy is to **evaluate whether merged firms improve their performance (profitability and growth),** relative to their competitors, after takeovers.
  - McKinsey and Co. examined 58 acquisition programs between 1972 and 1983 for evidence on two questions -
    - Did the return on the amount invested in the acquisitions exceed the cost of capital?
    - Did the acquisitions help the parent companies outperform the competition?
  - They concluded that **28 of the 58 programs failed both tests**, and 6 failed at least one test.
- **Large number of acquisitions that are reversed within fairly short time periods**. About 20.2% of the acquisitions made between 1982 and 1986 were divested by 1988. In studies that have tracked acquisitions for longer time periods (ten years or more) the **divestiture rate of acquisitions rises to almost 50%.**

Who gets the benefits of synergy?

- The sharing of the benefits of synergy among the two players will depend in large part on whether the bidding firm's contribution to the **creation of the synergy is unique or easily replaced**. If it can be easily replaced, the bulk of the synergy benefits will accrue to the target firm. It is unique, the sharing of benefits will be much more equitable.
- Bradley, Desai and Kim (1988) conclude that the benefits of synergy accrue primarily to the target firms when there are **multiple** bidders involved in the takeover. They estimate that the market-adjusted stock returns around the announcement of the takeover for the successful bidder to be 2%, in single bidder takeovers, and -1.33%, in contested takeovers.

Finding the Right Financing Mix: The Capital Structure Decision

Aswath Damodaran

Stern School of Business

First Principles

- Invest in projects that yield a return greater than the minimum acceptable hurdle rate.
  - The hurdle rate should be higher for riskier projects and reflect the financing mix used - owners' funds (equity) or borrowed money (debt)
  - Returns on projects should be measured based on cash flows generated and the timing of these cash flows; they should also consider both positive and negative side effects of these projects.
- Choose a financing mix that minimizes the hurdle rate and matches the assets being financed.
- If there are not enough investments that earn the hurdle rate, return the cash to stockholders.
  - The form of returns - dividends and stock buybacks - will depend upon the stockholders' characteristics.

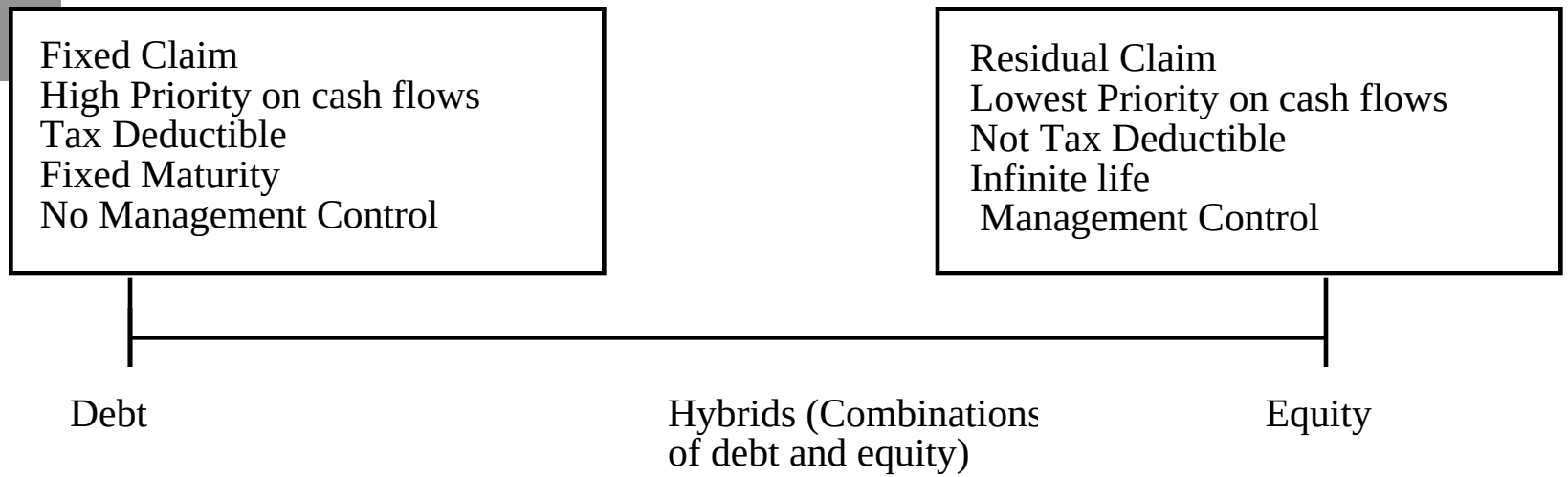
Objective: Maximize the Value of the Firm

The Choices in Financing

- There are only two ways in which a business can make money.
  - The first is debt. The essence of debt is that you promise to make fixed payments in the future (interest payments and repaying principal). If you fail to make those payments, you lose control of your business.
  - The other is equity. With equity, you do get whatever cash flows are left over after you have made debt payments.

Debt versus Equity

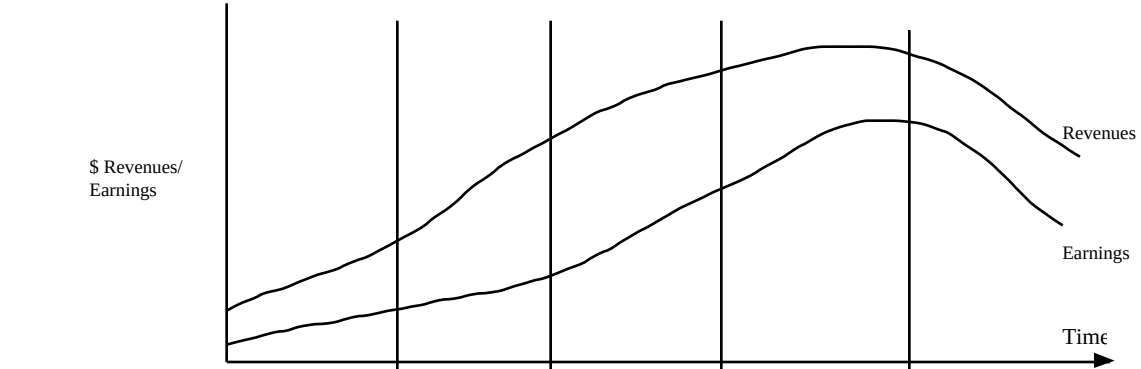
Debt versus Equity



The Choices

- Equity can take different forms:
  - For very small businesses: it can be owners investing their savings
  - For slightly larger businesses: it can be venture capital
  - For publicly traded firms: it is common stock
- Debt can also take different forms
  - For private businesses: it is usually bank loans
  - For publicly traded firms: it can take the form of bonds

A Life Cycle View of Financing Choices



External funding needs	High, but constrained by infrastructure	High, relative to firm value.	Moderate, relative to firm value.	Declining, as a percent of firm value	Low, as projects dry up.
Internal financing	Negative or low	Negative or low	Low, relative to funding needs	High, relative to funding needs	More than funding needs
External Financing	Owner's Equity Bank Debt	Venture Capital Common Stock	Common stock Warrants Convertibles	Debt	Retire debt Repurchase stock
Growth stage	Stage 1 Start-up	Stage 2 Rapid Expansion	Stage 3 High Growth	Stage 4 Mature Growth	Stage 5 Decline
Financing Transitions	Accessing private equity	Inital Public offering	Seasoned equity issue	Bond issues	

The Financing Mix Question

- In deciding to raise financing for a business, is there an optimal mix of debt and equity?
  - If yes, what is the trade off that lets us determine this optimal mix?
  - If not, why not?

Measuring a firm's financing mix

- The simplest measure of how much debt and equity a firm is using currently is to look at the proportion of debt in the total financing. This ratio is called the debt to capital ratio:

  Debt to Capital Ratio = Debt / (Debt + Equity)
- Debt includes all interest bearing liabilities, short term as well as long term.
- Equity can be defined either in accounting terms (as book value of equity) or in market value terms (based upon the current price). The resulting debt ratios can be very different.

Costs and Benefits of Debt

- Benefits of Debt
  - Tax Benefits
  - Adds discipline to management
- Costs of Debt
  - Bankruptcy Costs
  - Agency Costs
  - Loss of Future Flexibility

Tax Benefits of Debt

- When you borrow money, you are allowed to deduct interest expenses from your income to arrive at taxable income. This reduces your taxes. When you use equity, you are not allowed to deduct payments to equity (such as dividends) to arrive at taxable income.
- The dollar tax benefit from the interest payment in any year is a function of your tax rate and the interest payment:
  - Tax benefit each year = Tax Rate * Interest Payment
- Proposition 1: Other things being equal, the higher the marginal tax rate of a business, the more debt it will have in its capital structure.

The Effects of Taxes

You are comparing the debt ratios of real estate corporations, which pay the corporate tax rate, and real estate investment trusts, which are not taxed, but are required to pay 95% of their earnings as dividends to their stockholders. Which of these two groups would you expect to have the higher debt ratios?

- The real estate corporations
- The real estate investment trusts
- Cannot tell, without more information

Implications of The Tax Benefit of Debt

- The debt ratios of firms with higher tax rates should be higher than the debt ratios of comparable firms with lower tax rates. In supporting evidence,
- Firms that have substantial non-debt tax shields, such as depreciation, should be less likely to use debt than firms that do not have these tax shields.
- If tax rates increase over time, we would expect debt ratios to go up over time as well, reflecting the higher tax benefits of debt.
- Although it is always difficult to compare debt ratios across countries, we would expect debt ratios in countries where debt has a much larger tax benefit to be higher than debt ratios in countries whose debt has a lower tax benefit.

Debt adds discipline to management

- If you are managers of a firm with no debt, and you generate high income and cash flows each year, you tend to become complacent. The complacency can lead to inefficiency and investing in poor projects. There is little or no cost borne by the managers
- Forcing such a firm to borrow money can be an antidote to the complacency. The managers now have to ensure that the investments they make will earn at least enough return to cover the interest expenses. The cost of not doing so is bankruptcy and the loss of such a job.

Debt and Discipline

Assume that you buy into this argument that debt adds discipline to management. Which of the following types of companies will most benefit from debt adding this discipline?

- Conservatively financed (very little debt), privately owned businesses
- Conservatively financed, publicly traded companies, with stocks held by millions of investors, none of whom hold a large percent of the stock.
- Conservatively financed, publicly traded companies, with an activist and primarily institutional holding.

Empirical Evidence on the Discipline of Debt

- Firms that are acquired in hostile takeovers are generally characterized by poor performance in both accounting profitability and stock returns.
- There is evidence that increases in leverage are followed by improvements in operating efficiency, as measured by operating margins and returns on capital.
  - Palepu (1990) presents evidence of modest improvements in operating efficiency at firms involved in leveraged buyouts.
  - Kaplan(1989) and Smith (1990) also find that firms earn higher returns on capital following leveraged buyouts.
  - Denis and Denis (1993) study leveraged recapitalizations and report a median increase in the return on assets of 21.5%.

Bankruptcy Cost

- The expected bankruptcy cost is a function of two variables--
  - the cost of going bankrupt
    - direct costs: Legal and other Deadweight Costs
    - indirect costs: Costs arising because people perceive you to be in financial trouble
  - the probability of bankruptcy, which will depend upon how uncertain you are about future cash flows
- As you borrow more, you increase the probability of bankruptcy and hence the expected bankruptcy cost.

Indirect Bankruptcy Costs should be highest for….

- Firms that sell durable products with long lives that require replacement parts and service
- Firms that provide goods or services for which quality is an important attribute but where quality difficult to determine in advance
- Firms producing products whose value to customers depends on the services and complementary products supplied by independent companies:
- Firms that sell products requiring continuous service and support from the manufacturer

The Bankruptcy Cost Proposition

- Proposition 2: Other things being equal, the greater the indirect bankruptcy cost and/or probability of bankruptcy in the operating cashflows of the firm, the less debt the firm can afford to use.

Debt & Bankruptcy Cost

Rank the following companies on the magnitude of bankruptcy costs from most to least, taking into account both explicit and implicit costs:

- A Grocery Store
- An Airplane Manufacturer
- High Technology company

Implications of Bankruptcy Cost Proposition

- Firms operating in businesses with volatile earnings and cash flows should use debt less than otherwise similar firms with stable cash flows.
- If firms can structure their debt in such a way that the cash flows on the debt increase and decrease with their operating cash flows, they can afford to borrow more.
- If an external entity, such as the government or an agency of the government, provides protection against bankruptcy through either insurance or bailouts for troubled firms, firms will tend to borrow more.
- Firms with assets that can be easily divided and sold should borrow more than firms with assets that are less liquid.

Agency Cost

- An agency cost arises whenever you hire someone else to do something for you. It arises because your interests(as the principal) may deviate from those of the person you hired (as the agent).
- When you lend money to a business, you are allowing the stockholders to use that money in the course of running that business. Stockholders interests are different from your interests, because
  - You (as lender) are interested in getting your money back
  - Stockholders are interested in maximizing your wealth
- In some cases, the clash of interests can lead to stockholders
  - Investing in riskier projects than you would want them to
  - Paying themselves large dividends when you would rather have them keep the cash in the business.
- Proposition 3: Other things being equal, the greater the agency problems associated with lending to a firm, the less debt the firm can afford to use.

Debt and Agency Costs

Assume that you are a bank. Which of the following businesses would you perceive the greatest agency costs?

- A Large Pharmaceutical company
- A Large Regulated Electric Utility

Why?

How agency costs show up...

- If bondholders believe there is a significant chance that stockholder actions might make them worse off, they can build this expectation into bond prices by demanding much higher rates on debt.
- If bondholders can protect themselves against such actions by writing in restrictive covenants, two costs follow –
  - the direct cost of monitoring the covenants, which increases as the covenants become more detailed and restrictive.
  - the indirect cost of lost investments, since the firm is not able to take certain projects, use certain types of financing, or change its payout; this cost will also increase as the covenants becomes more restrictive.

Implications of Agency Costs..

- The agency cost arising from risk shifting is likely to be greatest in firms whose investments cannot be easily observed and monitored. These firms should borrow less than firms whose assets can be easily observed and monitored.
- The agency cost associated with monitoring actions and second-guessing investment decisions is likely to be largest for firms whose projects are long term, follow unpredictable paths, and may take years to come to fruition. These firms should also borrow less.

Loss of future financing flexibility

- When a firm borrows up to its capacity, it loses the flexibility of financing future projects with debt.
- Proposition 4: Other things remaining equal, the more uncertain a firm is about its future financing requirements and projects, the less debt the firm will use for financing current projects.

What managers consider important in deciding on how much debt to carry...

- A survey of Chief Financial Officers of large U.S. companies provided the following ranking (from most important to least important) for the factors that they considered important in the financing decisions

Factor	**Ranking (0-5)**
1. Maintain financial flexibility	4.55
2. Ensure long-term survival	4.55
3. Maintain Predictable Source of Funds	4.05
4. Maximize Stock Price	3.99
5. Maintain financial independence	3.88
6. Maintain high debt rating	3.56
7. Maintain comparability with peer group	2.47

Debt: Summarizing the Trade Off

Advantages of Borrowing	Disadvantages of Borrowing
1. Tax Benefit:	*1. Bankruptcy Cost:*
Higher tax rates --> Higher tax benefit	Higher business risk --> Higher Cost
2. Added Discipline:	*2. Agency Cost:*
Greater the separation between managers and stockholders --> Greater the benefit	Greater the separation between stock-holders & lenders --> Higher Cost
	3. Loss of Future Financing Flexibility:
	Greater the uncertainty about future financing needs --> Higher Cost

A Qualitative Analysis

Item	*Boeing*	*The Home Depot*	*InfoSoft*
Tax Benefits	Significant. The firm has a marginal tax rate of 35%. It does have large depreciation tax shields.	Significant. The firm has a marginal tax rate of 35%, as well. It does not have very much in non-interest tax shields.	Significant. The owners of InfoSoft face a 42% tax rate. By borrowing money, the income that flows through to the investor can be reduced.
Added Discipline	Benefits will be high, since managers are not large stockholders.	Benefits are smaller, since the CEO is a founder and large stockholder.	Benefits are non-existent. This is a private firm.
Bankruptcy Cost	Direct costs are likely to be small, but indirect costs can be substantial..	Direct costs are likely to be small. Assets are mostly real estate. Indirect costs will also be small.	Costs may be small but the owner has all of his wealth invested in the firm.
Agency Costs	Low. Assets are generally tangible and monitoring should be feasible.	Low. Assets are stores and real estate, tangible and marketable.	High. Assets are intangible and difficult to both monitor and to liquidate.
Flexibility Needs	Low. Firm has a long gestation period for projects, and knows how much it needs to invest in advance.	Low in existing business, but high, given its plans to grow overseas and online. Expansion and acquisition needs create need.	High. Firm might have to change its product and business mix, on short notice, as technology changes

⌛Application Test: Would you expect your firm to gain or lose from using a lot of debt?

- Considering, for your firm,
  - The potential tax benefits of borrowing
  - The benefits of using debt as a disciplinary mechanism
  - The potential for expected bankruptcy costs
  - The potential for agency costs
  - The need for financial flexibility
- Would you expect your firm to have a high debt ratio or a low debt ratio?
- Does the firm's current debt ratio meet your expectations?

A Hypothetical Scenario

- Assume you operate in an environment, where
  - (a) there are no taxes
  - (b) there is no separation between stockholders and managers.
  - (c) there is no default risk
  - (d) there is no separation between stockholders and bondholders
  - (e) firms know their future financing needs

The Miller-Modigliani Theorem

- In an environment, where there are no taxes, default risk or agency costs, capital structure is irrelevant.
- The value of a firm is independent of its debt ratio.

Implications of MM Theorem

(a) Leverage is irrelevant. A firm's value will be determined by its project cash flows.

(b) The cost of capital of the firm will not change with leverage. As a firm increases its leverage, the cost of equity will increase just enough to offset any gains to the leverage.

Can debt be irrelevant in a world with taxes?

- In the presence of personal taxes on both interest income and income from equity, it can be argued that debt could still be irrelevant if the cumulative taxes paid (by the firm and investors) on debt and equity are the same.
- Thus, if t_d is the personal tax rate on interest income received by investors, t_e is the personal tax rate on income on equity and t_c is the corporate tax rate, debt will be irrelevant if:

$$(1 - t_d) = (1-t_c)\ (1-t_e)$$

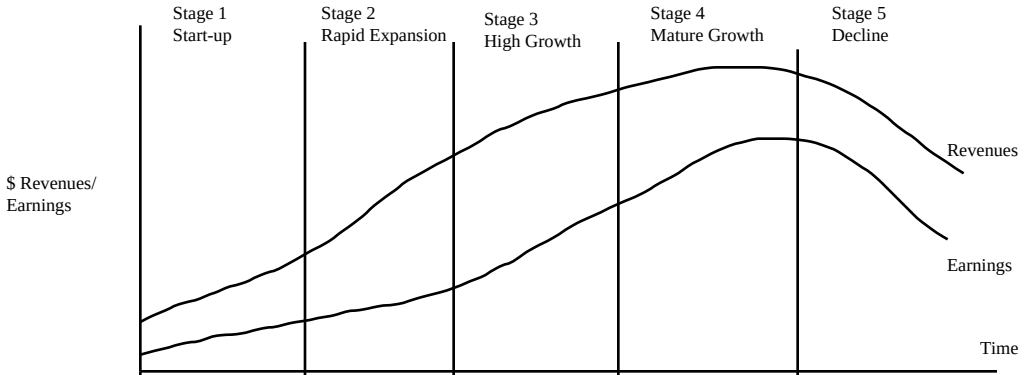
Is there an optimal capital structure? The Empirical Evidence

- The empirical evidence on whether leverage affects value is mixed.
  - Bradley, Jarrell, and Kim (1984) note that the debt ratio is lower for firms with more volatile operating income and for firms with substantial R&D and advertising expenses.
  - Barclay, Smith and Watts (1995) looked at 6780 companies between 1963 and 1993 and conclude that the most important determinant of a firm's debt ratio is its' investment opportunities. Firms with better investment opportunities (as measured by a high price to book ratio) tend to have much lower debt ratios than firms with low price to book ratios.
- Smith(1986) notes that leverage-increasing actions seem to be accompanied by positive excess returns while leverage-reducing actions seem to be followed by negative returns. This is not consistent with the theory that there is an optimal capital structure, unless we assume that firms tend to be under levered.

How do firms set their financing mixes?

- **Life Cycle:** Some firms choose a financing mix that reflects where they are in the life cycle; start- up firms use more equity, and mature firms use more debt.
- **Comparable firms**: Many firms seem to choose a debt ratio that is similar to that used by comparable firms in the same business.
- **Financing Heirarchy**: Firms also seem to have strong preferences on the type of financing used, with retained earnings being the most preferred choice. They seem to work down the preference list, rather than picking a financing mix directly.

The Debt Equity Trade Off Across the Life Cycle



	Stage 1 Start-up	Stage 2 Rapid Expansion	Stage 3 High Growth	Stage 4 Mature Growth	Stage 5 Decline
Tax Benefits	Zero, if losing money	Low, as earnings are limited	Increase, with earnings	High	High, but declining
Added Disceipline of Debt	Low, as owners run the firm	Low. Even if public, firm is closely held.	Increasing, as managers own less of firm	High. Managers are separated from owners	Declining, as firm does not take many new investments
Bamkruptcy Cost	Very high. Firm has no or negative earnings.	Very high. Earnings are low and volatile	High. Earnings are increasing but still volatile	Declining, as earnings from existing assets increase.	Low, but increases as existing projects end.
Agency Costs	Very high, as firm has almost no assets	High. New investments are difficult to monitor	High. Lots of new investments and unstable risk.	Declining, as assets in place become a larger portion of firm.	Low. Firm takes few new investments
Need for Flexibility	Very high, as firm looks for ways to establish itself	High. Expansion needs are large and unpredicatble	High. Expansion needs remain unpredictable	Low. Firm has low and more predictable investment needs.	Non-existent. Firm has no new investment needs.
Net Trade Off	Costs exceed benefits Minimal debt	Costs still likely to exceed benefits. Mostly equity	Debt starts yielding net benefits to the firm	Debt becomes a more attractive option.	Debt will provide benefits.

Comparable Firms

- When we look at the determinants of the debt ratios of individual firms, the strongest determinant is the average debt ratio of the industries to which these firms belong.
- This is not inconsistent with the existence of an optimal capital structure. If firms within a business share common characteristics (high tax rates, volatile earnings etc.), you would expect them to have similar financing mixes.
- This approach can lead to sub-optimal leverage, if firms within a business do not share common characteristics.

Rationale for Financing Hierarchy

- Managers value flexibility. External financing reduces flexibility more than internal financing.
- Managers value control. Issuing new equity weakens control and new debt creates bond covenants.

Preference rankings : Results of a survey

Ranking	Source	Score
1	Retained Earnings	5.61
2	Straight Debt	4.88
3	Convertible Debt	3.02
4	External Common Equity	2.42
5	Straight Preferred Stock	2.22
6	Convertible Preferred	1.72

Financing Choices

You are reading the Wall Street Journal and notice a tombstone ad for a company, offering to sell convertible preferred stock. What would you hypothesize about the health of the company issuing these securities?

- Nothing
- Healthier than the average firm
- In much more financial trouble than the average firm

The Search for an Optimal Financing Mix: Approaches

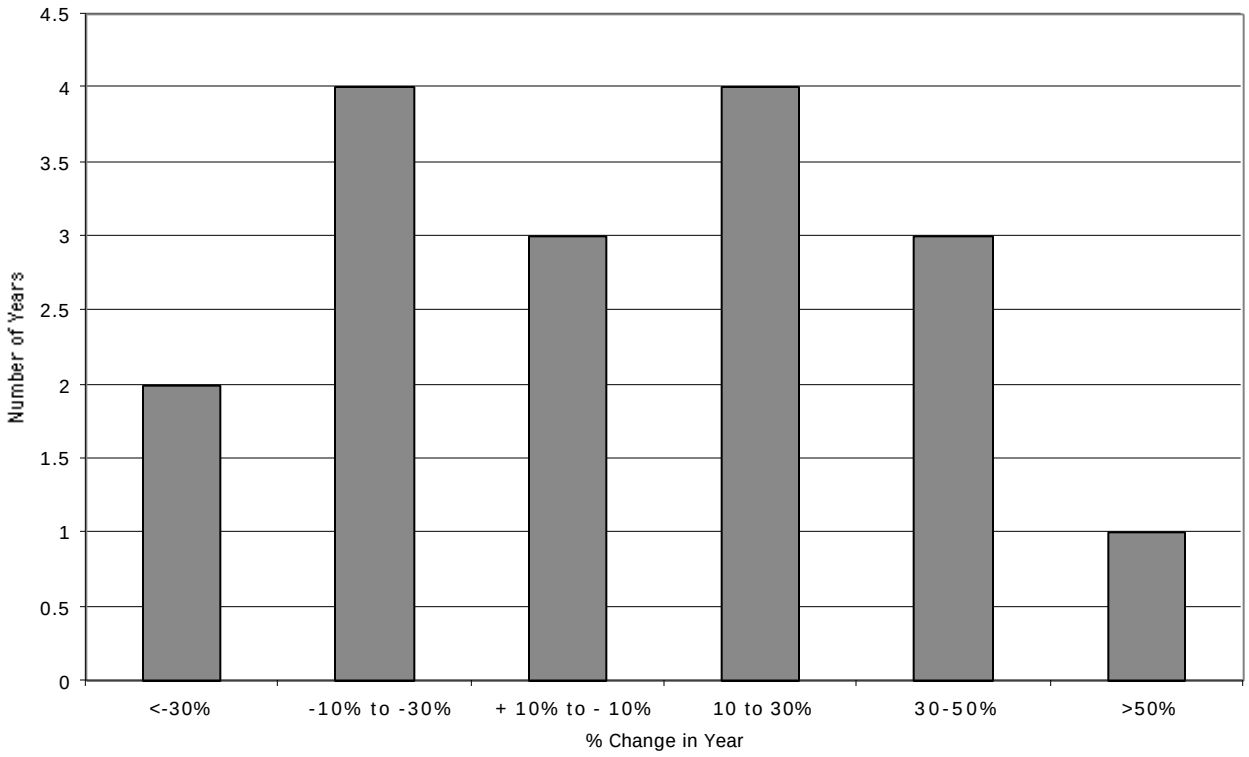
- **The Operating Income Approach**: In this approach, the optimal debt for a firm is chosen to ensure that the probability that the firm will default does not exceed a management-specified limit.
- **The Cost of Capital Approach**: In this approach, the optimal debt ratio is chosen to minimize cost of capital, if operating cash flows are unaffected by financing mix, or to maximize firm value.
- **The Adjusted Present Value Approach**: In this approach, the effect of adding debt to firm value is evaluated by measuring both the tax benefits and the bankruptcy costs.
- **The Return Differential Approach**: In this approach, the debt ratio is chosen to maximize the difference between ROE and cost of equity.
- **Comparables Approach**: The debt ratio is chosen by looking at how comparable firms are funded.

I. The Operating Income Approach

- Assess the firm's capacity to generate operating income based upon past history. The result is a distribution for expected operating income, with probabilities attached to different levels of income.
- For any given level of debt, we estimate the interest and principal payments that have to be made over time.
- Given the probability distribution of operating cash flows, we estimate the probability that the firm will be unable to make debt payments.
- We set a limit on the probability of its being unable to meet debt payments. Clearly, the more conservative the management of the firm, the lower this probability constraint will be.
- 5. We compare the estimated probability of default at a given level of debt to the probability constraint. If the probability of default is higher than the constraint, the firm chooses a lower level of debt; if it is lower than the constraint, the firm chooses a higher level of debt.

Boeing: Assessing the Probability Distribution

Figure 16.1: Boeing: Operating Income Changes - 1980-98



Estimating Debt Payments

- We estimate the interest and principal payments on a proposed bond issue of $ 5 billion by assuming that the debt will be rated A, lower than Boeing's current bond rating of AA. Based upon this rating, we estimated an interest rate of 6% on the debt. In addition, we assume that the sinking fund payment set aside to repay the bonds is 5% of the bond issue. This results in an annual debt payment of $ 550 million.

Additional Debt Payment = Interest Expense + Sinking Fund Payment

= 0.06 * 5,000 + .05 * 5,000 = $ 550 million

- The total debt payment then can be computed by adding the interest payment on existing debt in 1998 — $ 453 million — to the additional debt payment created by taking on $ 5 billion in additional debt.

Total Debt Payment = Interest on Existing Debt + Additional Debt Payment

= $ 453 million + $ 550 million = $ 1,003 million

Estimating Probability of Default

- We can now estimate the probability of default from the distribution of operating income by assuming that the percentage changes in operating income are normally distributed and by considering the earnings before interest, taxes, depreciation and amortization (EBITDA) of $ 3,237 million that Boeing earned in 1998 as the base year income.

T statistic = (Current EBITDA - Debt Payment) / σ_{OI} (Current Operating Income)

= ($ 3,237 - $ 1,003 million) / (.3583 * $3237) = 1.93

- Based upon this t statistic, the probability of default < 3%.

Management Constraints and Maximum Debt Capacity

- Assume that the management at Boeing set a constraint that the probability of default be no greater than 5%.
- If the distribution of operating income changes is normal, we can estimate the level of debt payments Boeing can afford to make for a probability of default of 5%.

  T statistic for 5% probability level = 1.645

  ($3,237 - X)/ (.3583 * $3,237) = 1.645

  Break Even Debt Payment = $ 1,329 million
- If we assume that the interest rate remains unchanged at 6% and the sinking fund will remain at 5% of the outstanding debt, this yields an optimal debt level of $ 12,082 million.

Optimal Debt= Break Even Debt Payment / (Interest Rate + Sinking Fund Rate)

= $ 1,329 / (.06 + .05) = $ 12,082 million

II. The Cost of Capital Approach

- It will depend upon:
  - (a) the components of financing: Debt, Equity or Preferred stock
  - (b) the cost of each component
- In summary, the cost of capital is the cost of each component weighted by its relative market value.

$$WACC = k_e (E/(D+E)) + k_d (D/(D+E))$$

Recapping the Measurement of cost of capital

- The cost of debt is the market interest rate that the firm has to pay on its borrowing. It will depend upon three components
  (a) The general level of interest rates
  (b) The default premium
  (c) The firm's tax rate
- The cost of equity is
  - 1. the required rate of return given the risk
  - 2. inclusive of both dividend yield and price appreciation
- The weights attached to debt and equity have to be market value weights, not book value weights.

Costs of Debt & Equity

A recent article in an Asian business magazine argued that equity was cheaper than debt, because dividend yields are much lower than interest rates on debt. Do you agree with this statement

- Yes
- No

Can equity ever be cheaper than debt?

- Yes
- No

Issue: Use of Book Value

Many CFOs argue that using book value is more conservative than using market value, because the market value of equity is usually much higher than book value. Is this statement true, from a cost of capital perspective? (Will you get a more conservative estimate of cost of capital using book value rather than market value?)

- Yes
- No

Why does the cost of capital matter?

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

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

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

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

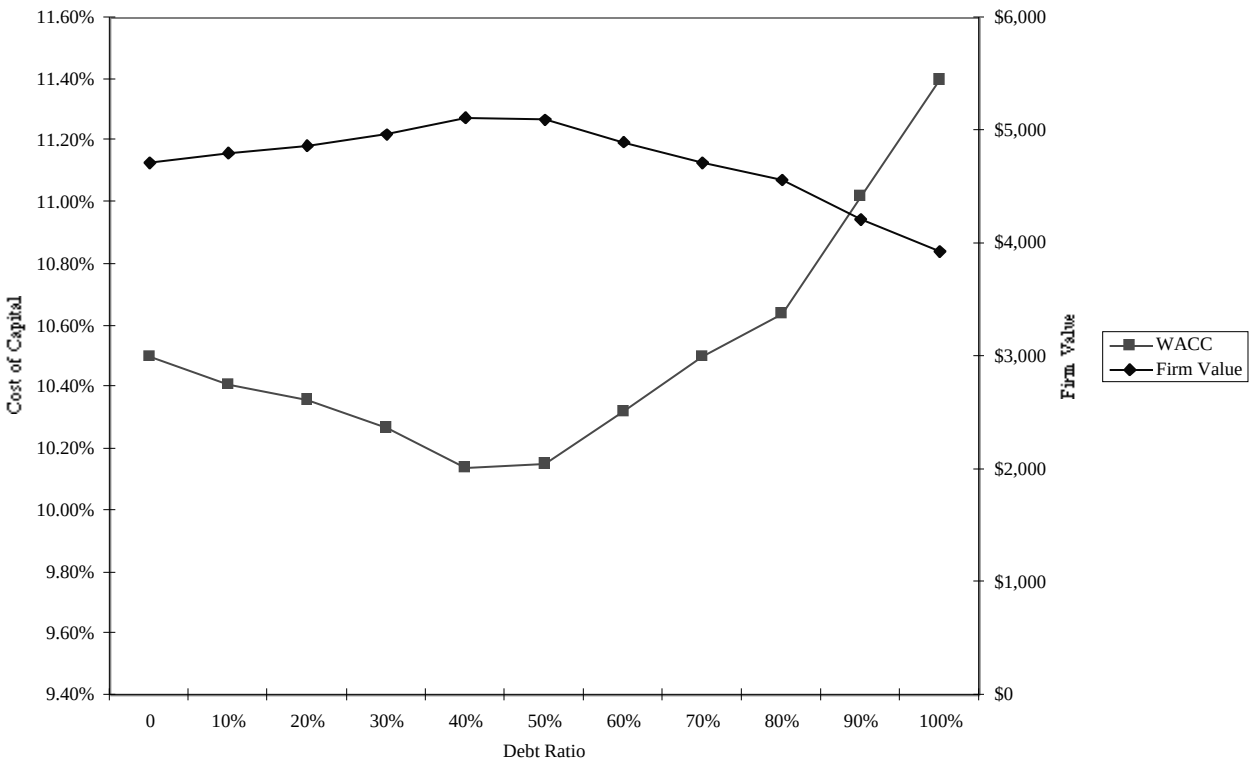
  = 200 (1.06)/(Cost of capital - .06)

Cost of Capital and Firm Value

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

A Pictorial View

Figure 19.2: Cost of Capital and Firm Value



Current Cost of Capital: Boeing

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

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

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

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

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

  = 5.50% (1- 0.35) = 3.58%

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

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

Mechanics of Cost of Capital Estimation

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

Ratings and Financial Ratios

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

Synthetic Ratings

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

Process of Ratings and Rate Estimation

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

Interest Coverage Ratios and Bond Ratings

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

Spreads over long bond rate for ratings classes: February 1999

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

Current Income Statement for Boeing: 1998

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

Estimating Cost of Equity

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

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

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

Cost of Equity = Riskfree rate + Beta * Risk Premium

Estimating Cost of Equity: Boeing at Different Debt Ratios

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

Market premium = 5.5% Treasury Bond rate = 7.00% t=35%

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

Estimating Cost of Debt

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

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

The Ratings Table

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

A Test: Can you do the 20% level?

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

Bond Ratings, Cost of Debt and Debt Ratios

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

Why does the tax rate change?

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

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

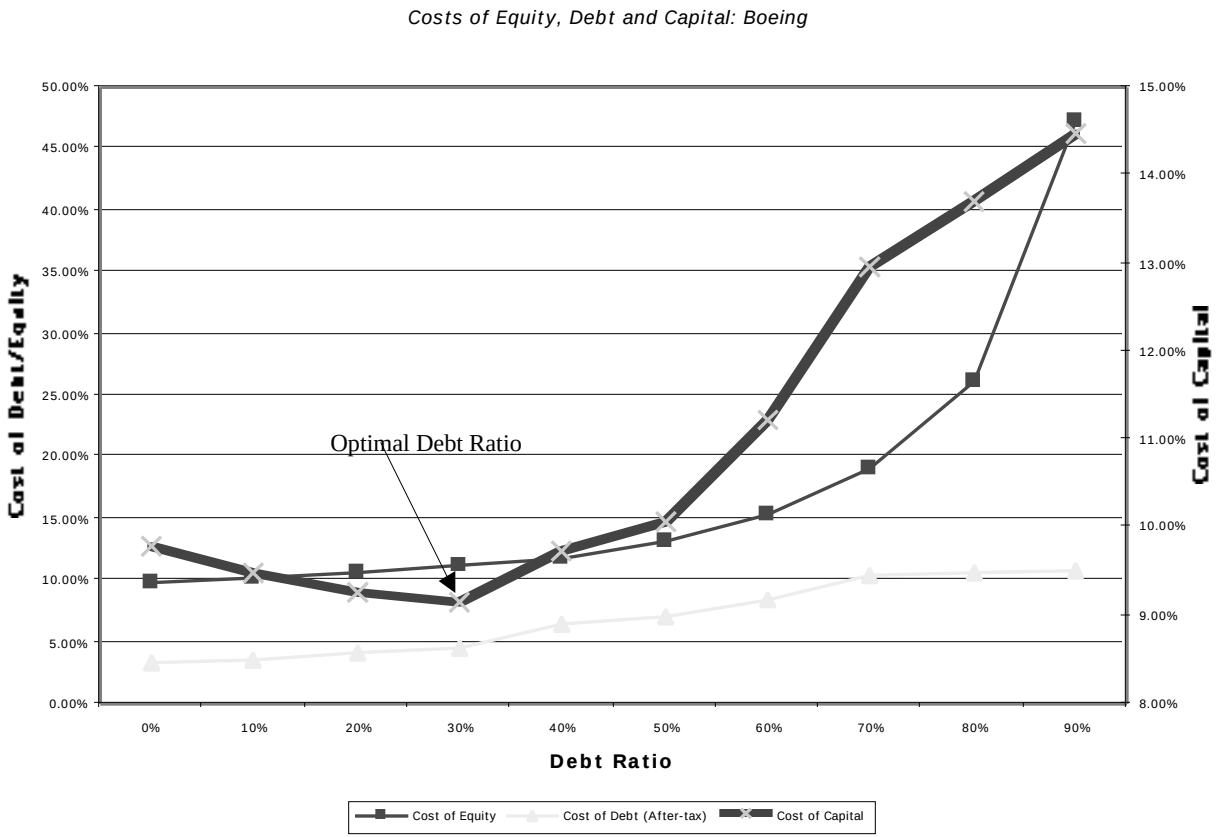
Maximum Tax Benefit = 35% of $1,751 = $613 million

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

Boeing's Cost of Capital Schedule

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

Boeing: Cost of Capital Chart



The Home Depot: Cost of Capital Schedule

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

Effect of Moving to the Optimal on Firm Value

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

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

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

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

But what growth rate do we use? One solution

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

  Assuming a perpetual growth model,

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

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

  Solving for g,

  Implied growth rate = .0611 or 6.11%

Change in Firm Value for Boeing: Firm Valuation Approach

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

Effect on Firm Value on Boeing: Annual Savings Approach

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

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

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

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

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

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

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

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

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

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

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

A Test: The Repurchase Price

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

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

The Downside Risk

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

Boeing's Operating Income History

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

Boeing: Operating Income and Optimal Capital Structure

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

Constraints on Ratings

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

Ratings Constraints for Boeing

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

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

What if you do not buy back stock..

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

Analyzing Financial Service Firms

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

Long Term Interest Coverage Ratios for Financial Service Firms

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

J.P. Morgan: Optimal Capital Structure

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

Analyzing Companies after Abnormal Years

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

Analyzing a Private Firm

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

Estimating the Optimal Debt Ratio for a Private Software Firm

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

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

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

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

Interest Coverage Ratios, Spreads and Ratings: Small Firms

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

Optimal Debt Ratio for InfoSoft

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

Determinants of Optimal Debt Ratios

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

    Higher - - > Lower Optimal Debt Ratio

    Lower - - > Higher Optimal Debt Ratio

Application Test: Your firm's optimal financing mix

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

III. The APV Approach to Optimal Capital Structure

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

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

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

Implementing the APV Approach

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

Estimating Expected Bankruptcy Cost

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

Ratings and Default Probabilities

Rating	Default Risk
AAA	0.01%
AA	0.28%
A+	0.40%
A	0.53%
A-	1.41%
BBB	2.30%
BB	12.20%
B+	19.28%
B	26.36%
B-	32.50%
CCC	46.61%
CC	52.50%
C	60%
D	75%

Boeing: Estimating Unlevered Firm Value

- Value of Boeing in 1999 = Value of Equity + Value of Debt = $32,595+$8,194 = $ 40,789

PV of Tax Savings from Existing Debt = Existing Debt * Tax Rate
= $8,194 * 0.35 = $ 2,868 million

- Based upon Boeing's current rating of AA, we estimate a probability of bankruptcy of 0.28%. The bankruptcy cost is assumed to be 30% of the firm value, prior to the tax savings.

PV of Expected Bankruptcy Cost = Probability of Default * Bankruptcy cost = 0.28% * (0.30 * (40,789-2,868)) = $ 32

- Value of Boeing as an Unlevered Firm

= Market Value – PV of Tax Savings + Expected Bankruptcy Costs

= $ 40,789 + $ 2,868 - $ 32 = $ 37,953 million

Tax Benefits at Debt Ratios

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

Tax Benefits capped when interest expenses exceed EBIT

Expected Bankruptcy Costs

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

Boeing: APV at Debt Ratios

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

Exp. Bk. Cst: Expected Bankruptcy cost

Relative Analysis

The “safest” place for any firm to be is close to the industry average.

- Subjective adjustments can be made to these averages to arrive at the right debt ratio.
  - Higher tax rates -> Higher debt ratios (Tax benefits)
  - Lower insider ownership -> Higher debt ratios (Greater discipline)
  - More stable income -> Higher debt ratios (Lower bankruptcy costs)
  - More intangible assets -> Lower debt ratios (More agency problems)

Examining Industry Averages

	Boeing	*Aerospace*	*Home Depot*	*Building Supplies*
Market Debt Ratio	18.97%	23.94%	1.65%	27.09%
Book Debt Ratio	36.15%	38.94%	15.31%	29.95%

The Home Depot's Comparables

Company Name	*Market D/(D+E)*	*Net Plant/Total Assets*	*Cap Ex/Total Assets*
Building Materials	47.23%	34.74%	3.90%
Catalina Lighting	51.17%	28.21%	1.95%
Cont'l Materials Corp	19.74%	36.02%	0.22%
Eagle Hardware	12.02%	52.54%	8.88%
Emco Limited	39.04%	22.64%	4.23%
Fastenal Co.	1.21%	27.82%	13.97%
Home Depot	1.65%	57.97%	13.19%
HomeBase Inc.	40.76%	36.15%	3.07%
Hughes Supply	37.97%	11.19%	2.94%
Lowe's Cos.	5.14%	57.58%	14.81%
National Home Centers	81.27%	47.40%	0.65%
Westburne Inc.	5.87%	11.19%	2.09%
White Cap Industries	13.04%	7.83%	3.08%
Wolohan Lumber	23.40%	28.21%	3.42%

Examining the Determinants of Capital Structure: Home Improvement Business

- Using a sample of home improvement firms, we arrived at the following regression:

Debt = 0.174 + 0.50 (Net Plant/Firm Value) – 1.39 (Cap Exp/ Assets)

(1.61) (2.86) (1.42)

- The R squared of the regression is 60%. This regression can be used to arrive at a predicted value for The Home Depot of:

$DFR_{\text{Home Depot}} = 0.174 + 0.50\ (0.0699) - 1.39\ (0.1319) = 0.0256$ or 2.56%

- Based upon the capital structure of other firms in the home improvement industry, Boeing should have a market value debt ratio of 2.56%.

Cross Sectional Regression: 1998 Data

- Using 1998 data for 3000 firms listed on the NYSE, AMEX and NASDAQ data bases, we categorized firms by SIC code. The regression across these sectors provides the following results –

DFR = 0.1608- 0.3411 OISTD +.2153 CLSH - 0.3159 CPXFR + 1.4185 E/V

(26.41[a]) (3.15[a]) (1.95[b]) (1.68[b]) (8.21[a])

where,

DFR = Debt / (Debt + Market Value of Equity)

OISTD = Standard Deviation in Operating Income (previous 5 years)

CLSH = Closely held shares as a percent of outstanding shares

CPXFR = Capital Expenditures / Total Assets

E/V = EBITDA / Firm Value

- The R squared of the regression is 57%.

Applying the Market Regression

	Boeing	The Home Depot
Standard Deviation in Operating Income	25.35%	24.06%
Insider Holdings as percent of outstanding stock	1%	23%
Capital Expenditures/Total Assets	4.32%	13.19%
EBITDA/ Firm Value	7.94%	3.38%
Predicted Debt Ratio	17.55%	13.45%

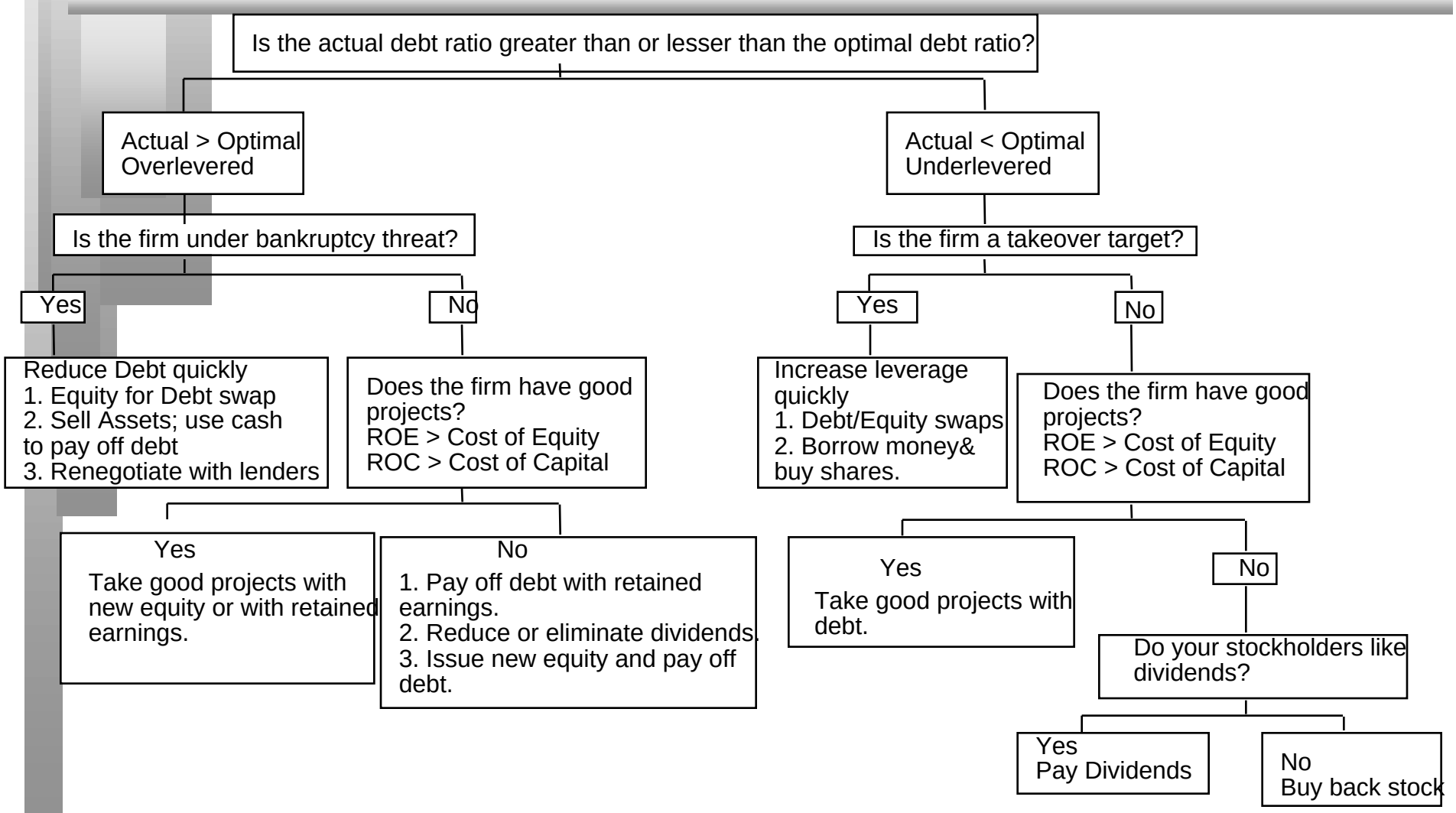
Reconciling the Different Analysis

	Boeing	*The Home Depot*
Actual Debt Ratio		
-Without operating leases	18.97%	1.65%
- With operating leases	20.09%	4.55%
Optimal		
I. Operating Income	28.41%	17.56%
II. Cost of Capital		
With no constraints	30.00%	20.00%
With BBB constraint	20.00%	15.00%
III. Return Differential	20.00%	30.00%
IV. APV	30.00%	20.00%
V. Comparable		
To Industry	22.56%	2.56%
To Market	17.55%	13.45%

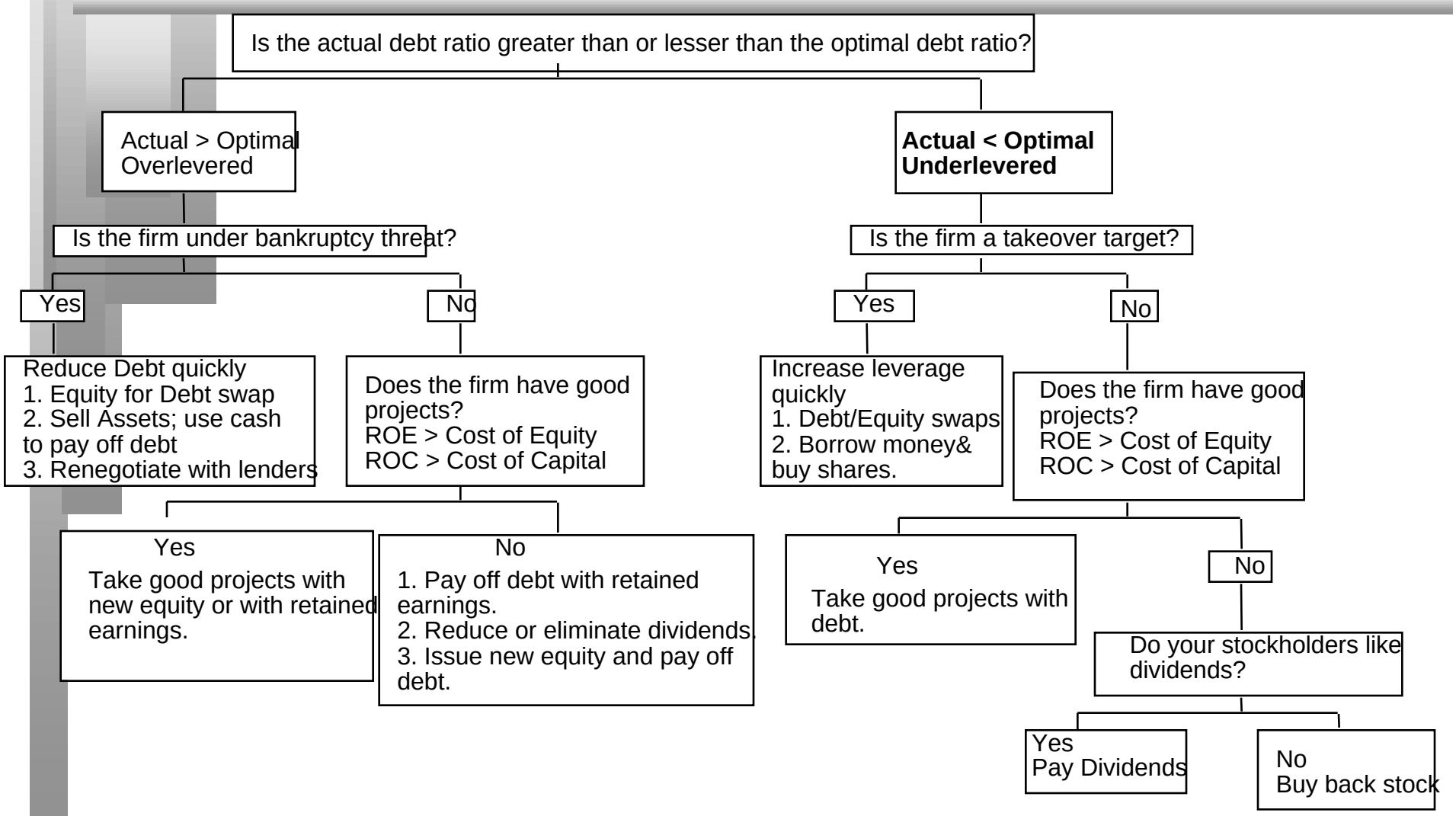
Analytical Conclusions

- Boeing is close to its optimal debt ratio.
- The Home Depot is under levered. Even with a BBB rating constraint, the Home Depot can afford to borrow significantly more than it does now.

A Framework for Getting to the Optimal



The Home Depot: Applying the Framework



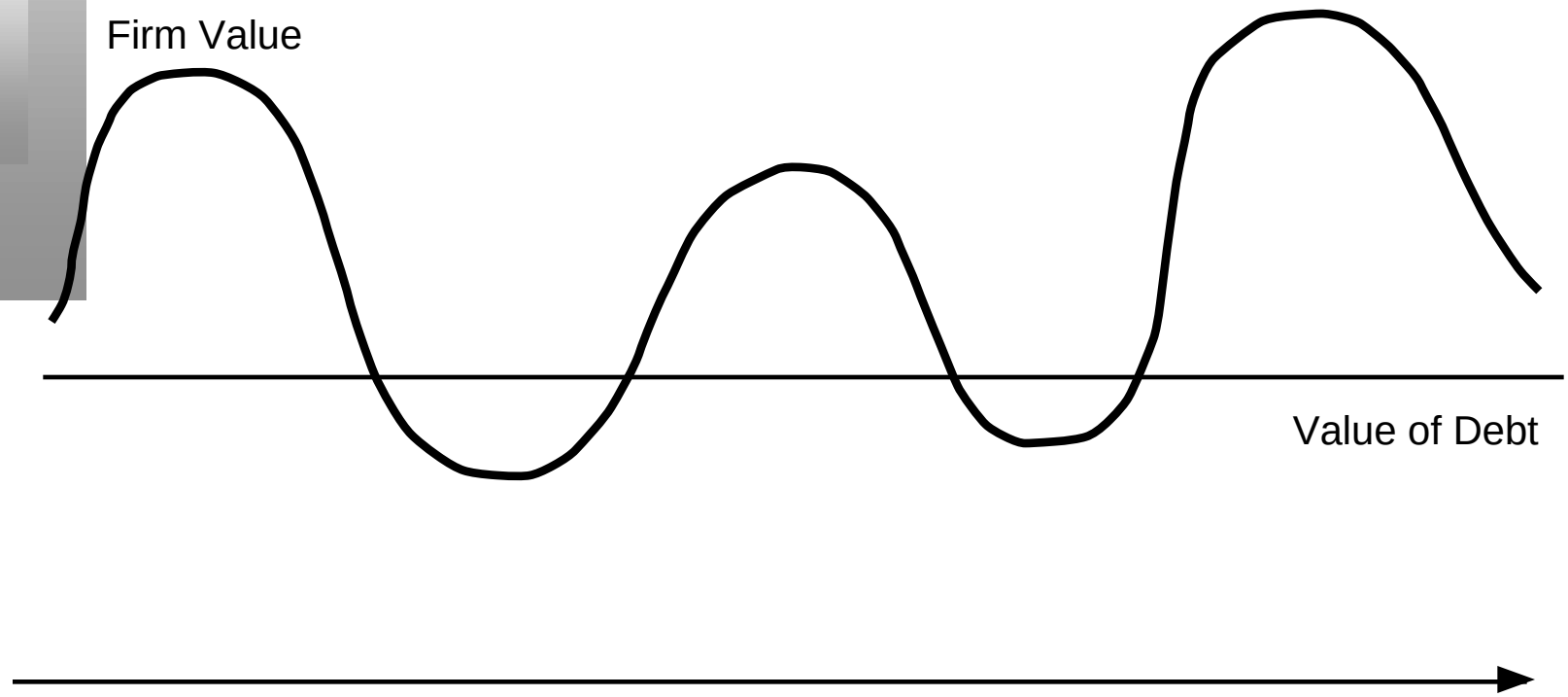
Application Test: Getting to the Optimal

- Based upon your analysis of both the firm's capital structure and investment record, what path would you map out for the firm?
  - Immediate change in leverage
  - Gradual change in leverage
  - No change in leverage
- Would you recommend that the firm change its financing mix by
  - Paying off debt/Buying back equity
  - Take projects with equity/debt

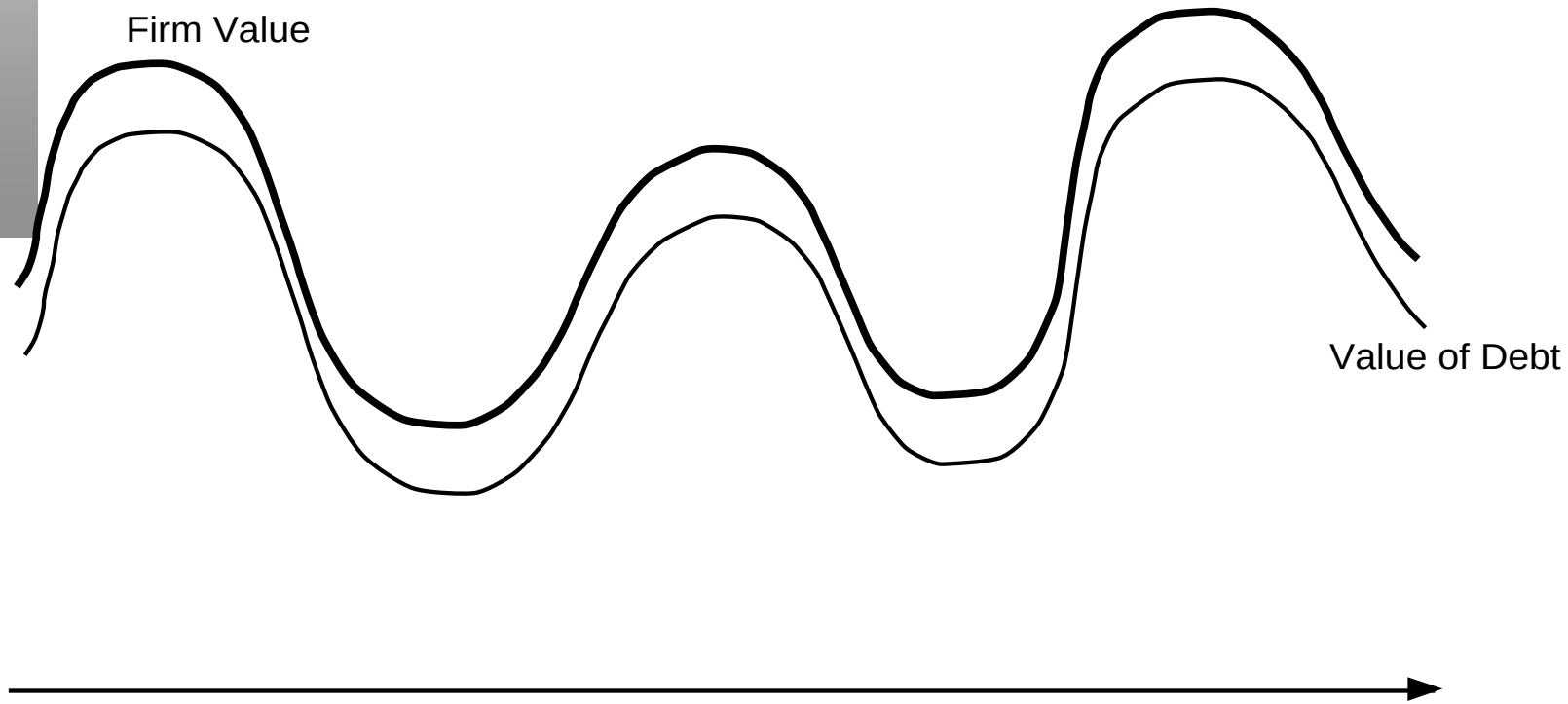
Designing Debt: The Fundamental Principle

- The objective in designing debt is to make the cash flows on debt match up as closely as possible with the cash flows that the firm makes on its assets.
- By doing so, we reduce our risk of default, increase debt capacity and increase firm value.

Firm with mismatched debt

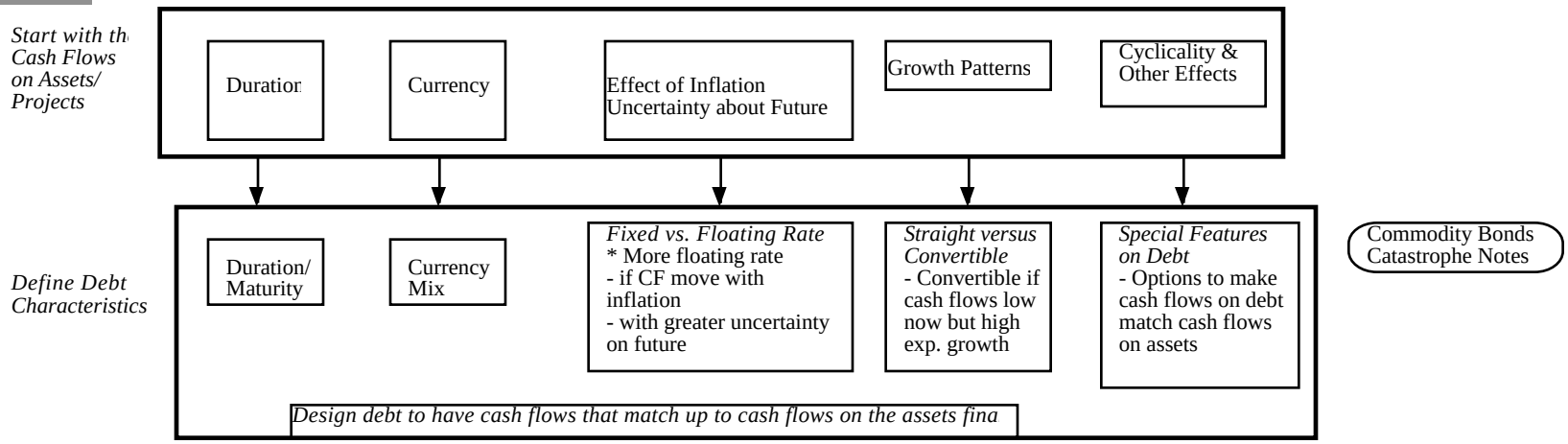


Firm with matched Debt



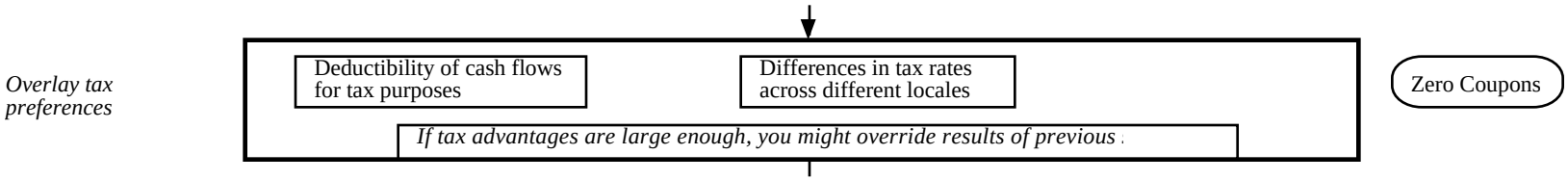
Design the perfect financing instrument

- The perfect financing instrument will
  - Have all of the tax advantages of debt
  - While preserving the flexibility offered by equity



Ensuring that you have not crossed the line drawn by the tax code

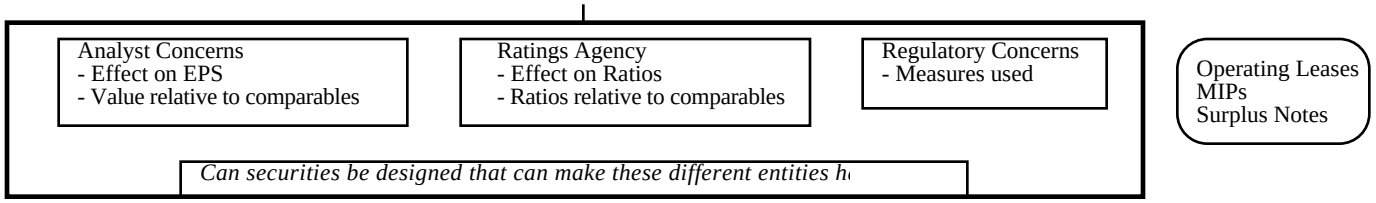
- All of this design work is lost, however, if the security that you have designed does not deliver the tax benefits.
- In addition, there may be a trade off between mismatching debt and getting greater tax benefits.



While keeping equity research analysts, ratings agencies and regulators applauding

- Ratings agencies want companies to issue equity, since it makes them safer. Equity research analysts want them not to issue equity because it dilutes earnings per share. Regulatory authorities want to ensure that you meet their requirements in terms of capital ratios (usually book value). Financing that leaves all three groups happy is nirvana.

Consider ratings agency & analyst concerns



Debt or Equity: The Strange Case of Trust Preferred

- Trust preferred stock has
  - A fixed dividend payment, specified at the time of the issue
  - That is tax deductible
  - And failing to make the payment can cause ? (Can it cause default?)
- When trust preferred was first created, ratings agencies treated it as equity. As they have become more savvy, ratings agencies have started giving firms only partial equity credit for trust preferred.

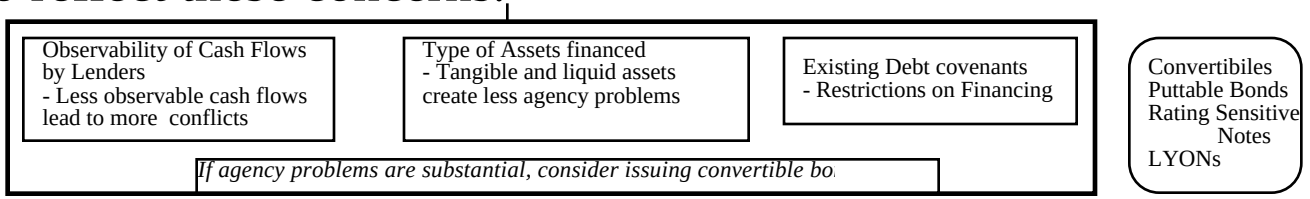
Debt, Equity and Quasi Equity

- Assuming that trust preferred stock gets treated as equity by ratings agencies, which of the following firms is the most appropriate firm to be issuing it?
  - A firm that is under levered, but has a rating constraint that would be violated if it moved to its optimal
  - A firm that is over levered that is unable to issue debt because of the rating agency concerns.

Soothe bondholder fears

- There are some firms that face skepticism from bondholders when they go out to raise debt, because
  - Of their past history of defaults or other actions
  - They are small firms without any borrowing history
- Bondholders tend to demand much higher interest rates from these firms to reflect these concerns.

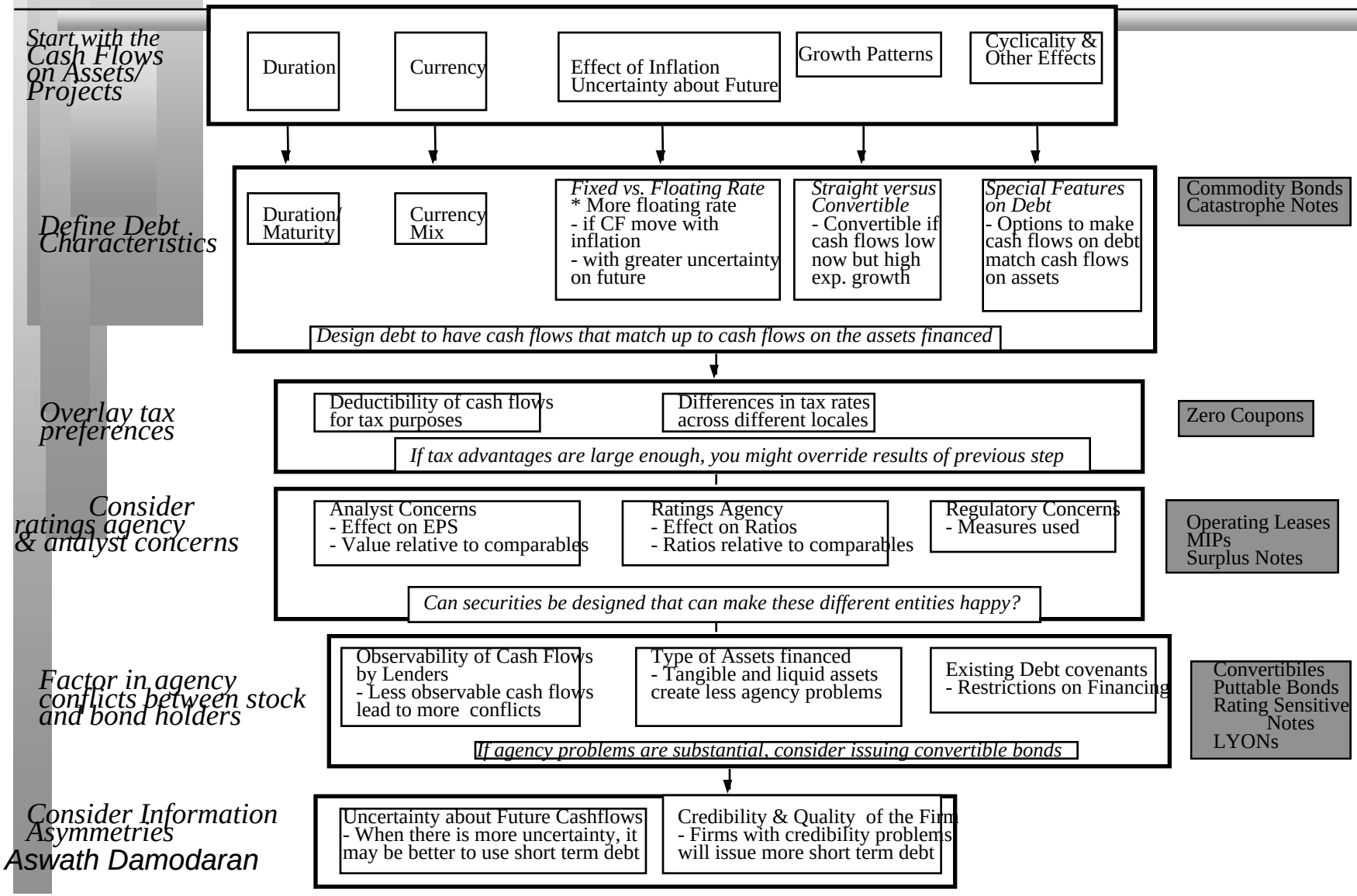
Factor in agency conflicts between stock and bond holders



And do not lock in market mistakes that work against you

- Ratings agencies can sometimes under rate a firm, and markets can under price a firm's stock or bonds. If this occurs, firms should not lock in these mistakes by issuing securities for the long term. In particular,
  - Issuing equity or equity based products (including convertibles), when equity is under priced transfers wealth from existing stockholders to the new stockholders
  - Issuing long term debt when a firm is under rated locks in rates at levels that are far too high, given the firm's default risk.
- What is the solution
  - If you need to use equity?
  - If you need to use debt?

Designing Debt: Bringing it all together



Approaches for evaluating Asset Cash Flows

- I. Intuitive Approach
  - Are the projects typically long term or short term? What is the cash flow pattern on projects?
  - How much growth potential does the firm have relative to current projects?
  - How cyclical are the cash flows? What specific factors determine the cash flows on projects?
- II. Project Cash Flow Approach
  - Project cash flows on a typical project for the firm
  - Do scenario analyses on these cash flows, based upon different macro economic scenarios
- III. Historical Data
  - Operating Cash Flows
  - Firm Value

Coming up with the financing details: Intuitive Approach - The Home Depot

- Historically, the Home Depot's typical project has been a new home-improvement products store of roughly 100,000 square feet, with a fairly long life and a substantial real estate investment.
- The construction of the store takes a relatively short time (1-2 years), and the stores start generating cash flows immediately.
- In addition, most of the growth for the firm since its inception has come from the United States.

The Home Depot: The Right Debt

- It should be long term, with a life roughly matching the life of the store.
- The debt should have a fixed rate or fixed payments each year, because the stores start to generate cash flows immediately and there is an absence of pricing power in this business. If the Home Depot had more pricing power, it could consider using floating rate debt, since cash flows are more likely to move with inflation.
- The debt should be in U.S. dollars, at least for new stores in the United States.
- If possible, the value of the debt should be tied to the value of the real estate underlying the store

Application Test: Choosing your Financing Type

- Based upon the business that your firm is in, and the typical investments that it makes, what kind of financing would you expect your firm to use in terms of
  - Duration (long term or short term)
  - Currency
  - Fixed or Floating rate
  - Straight or Convertible

Quantitative Approach

1. Operating Cash Flows
   - The question of how sensitive a firm's asset cash flows are to a variety of factors, such as interest rates, inflation, currency rates and the economy, can be directly tested by regressing changes in the operating income against changes in these variables.
   - Change in Operating Income(t)= a + b Change in Macro Economic Variable(t)
   - This analysis is useful in determining the coupon/interest payment structure of the debt.
2. Firm Value
   - The firm value is clearly a function of the level of operating income, but it also incorporates other factors such as expected growth & cost of capital.
   - The firm value analysis is useful in determining the overall structure of the debt, particularly maturity.

Historical Data

Period	*Operating Income*	*Firm Value*	*Change in LT Bond Rate*	*Change in GDP*	*Change in Inflation*	*Change in Currency*
1998	$2,661	$90,845	-1.03%	4.22%	-0.10%	-4.38%
1997	$2,016	$45,603	-0.63%	3.83%	-1.55%	9.80%
1996	$1,534	$25,034	0.80%	3.90%	0.78%	6.73%
1995	$1,232	$22,251	-2.09%	2.06%	-0.19%	-3.55%
1994	$1,039	$22,654	1.92%	3.27%	0.00%	-6.29%
1993	$744	$18,538	-0.83%	2.38%	-0.19%	0.61%
1992	$549	$22,513	-0.02%	3.61%	-0.19%	5.83%
1991	$382	$13,282	-1.26%	0.43%	-2.83%	2.67%
1990	$266	$5,595	0.12%	-0.21%	1.15%	-5.88%
1989	$185	$3,116				

Sensitivity to Interest Rate Changes

- The answer to this question is important because it
  - it provides a measure of the duration of the firm's projects
  - it provides insight into whether the firm should be using fixed or floating rate debt.

Firm Value versus Interest Rate Changes

- Regressing changes in firm value against changes in interest rates over this period yields the following regression –

  Change in Firm Value = 0.51 - 7.49 (Change in Interest Rates)

  (2.68) (0.46)

  T statistics are in brackets.

- Conclusion: The duration (interest rate sensitivity) of The Home Depot's asset values is about 7.49 years. Consequently, its debt should have at least as long a duration.

Why the coefficient on the regression is duration..

- The duration of a straight bond or loan issued by a company can be written in terms of the coupons (interest payments) on the bond (loan) and the face value of the bond to be –

$$\text{Duration of Bond} = \frac{dP/P}{dr/r} = \frac{\left[\sum_{t=1}^{t=N} \frac{t * \text{Coupon}_t}{(1+r^t)} + \frac{N * \text{Face Value}}{(1+r)^N}\right]}{\left[\sum_{t=1}^{t=N} \frac{\text{Coupon}_t}{(1+r)^t} + \frac{\text{Face Value}}{(1+r)^N}\right]}$$

- Holding other factors constant, the duration of a bond will increase with the maturity of the bond, and decrease with the coupon rate on the bond.

Duration of a Firm's Assets

- This measure of duration can be extended to any asset with expected cash flows on it. Thus, the duration of a project or asset can be estimated in terms of the pre-debt operating cash flows on that project.

$$\text{Duration of Project/Asset} = \frac{dPV/PV}{dr} = \frac{\left[\sum_{t=1}^{t=N} \frac{t * CF_t}{(1+r^t)} + \frac{N * \text{Terminal Value}}{(1+r)^N}\right]}{\left[\sum_{t=1}^{t=N} \frac{CF_t}{(1+r)^t} + \frac{\text{Terminal Value}}{(1+r)^N}\right]}$$

where,

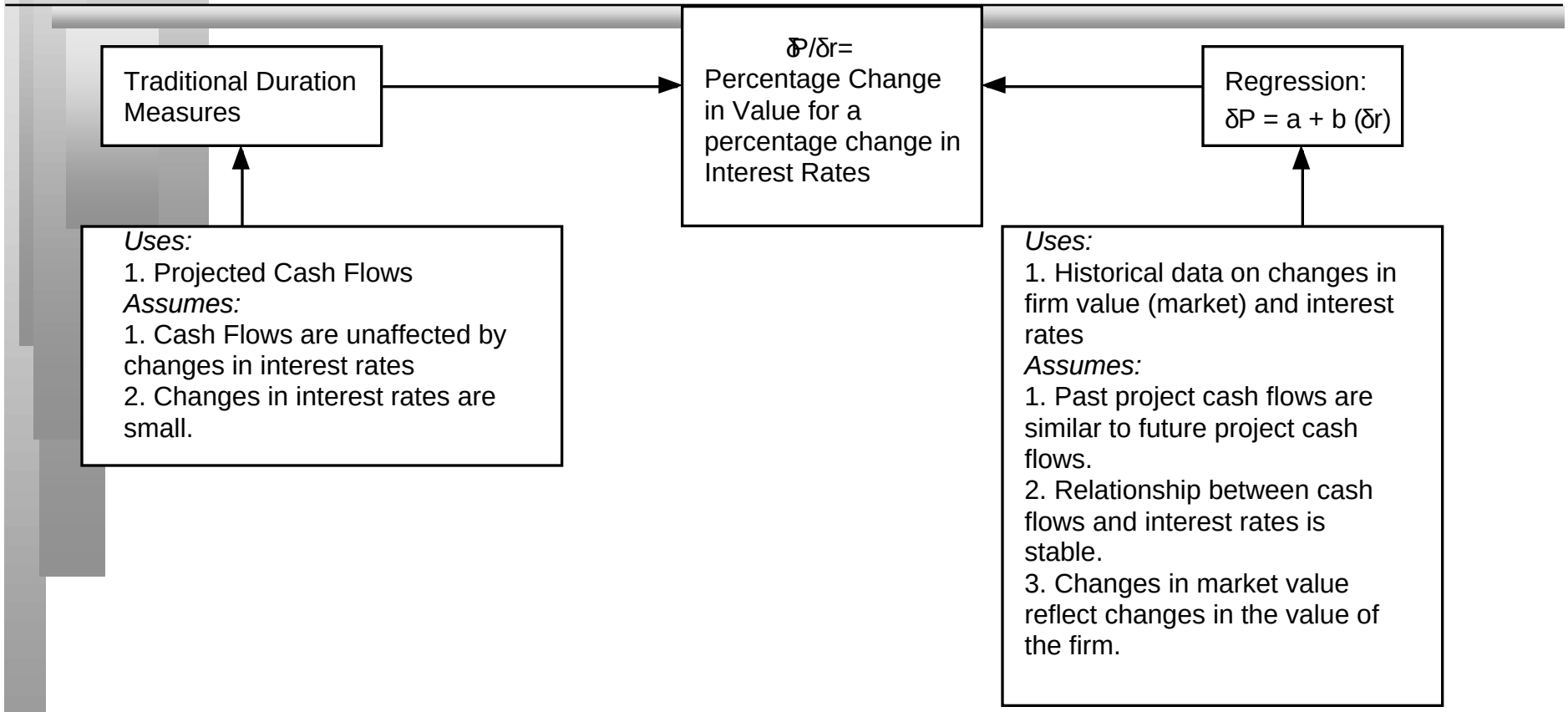
CFt = After-tax operating cash flow on the project in year t

Terminal Value = Salvage Value at the end of the project lifetime

N = Life of the project

- The duration of any asset provides a measure of the interest rate risk embedded in that asset.

Duration: Comparing Approaches



Operating Income versus Interest Rates

- Change in Operating Income = 0.36 + 2.55 (Change in Interest Rates)
  (11.28) (0.95)
- Generally speaking, the operating cash flows are smoothed out more than the value and hence will exhibit lower duration that the firm value.

Sensitivity to Changes in GNP

- The answer to this question is important because
  - it provides insight into whether the firm's cash flows are cyclical and
  - whether the cash flows on the firm's debt should be designed to protect against cyclical factors.
- If the cash flows and firm value are sensitive to movements in the economy, the firm will either have to issue less debt overall, or add special features to the debt to tie cash flows on the debt to the firm's cash flows.

Regression Results

- Regressing changes in firm value against changes in the GNP over this period yields the following regression –

Change in Firm Value = 0.74 **-7.82** (GDP Growth)

(2.05) (0.65)

- Conclusion: The Home Depot is counter-cyclical (?)
- Regressing changes in operating cash flow against changes in GNP over this period yields the following regression –

Change in Operating Income = 0.41 **– 2.25** (GNP Growth)

(6.86) (1.14)

Conclusion: Disney's operating income is slightly less sensitive to the economic cycle, but also counter-cyclical.

Sensitivity to Currency Changes

- The answer to this question is important, because
  - it provides a measure of how sensitive cash flows and firm value are to changes in the currency
  - it provides guidance on whether the firm should issue debt in another currency that it may be exposed to.
- If cash flows and firm value are sensitive to changes in the dollar, the firm should
  - figure out which currency its cash flows are in;
  - and issued some debt in that currency

Regression Results

- Regressing changes in firm value against changes in the dollar over this period yields the following regression –

Change in Firm Value = 0.52 + **1.13** (Change in Dollar)

(2.86) (0.34)

  - Conclusion: The Home Depot's value has not been very sensitive to changes in the dollar over the last 15 years.

- Regressing changes in operating cash flow against changes in the dollar over this period yields the following regression –

Change in Operating Income = 0.35 - **0.14** (Change in Dollar)

(10.83) (0.24)

  - Conclusion: The Home Depot's operating income has also been unaffected by changes in exchange rates.

Sensitivity to Inflation

- The answer to this question is important, because
  - it provides a measure of whether cash flows are positively or negatively impacted by inflation.
  - it then helps in the design of debt; whether the debt should be fixed or floating rate debt.
- If cash flows move with inflation, increasing (decreasing) as inflation increases (decreases), the debt should have a larger floating rate component.

Regression Results

- Regressing changes in firm value against changes in inflation over this period yields the following regression –

Change in Firm Value = 0.45 **- 23.39** (Change in Inflation Rate)

(2.78) (1.68)

  - Conclusion: The Home Depot's firm value is negatively affected by increases in inflation.

- Regressing changes in operating cash flow against changes in inflation over this period yields the following regression –

Change in Operating Income = 1.40 – 1.40 (Change in Inflation Rate)

(10.37) (0.50)

  - Conclusion: The Home Depot's operating income is also negatively affected by increases in inflation, though the effect is smaller.

Bottom-up Estimates

	Change in Firm Value versus			
	Interest Rates	GDP Growth	Inflation	Currency
Building Supplies	-6.56	0.73	-5.11	-1.93

On a bottom-up basis,

The Home Depot should have debt

- With a duration of 6.56 years
- That is unaffected by economic cycles
- Is is fixed rate (Value does not increase as inflation goes up)
- In dollars

Analyzing The Home Depot's Current Debt

- The Home Depot's existing debt is almost entirely in the form of long term leases on U.S. stores.
- Consequently, its existing debt is in line with what you would expect the Home Depot to have.

Analyzing Boeing's existing debt

	Existing Debt	*Optimal*
Duration	7.55	9.05
Floating Rate Component	12%	Low
Foreign Currency Debt	8%	47.24%
Convertible Debt	0%	0%

Boeing should increase its proportion of foreign currency debt and increase the maturity of its debt shortly.

The optimal debt ratios were estimated based upon bottom-up estimates for the aerospace and defense businesses.

Returning Cash to the Owners: Dividend Policy

Aswath Damodaran

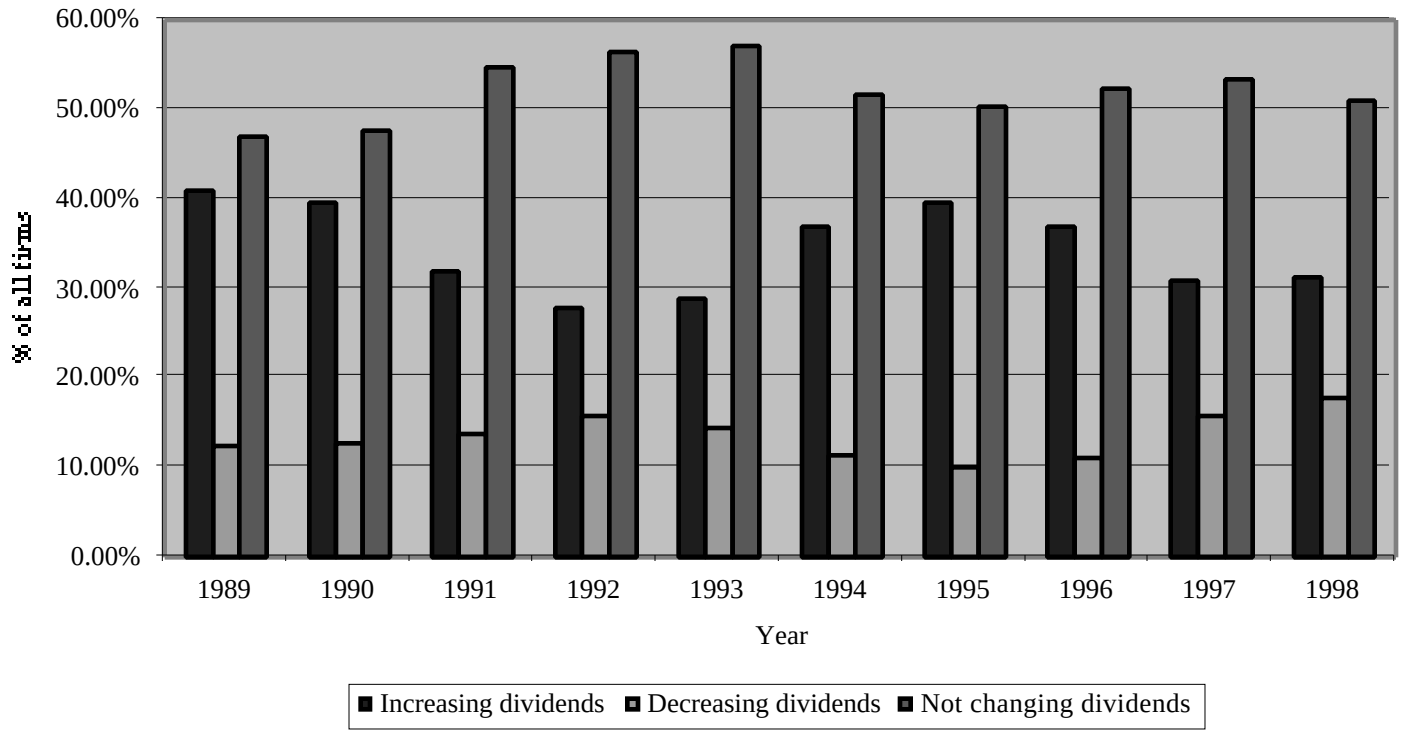
First Principles

- Invest in projects that yield a return greater than the minimum acceptable hurdle rate.
  - The hurdle rate should be higher for riskier projects and reflect the financing mix used - owners' funds (equity) or borrowed money (debt)
  - Returns on projects should be measured based on cash flows generated and the timing of these cash flows; they should also consider both positive and negative side effects of these projects.
- Choose a financing mix that minimizes the hurdle rate and matches the assets being financed.
- **If there are not enough investments that earn the hurdle rate, return the cash to stockholders.**
  - **The form of returns - dividends and stock buybacks - will depend upon the stockholders' characteristics.**

Objective: Maximize the Value of the Firm

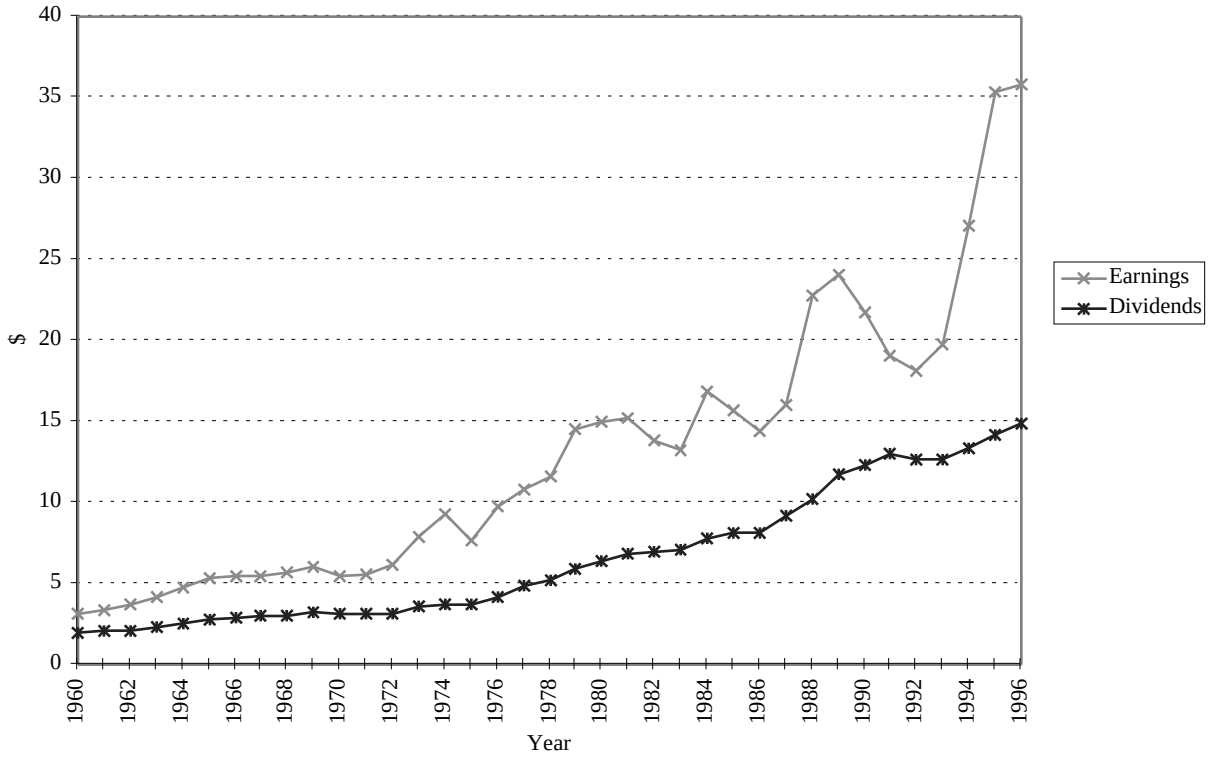
Dividends are sticky

Figure 21.6: Dividend Changes : 1989-1998



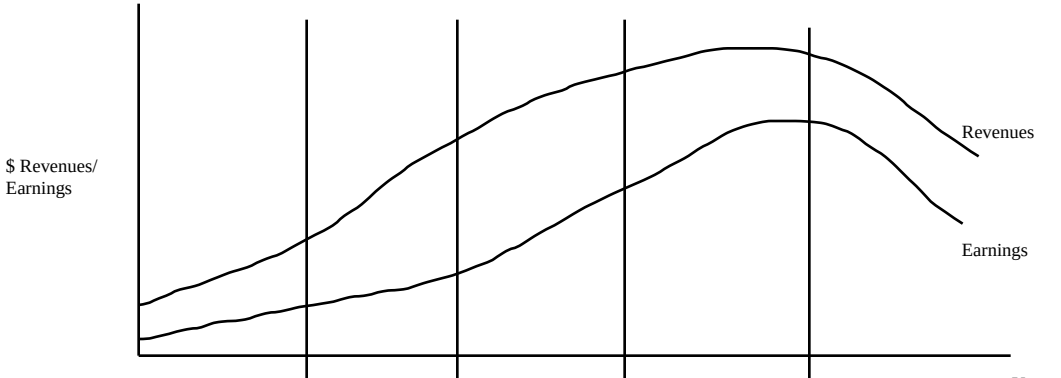
Dividends tend to follow Earnings

Figure 10.1: Aggregate Earnings and Dividends: S & P 500 - 1960-1996



Dividends follow the Life Cycle

Figure 21.7: Life Cycle Analysis of Dividend Policy

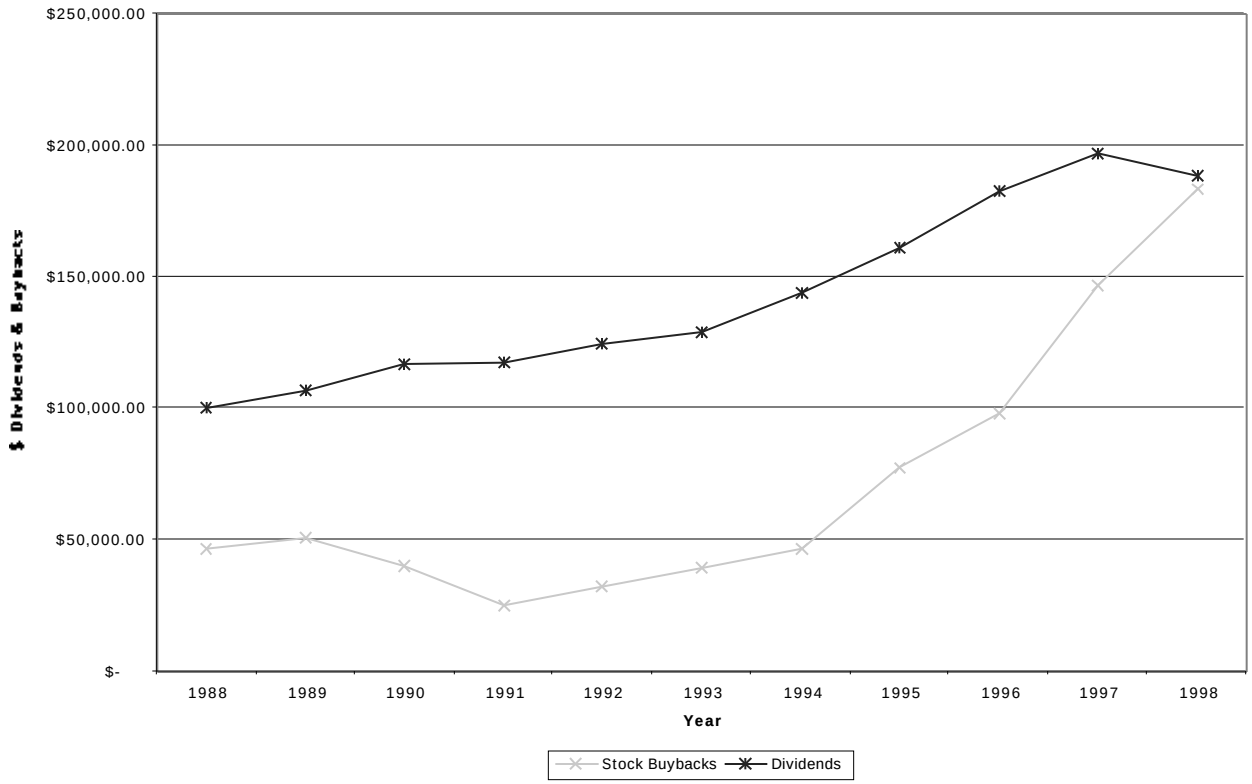


External funding needs	High, but constrained by infrastructure	High, relative to firm value.	Moderates, relative to firm value.	Low, as projects dry up.	Low, as projects dry up.
Internal financing	Negative or low	Negative or low	Low, relative to funding needs	High, relative to funding needs	More than funding needs
Capacity to pay dividends	None	None	Very low	Increasing	High
Growth stage	Stage 1 Start-up	Stage 2 Rapid Expansion	Stage 3 High Growth	Stage 4 Mature Growth	Stage 5 Decline

Years

More companies are buying back stock..

Figure 22.1: Stock Buybacks and Dividends: Aggregate for US Firms - 1989-98

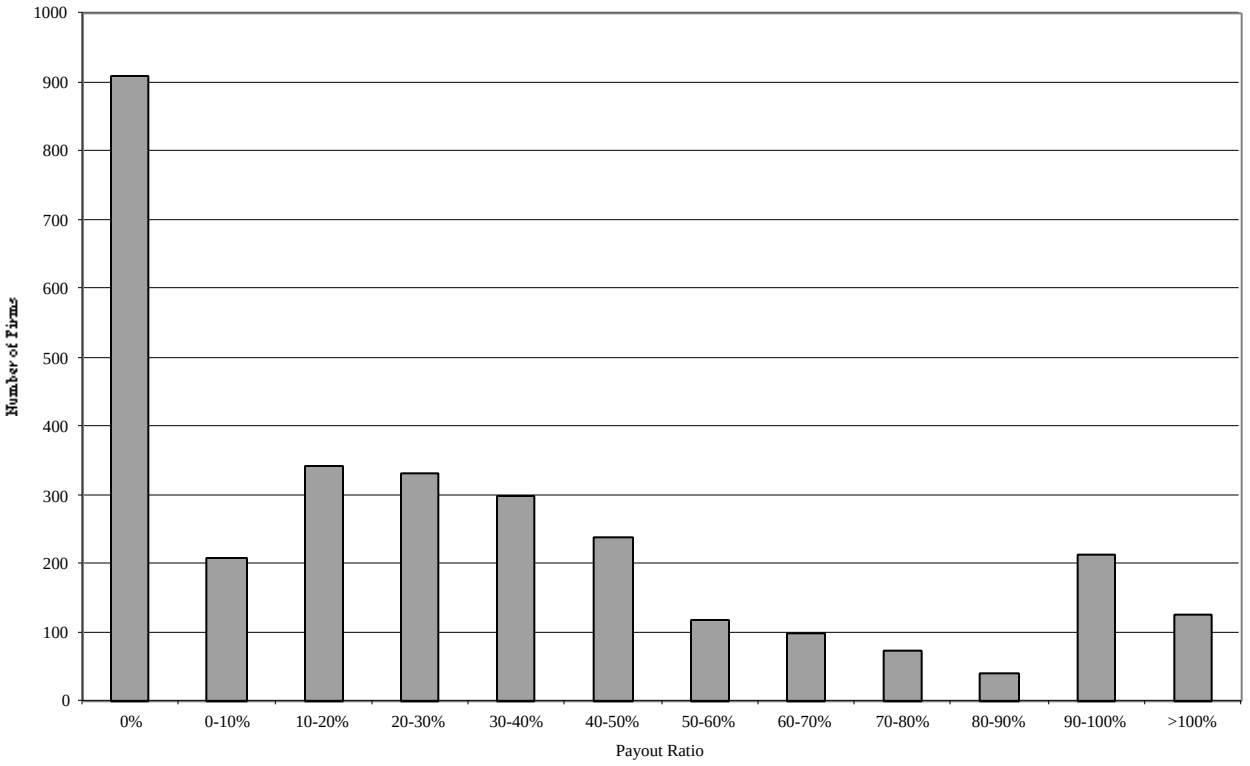


Measures of Dividend Policy

- Dividend Payout:
  - measures the percentage of earnings that the company pays in dividends
  - = Dividends / Earnings
- Dividend Yield :
  - measures the return that an investor can make from dividends alone
  - = Dividends / Stock Price

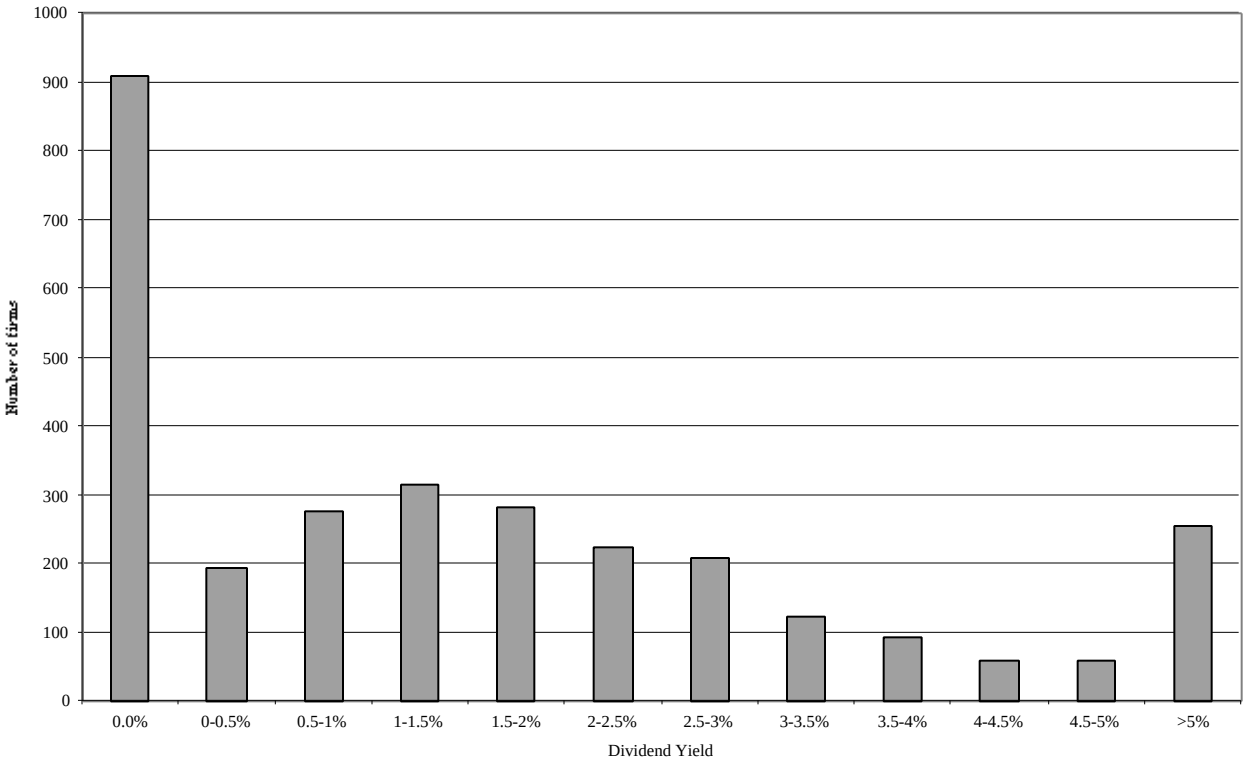
Dividend Payout Ratios in the United States

Figure 21.4: Dividend Payout Ratios: US Companies - April 19



Dividend Yields in the United States

Figure 21.2: Dividend Yields: US Companies - April 199



Three Schools Of Thought On Dividends

- 1. If
  - (a) there are no tax disadvantages associated with dividends
  - (b) companies can issue stock, at no cost, to raise equity, whenever needed
  - **Dividends do not matter, and dividend policy does not affect value.**
- 2. If dividends have a tax disadvantage,
  - **Dividends are bad, and increasing dividends will reduce value**
- 3. If stockholders like dividends, or dividends operate as a signal of future prospects,
  - **Dividends are good, and increasing dividends will increase value**

Dividends don’t affect value

- The Miller-Modigliani Hypothesis: **Dividends do not affect value**
- Basis:
  - If a firm's investment policy (and hence cash flows) don't change, the value of the firm cannot change with dividend policy. If we ignore personal taxes, investors have to be indifferent to receiving either dividends or capital gains.
- Underlying Assumptions:
  - (a) There are no tax differences between dividends and capital gains.
  - (b) If companies pay too much in cash, they can issue new stock, with no flotation costs or signaling consequences, to replace this cash.
  - (c) If companies pay too little in dividends, they do not use the excess cash for bad projects or acquisitions.

A Simple Example proving Dividend Irrelevance

- LongLast Corporation, an unlevered firm manufacturing furniture, has operating income after taxes of $ 100 million, growing at 5% a year, and that its cost of capital is 10%. Further, assume that this firm has reinvestment needs of $ 50 million, also growing at 5% a year, and that there are 105 million shares outstanding. Finally, assume that this firm pays out residual cash flows as dividends each year.

Free Cash Flow to the Firm = EBIT (1- tax rate) – Reinvestment needs

= $ 100 million - $ 50 million = $ 50 million

Value of the Firm = Free Cash Flow to Firm (1+g) / (WACC - g)

= $ 50 (1.05) / (.10 - .05) = $ 1050 million

- Price per share = $ 1050 million / 105 million = $ 10.00
- Dividend per share = $ 50 million/105 million = $ 0.476
- Total Value per Share = $ 10.00 + $ 0.48 = $10.476

LongLast doubles dividends

- Assuming that the firm's investment policy does not change, this will mean that the firm has to issue $ 50 million of equity to meet its reinvestment needs:

  Value of the Firm = $ 50 (1.05) / (.10 - .05) = $ 1050 million

Value of the Firm for existing stockholders after dividend payment = $ 1000 million (The remaining $ 50 million belongs to new stockholders)

Price per share = $ 1000 million / 105 million = $ 9.523

Dividends per share = $ 100 million/105 million shares = $ 0.953

Total Value Per Share = $ 9.523 + $0.953 = $10.476

LongLast eliminates dividends

- In this case, the firm will accumulate a cash balance of $ 50 million. The total value of the firm can be estimated as follows:

Value of Firm = Present Value of After-tax Operating CF + Cash Balance

= $ 50 (1.05) / (.10 - .05) + $ 50 million = $1100 million

Value per share = $ 1100 million / 105 million shares = $10.476

The Tax Response: Dividends are taxed more than capital gains

- Basis:
  - Dividends are taxed more heavily than capital gains. A stockholder will therefore prefer to receive capital gains over dividends.
- Evidence:
  - Examining ex-dividend dates should provide us with some evidence on whether dividends are perfect substitutes for capital gains.

Price Behavior on Ex-Dividend Date

Let P_b= Price before the stock goes ex-dividend

P_a=Price after the stock goes ex-dividend

D = Dividends declared on stock

t_o, t_{cg} = Taxes paid on ordinary income and capital gains respectively

Cashflows from Selling around Ex-Dividend Day

- The cash flows from selling before then are-

$$P_b - (P_b - P)\, t_{cg}$$

- The cash flows from selling after the ex-dividend day are-

$$P_a - (P_a - P)\, t_{cg} + D(1-t_o)$$

Since the average investor should be indifferent between selling before the ex-dividend day and selling after the ex-dividend day -

$$P_b - (P_b - P)\, t_{cg} = P_a - (P_a - P)\, t_{cg} + D(1-t_o)$$

Moving the variables around, we arrive at the following:

Price Change, Dividends and Tax Rates

$$\frac{P_b - P_a}{D} = \frac{(1-t_o)}{(1-t_{cg})}$$

If	$P_b - P_a = D$	then	$t_o = t_{cg}$
	$P_b - P_a < D$	then	$t_o > t_{cg}$
	$P_b - P_a > D$	then	$t_o < t_{cg}$

The Evidence on Ex-Dividend Day Behavior

	Ordinary Income	Capital Gains	$(P_b - P_a)/D$
Before 1981	70 %	28 %	0.78 (1966-69)
1981-85	50 %	20 %	0.85
1986-1990	28 %	28 %	0.90
1991-1993	33 %	28 %	0.92
1994.	39.6 %	28 %	?

Dividend Arbitrage

- Assume that you are a tax exempt investor, and that you know that the price drop on the ex-dividend day is only 90% of the dividend. How would you exploit this differential?
  - Invest in the stock for the long term
  - Sell short the day before the ex-dividend day, buy on the ex-dividend day
  - Buy just before the ex-dividend day, and sell after.
  - _____

Example of dividend capture strategy with tax factors

- XYZ company is selling for $50 at close of trading May 3. On May 4, XYZ goes ex-dividend; the dividend amount is $1. The price drop (from past examination of the data) is only 90% of the dividend amount.
- The transactions needed by a tax-exempt U.S. pension fund for the arbitrage are as follows:
  - 1. Buy 1 million shares of XYZ stock cum-dividend at $50/share.
  - 2. Wait till stock goes ex-dividend; Sell stock for $49.10/share (50 - 1* 0.90)
  - 3. Collect dividend on stock.
- Net profit = - 50 million + 49.10 million + 1 million = $0.10 million

Bad Reasons for Paying Dividends

- **The bird in the hand fallacy**: Dividends are better than capital gains because dividends are certain and capital gains are not.
- **The Excess Cash Argument**: The excess cash that a firm has in any period should be paid out as dividends in that period.

The bird in the hand fallacy

- **Argument**: Dividends now are more certain than capital gains later. Hence dividends are more valuable than capital gains.
- **Counter:** The appropriate comparison should be between dividends today and price appreciation today. (The stock price drops on the ex-dividend day.)

The excess cash hypothesis

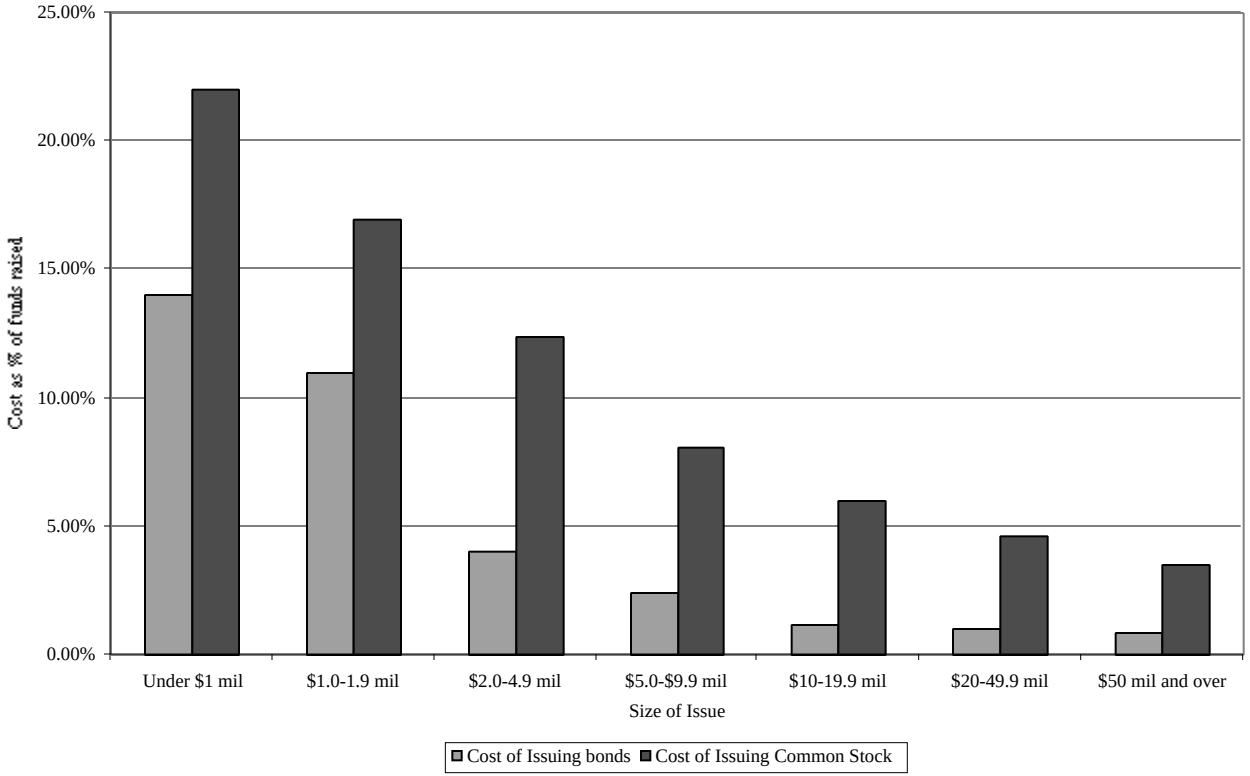
- **Argument**: The firm has excess cash on its hands this year, no investment projects this year and wants to give the money back to stockholders.
- **Counter**: So why not just repurchase stock? If this is a one-time phenomenon, the firm has to consider future financing needs. Consider the cost of issuing new stock:

The Cost of Raising Funds

- Issuing new equity is much more expensive than raising new debt for companies that are already publicly traded, in terms of transactions costs and investment banking fees
- Raising small amounts is much more expensive than raising large amounts, for both equity and debt. Making a small equity issue (say $ 25-$ 50 million might be prohibitively expensive)

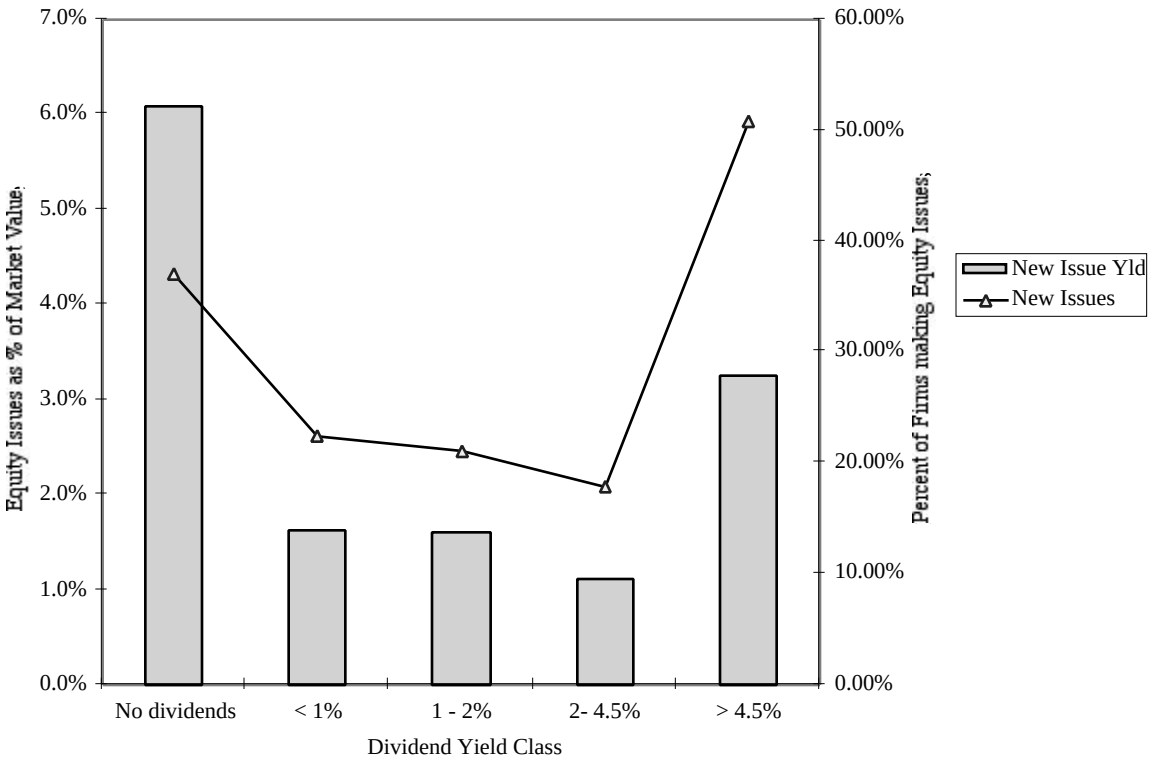
Issuance Costs

Figure 21.10: Issuance Costs for Stocks and Bonds



Some companies pay dividends and fund them by issuing stock….

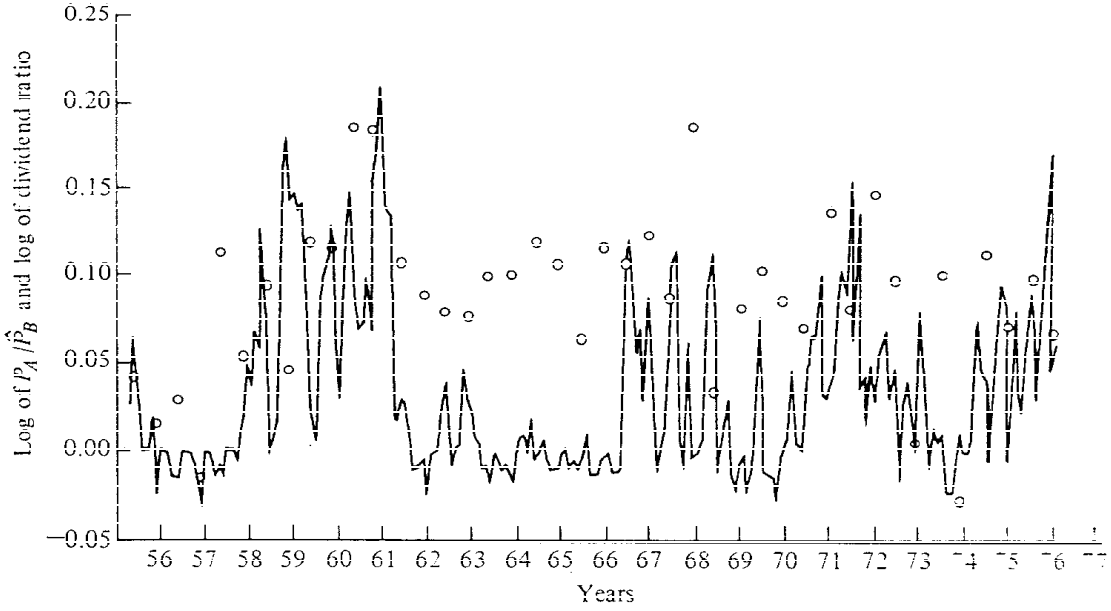
Figure 21.11: Equity Issues by Dividend Class, United States



Potentially Good Reasons for Paying Dividends

- **The Clientele Argument**: There are stockholders who like dividends, either because they value the regular cash payments or do not face a tax disadvantage. If these are the stockholders in your firm, paying more in dividends will increase value.
- **Dividends as Signals**: Dividend increases may operate as a positive signal to financial markets and thus increase stock prices.
- **Wealth Transfer**: By returning more cash to stockholders, there might be a transfer of wealth from the bondholders to the stockholders.

Some stockholders like dividends: A Case Study



The natural log of $P_A/\hat{P}_B$ (the connected monthly observations) and the natural log of the semi-annual ratio of Series A to Series B dividends (the unconnected 0's) for the period 1956–1976. $\hat{P}_B$ is the price per share of Series B stock with dividends reinvested during each half-year prior to payment of the semi-annual Series A dividend. The unconnected points representing the log of the dividend ratio are placed in the figure at the end of the half-years to which they refer.

Evidence from Canadian Firms

Company	*Premium for Cash dividend over Stock Dividend Shares*
Consolidated Bathurst	19.30%
Donfasco	13.30%
Dome Petroleum	0.30%
Imperial Oil	12.10%
Newfoundland Light & Power	1.80%
Royal Trustco	17.30%
Stelco	2.70%
TransAlta	1.10%
Average	**7.54%**

A clientele based explanation

- **Basis**: Investors may form clienteles based upon their tax brackets. Investors in high tax brackets may invest in stocks which do not pay dividends and those in low tax brackets may invest in dividend paying stocks.
- **Evidence**: A study of 914 investors' portfolios was carried out to see if their portfolio positions were affected by their tax brackets. The study found that
  - (a) Older investors were more likely to hold high dividend stocks and
  - (b) Poorer investors tended to hold high dividend stocks

Results from Regression: Clientele Effect

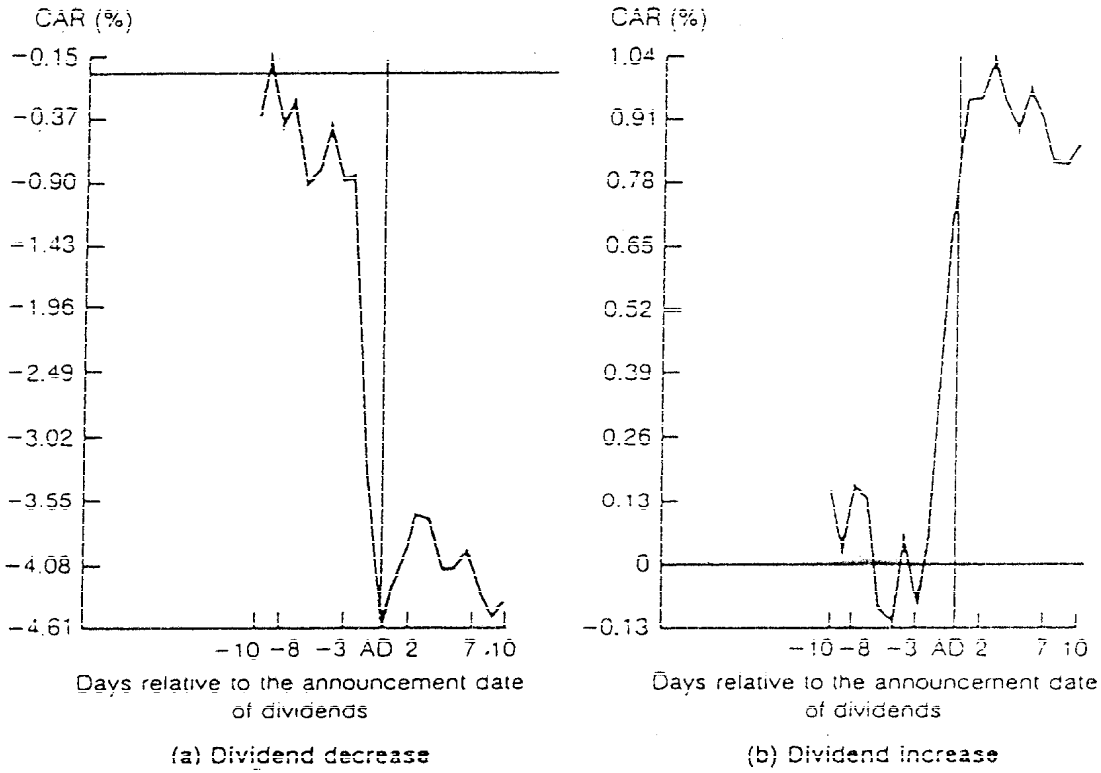
$$\text{Dividend Yield}_t = a + b\,\beta_t + c\,\text{Age}_t + d\,\text{Income}_t + e\,\text{Differential Tax Rate}_t + \varepsilon_t$$

Variable	Coefficient	Implies
Constant	4.22%	
Beta Coefficient	-2.145	Higher beta stocks pay lower dividends.
Age/100	3.131	Firms with older investors pay higher dividends.
Income/1000	-3.726	Firms with wealthier investors pay lower dividends.
Differential Tax Rate	-2.849	If ordinary income is taxed at a higher rate than capital gains, the firm pays less dividends.

Dividend Policy and Clientele

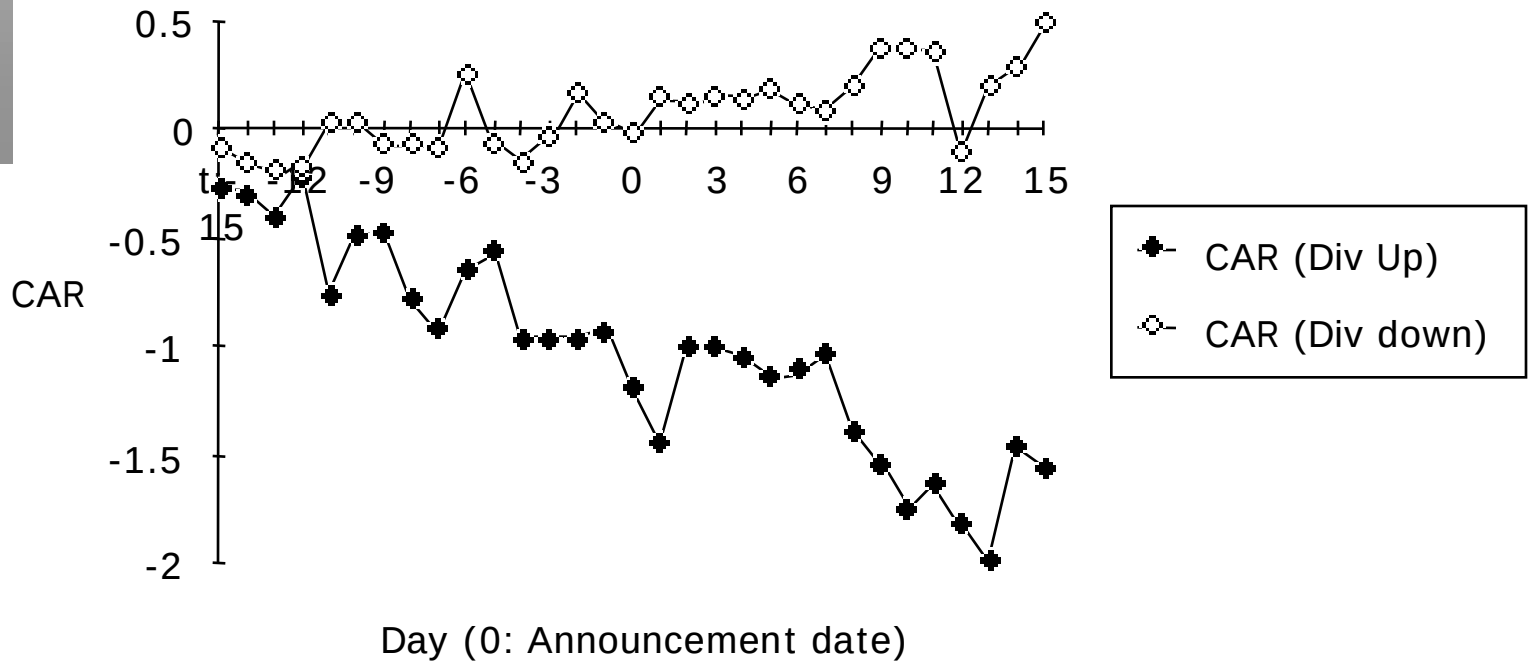
- Assume that you run a phone company, and that you have historically paid large dividends. You are now planning to enter the telecommunications and media markets. Which of the following paths are you most likely to follow?
  - Courageously announce to your stockholders that you plan to cut dividends and invest in the new markets.
  - Continue to pay the dividends that you used to, and defer investment in the new markets.
  - Continue to pay the dividends that you used to, make the investments in the new markets, and issue new stock to cover the shortfall
  - Other

The Signaling Hypothesis



The Wealth Transfer Hypothesis

EXCESS RETURNS ON STRAIGHT BONDS AROUND DIVIDEND CHANGES



Questions to Ask in Dividend Policy Analysis

- How much could the company have paid out during the period under question?
- How much did the the company actually pay out during the period in question?
- How much do I trust the management of this company with excess cash?
  - How well did they make investments during the period in question?
  - How well has my stock performed during the period in question?

A Measure of How Much a Company Could have Afforded to Pay out: FCFE

- The Free Cashflow to Equity (FCFE) is a measure of how much cash is left in the business after non-equity claimholders (debt and preferred stock) have been paid, and after any reinvestment needed to sustain the firm's assets and future growth.

  Net Income

  + Depreciation & Amortization

  = Cash flows from Operations to Equity Investors

  - Preferred Dividends

  - Capital Expenditures

  - Working Capital Needs

  - Principal Repayments

  + Proceeds from New Debt Issues

  = Free Cash flow to Equity

Estimating FCFE: The Home Depot

Year	*Net Income*	*Depreciation*	*Capital Spending*	*Change in Non-cash Working Capital*	*Net Debt Issued*	*FCFE*
1	$111.95	$21.12	$190.24	$6.20	$181.88	$118.51
2	$163.43	$34.36	$398.11	$10.41	$228.43	$17.70
3	$249.15	$52.28	$431.66	$47.14	-$1.94	($179.31)
4	$362.86	$69.54	$432.51	$93.08	$802.87	$709.68
5	$457.40	$89.84	$864.16	$153.19	-$2.01	($472.12)
6	$604.50	$129.61	$1,100.65	$205.29	$97.83	($474.00)
7	$731.52	$181.21	$1,278.10	$247.38	$497.18	($115.57)
8	$937.74	$232.34	$1,194.42	$124.25	$470.24	$321.65
9	$1,160.00	$283.00	$1,481.00	$391.00	-$25.00	($454.00)
10	$1,615.00	$373.00	$2,059.00	$131.00	$238.00	$36.00
Average	$639.36	$146.63	$942.99	$140.89	$248.75	($49.15)

Estimating FCFE when Leverage is Stable

Net Income

- (1- δ) (Capital Expenditures - Depreciation)

- (1- δ) Working Capital Needs

= Free Cash flow to Equity

δ = Debt/Capital Ratio

For this firm,

- Proceeds from new debt issues = Principal Repayments + δ (Capital Expenditures - Depreciation + Working Capital Needs)

Re-estimating FCFE: The Home Depot

Year	*Net Income*	*Net Capital Expenditures (1-DR)*	*Change in Non-Cash WC (1-DR)*	*FCFE*
1	$111.95	$124.24	$4.55	($16.84)
2	$163.43	$267.21	$7.65	($111.43)
3	$249.15	$278.69	$34.63	($64.17)
4	$362.86	$266.64	$68.38	$27.85
5	$457.40	$568.81	$112.53	($223.95)
6	$604.50	$713.32	$150.81	($259.63)
7	$731.52	$805.77	$181.72	($255.98)
8	$937.74	$706.74	$91.27	$139.72
9	$1,160.00	$880.05	$287.23	($7.28)
10	$1,615.00	$1,238.53	$96.23	$280.24
Average	$639.36	$585.00	$103.50	($49.15)

∂ = Average debt ratio during the period = 26.54%

The Home Depot: Cash Returned to Stockholders

Year	*Dividends (in $)*	*Equity Repurchases (in $)*	*Cash to Equity*
1989	$8.39	$0.00	$8.39
1990	$12.84	$0.00	$12.84
1991	$22.45	$0.00	$22.45
1992	$35.82	$0.00	$35.82
1993	$50.34	$0.00	$50.34
1994	$67.79	$0.00	$67.79
1995	$89.75	$0.00	$89.75
1996	$110.21	$0.00	$110.21
1997	$139.00	$0.00	$139.00
1998	$168.00	$0.00	$168.00

Dividends with Negative FCFE

- During the period 1989-98, the Home Depot has consistently had negative free cash flows to equity. It has, however, managed to pay dividends in each of these years.
- How does a company with negative free cash flows to equity pay dividends (or buy back stock)?
- Why might it do so?

Estimating FCFE: Boeing

Year	*Net Income*	*Net Capital Expenditures (1-DR)*	*Change in Non-Cash WC (1-DR)*	*FCFE*
1	$973.00	$423.80	$333.27	$215.93
2	$1,385.00	$523.55	$113.59	$747.86
3	$1,567.00	$590.44	($55.35)	$1,031.92
4	$552.00	$691.34	($555.26)	$415.92
5	$1,244.00	$209.88	$268.12	$766.00
6	$856.00	($200.08)	$6.34	$1,049.74
7	$393.00	($232.95)	($340.77)	$966.72
8	$1,818.00	($155.68)	($21.91)	$1,995.59
9	($178.00)	$516.63	($650.98)	($43.65)
10	$1,120.00	$754.77	$107.25	$257.98
Average	$973.00	$312.17	($79.57)	$740.40

∂ = Average debt ratio during the period = 42.34%

Boeing: Cash Returned to Stockholders

Year	Dividends (in $)	Equity Repurchases (in $)	Cash to Equity
1989	$269.00	$2.00	$271.00
1990	$328.00	$156.00	$484.00
1991	$343.00	$127.00	$470.00
1992	$340.00	$109.00	$449.00
1993	$340.00	$0.00	$340.00
1994	$340.00	$0.00	$340.00
1995	$342.00	$0.00	$342.00
1996	$480.00	$718.00	$1,198.00
1997	$557.00	$141.00	$698.00
1998	$564.00	$1,397.00	$1,961.00

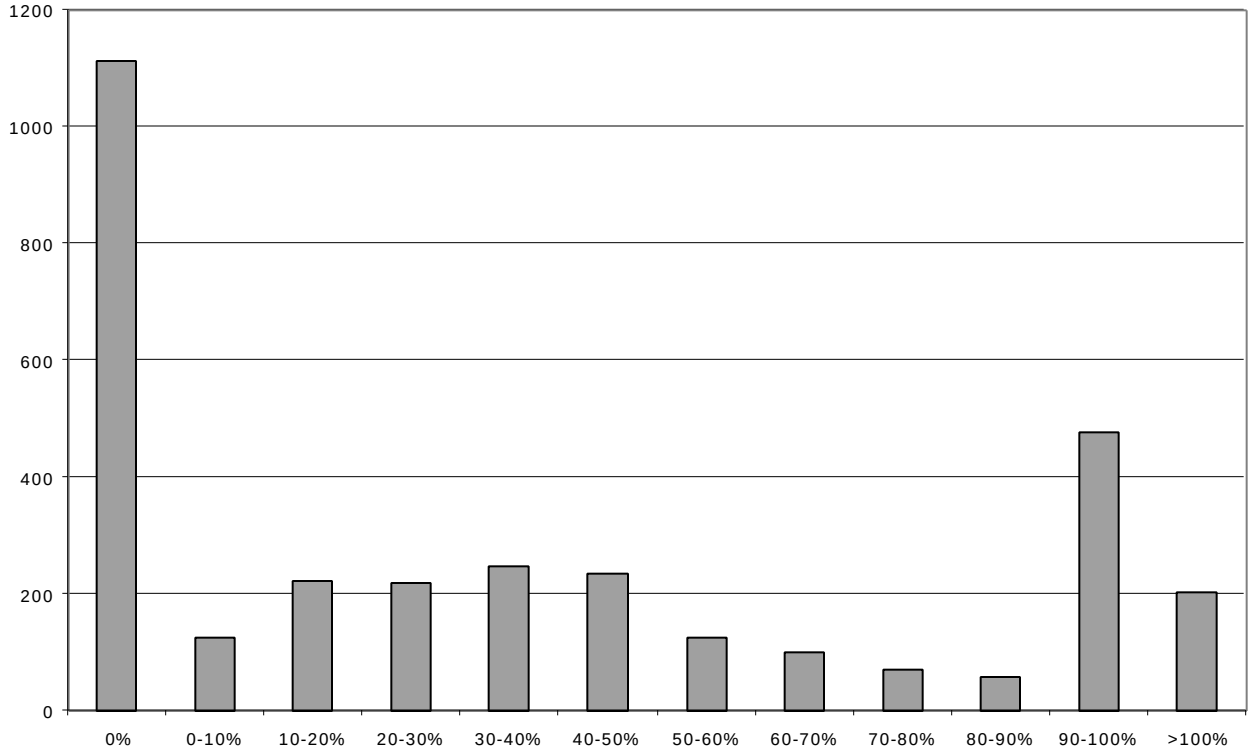
Cash Returned versus FCFE

- On average, Boeing has returned $ 655 million a year over this 10 year period. On average, Boeing has had free cash flows to equity of $ 740 million each year over the same period.
- Where does the difference ($740- $ 655) accumulate?

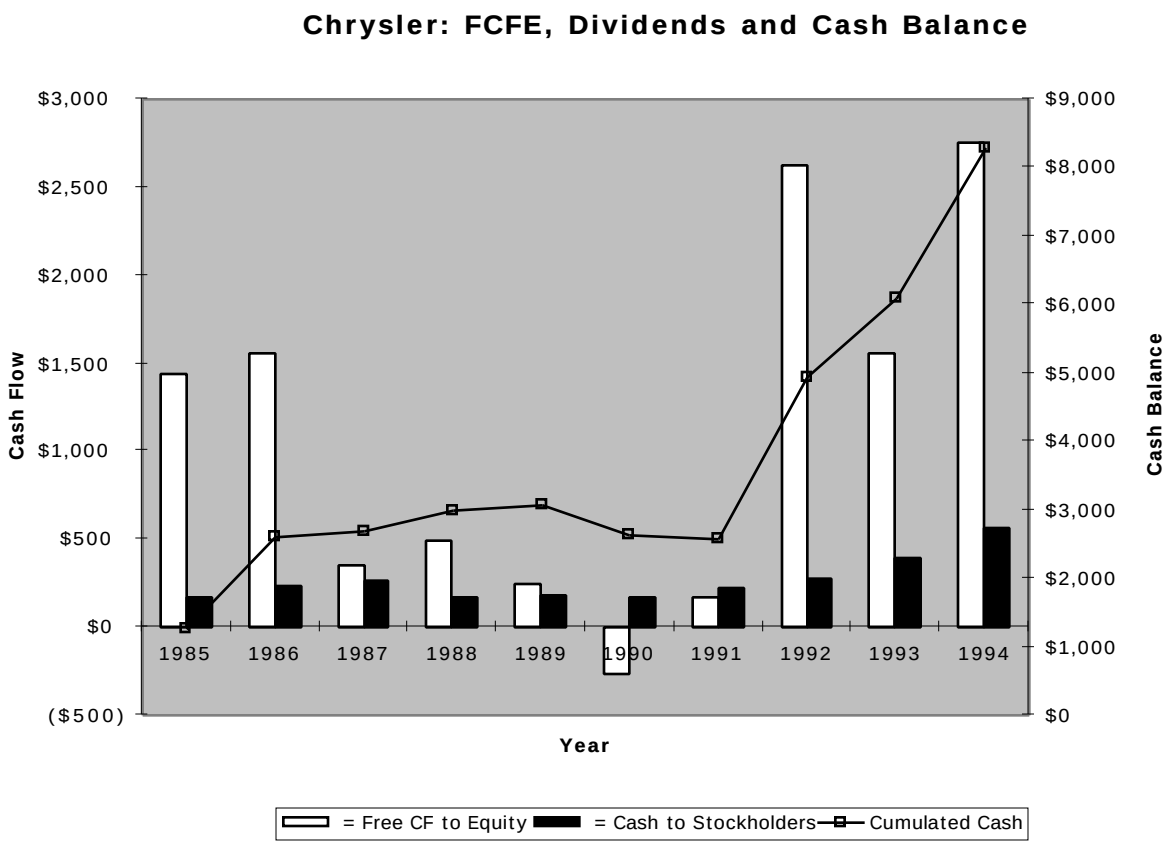
- Why might firms pay out less than they have available as FCFE?

Dividends versus FCFE: U.S.

Figure 22.2: Cash Returned as Percent of FCFE



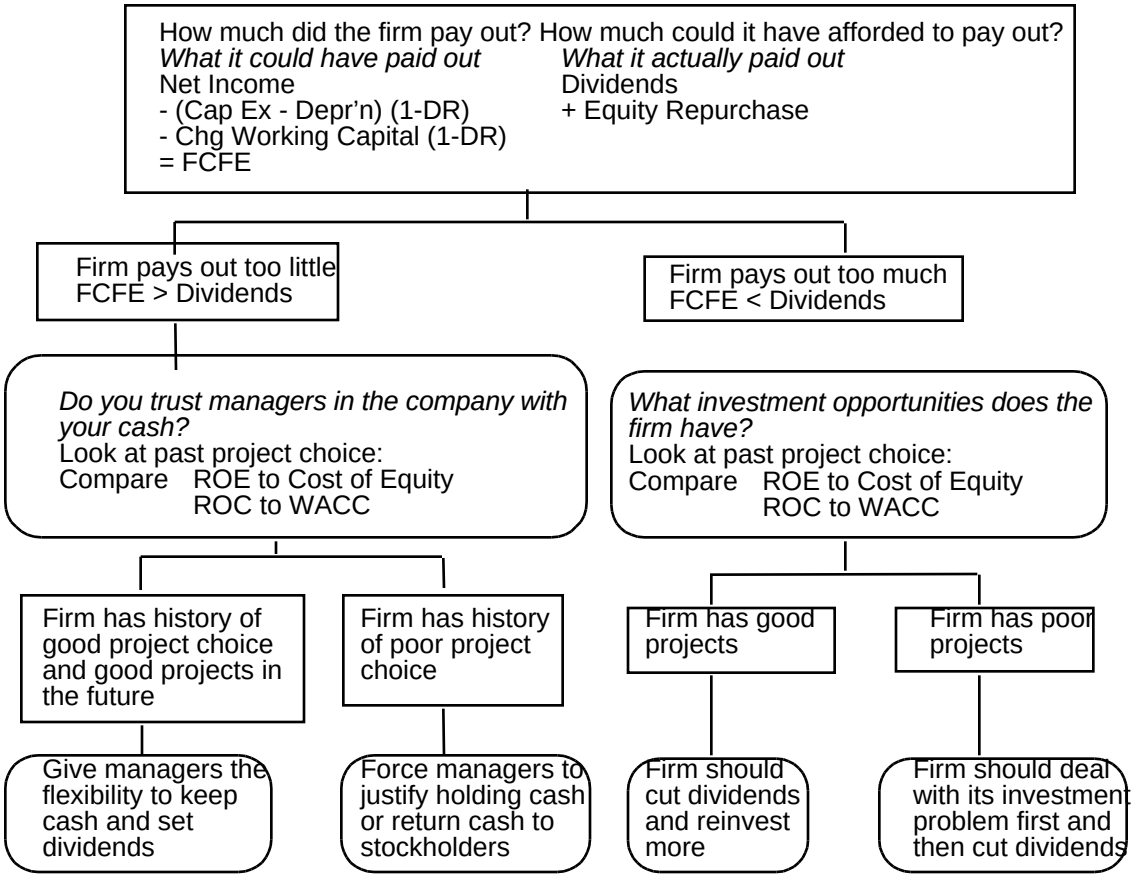
The Consequences of Failing to pay FCFE



Application Test: Estimating your firm's FCFE

In General,	If cash flow statement used
Net Income	Net Income
+ Depreciation & Amortization	+ Depreciation & Amortization
- Capital Expenditures	+ Capital Expenditures
- Change in Non-Cash Working Capital	+ Changes in Non-cash WC
- Preferred Dividend	+ Preferred Dividend
- Principal Repaid	+ Increase in LT Borrowing
+ New Debt Issued	+ Decrease in LT Borrowing
	+ Change in ST Borrowing
= FCFE	= FCFE
Compare to	
Dividends (Common)	-Common Dividend +
Stock Buybacks	- Decrease in Capital Stock
	+ Increase in Capital Stock

A Practical Framework for Analyzing Dividend Policy



Evaluating the Quality of Investments

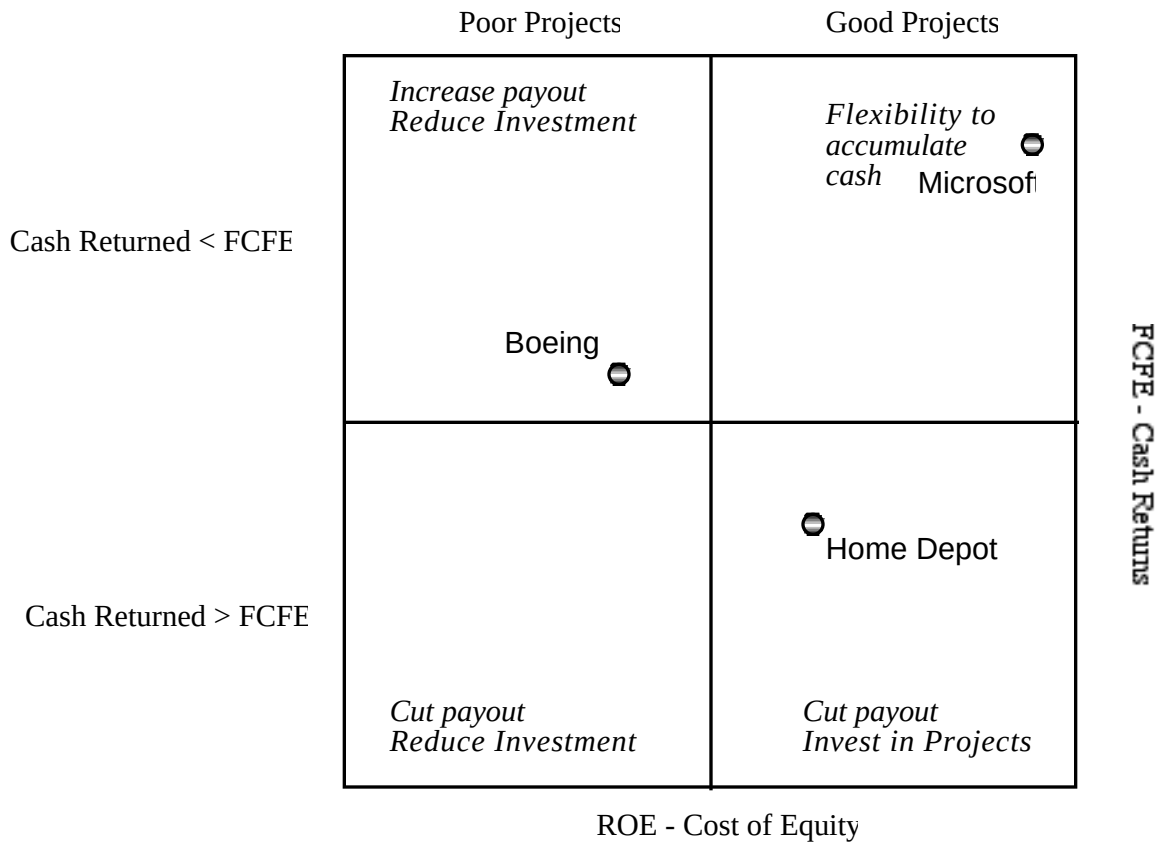
- Measuring Project Quality
  - Accounting Return differentials, where we compare the accounting return on equity to the cost of equity and the accounting return on capital to the cost of capital.
  - Economic value Added, which measures the excess return earned on capital invested in existing investments, and can be computed either on an equity or capital basis.
- Stock Price Performance
  - Excess returns, relative to the market (given the riskiness of a stock)
  - In an efficient market, this can be considered to be an evaluation of whether a firm earn a return on its investments that were greater than or less than those expected by the market.

The Four Possible Combinations

- *A firm may have good projects and may be paying out more than its free cash flow to equity*: The firm is losing value in two ways.
  - It is creating a cash shortfall that has to be met by issuing more securities.
  - Overpaying may create capital rationing constraints; as a result, the firm may reject good projects it otherwise would have taken.
- *A firm may have good projects and may be paying out less than its free cash flow to equity as a dividend*. This firm will accumulate cash, but stockholders are unlikely to
- *A firm may have poor projects and may be paying out less than its free cash flow to equity as a dividend*. This firm will also accumulate cash, but find itself under pressure from stockholders to distribute the cash.
- *A firm may have poor projects and may be paying out more than its free cash flow to equity as a dividend*. This firm has an investment problem and a dividend problem.

A Dividend Matrix

Figure 22.5: Analyzing Dividend Poli

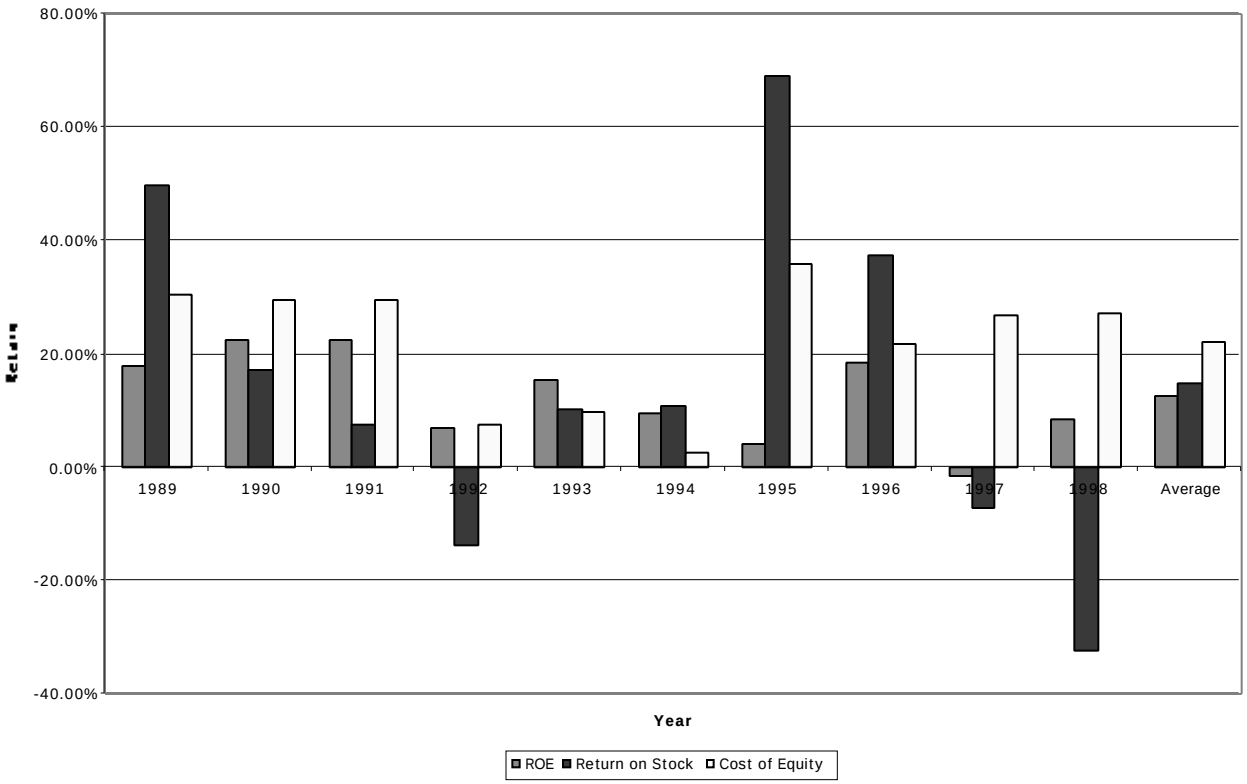


Boeing: Summary Statistics on Cash Returned versus FCFE

Year	*Dividends*	*Net Income*	*Payout Ratio*	*Dividends + Stock Buybacks*	*FCFE*	*Cash to Stockholders/FCFE*
1	$269.00	$973.00	27.6%	$271.00	$215.93	125.51%
2	$328.00	$1,385.00	23.7%	$484.00	$747.86	64.72%
3	$343.00	$1,567.00	21.9%	$470.00	$1,031.92	45.55%
4	$340.00	$552.00	61.6%	$449.00	$415.92	107.95%
5	$340.00	$1,244.00	27.3%	$340.00	$766.00	44.39%
6	$340.00	$856.00	39.7%	$340.00	$1,049.74	32.39%
7	$342.00	$393.00	87.0%	$342.00	$966.72	35.38%
8	$480.00	$1,818.00	26.4%	$1,198.00	$1,995.59	60.03%
9	$557.00	($178.00)	-312.9%	$698.00	($43.65)	-1598.99%
10	$564.00	$1,120.00	50.4%	$1,961.00	$257.98	760.12%
Avg	$390.30	$973.00	40.1%	$655.30	$740.40	88.51%

Boeing: Measuring Investment Quality

Figure 22.3: Boeing: Project and Stock Returns: 1989-98



Can you trust Boeing's management?

- If you were a Boeing stockholder, would you be comfortable with Boeing's dividend policy?
- Yes
- No

Aracruz: Dividends and FCFE: 1994-1996

	1994	*1995*	*1996*
Net Income	BR248.21	BR326.42	BR47.00
- (Cap. Exp - Depr)*(1-DR)	BR174.76	BR197.20	BR14.96
- ∂ Working Capital*(1-DR)	(BR47.74)	BR15.67	(BR23.80)
= Free CF to Equity	BR121.19	BR113.55	BR55.84
Dividends	BR80.40	BR113.00	BR27.00
+ Equity Repurchases	BR 0.00	BR 0.00	BR 0.00
= Cash to Stockholders	BR80.40	BR113.00	BR27.00

Aracruz: Investment Record

	1994	*1995*	*1996*
Project Performance Measures			
ROE	19.98%	16.78%	2.06%
Required rate of return	3.32%	28.03%	17.78%
Difference	16.66%	-11.25%	-15.72%
Stock Performance Measure			
Returns on stock	50.82%	-0.28%	8.65%
Required rate of return	3.32%	28.03%	17.78%
Difference	47.50%	-28.31%	-9.13%

Aracruz: Its your call..

- Assume that you are a large stockholder in Aracruz. They have a history of paying less in dividends than they have available in FCFE and have accumulated a cash balance of roughly 1 billion BR (25% of the value of the firm). Would you trust the managers at Aracruz with your cash?
  - Yes
  - No

Mandated Dividend Payouts

- There are many countries where companies are mandated to pay out a certain portion of their earnings as dividends. Given our discussion of FCFE, what types of companies will be hurt the most by these laws?
  - Large companies making huge profits
  - Small companies losing money
  - High growth companies that are losing money
  - High growth companies that are making money

BP: Dividends- 1983-92

	1	2	3	4	5	6	7	8	9	10
Net Income	$1,256.00	$1,626.00	$2,309.00	$1,098.00	$2,076.00	$2,140.00	$2,542.00	$2,946.00	$712.00	$947.00
- (Cap. Exp - Depr)*(1-DR)	$1,499.00	$1,281.00	$1,737.50	$1,600.00	$580.00	$1,184.00	$1,090.50	$1,975.50	$1,545.50	$1,100.00
∂ Working Capital*(1-DR)	$369.50	($286.50)	$678.50	$82.00	($2,268.00)	($984.50)	$429.50	$1,047.50	($305.00)	($415.00)
= Free CF to Equity	($612.50)	$631.50	($107.00)	($584.00)	$3,764.00	$1,940.50	$1,022.00	($77.00)	($528.50)	$262.00
Dividends	$831.00	$949.00	$1,079.00	$1,314.00	$1,391.00	$1,961.00	$1,746.00	$1,895.00	$2,112.00	$1,685.00
+ Equity Repurchases										
= Cash to Stockholders	$831.00	$949.00	$1,079.00	$1,314.00	$1,391.00	$1,961.00	$1,746.00	$1,895.00	$2,112.00	$1,685.00
Dividend Ratios										
Payout Ratio	66.16%	58.36%	46.73%	119.67%	67.00%	91.64%	68.69%	64.32%	296.63%	177.93%
Cash Paid as % of FCFE	-135.67%	150.28%	-1008.41%	-225.00%	36.96%	101.06%	170.84%	-2461.04%	-399.62%	643.13%
Performance Ratios										
1. Accounting Measure										
ROE	9.58%	12.14%	19.82%	9.25%	12.43%	15.60%	21.47%	19.93%	4.27%	7.66%
Required rate of return	19.77%	6.99%	27.27%	16.01%	5.28%	14.72%	26.87%	-0.97%	25.86%	7.12%
Difference	-10.18%	5.16%	-7.45%	-6.76%	7.15%	0.88%	-5.39%	20.90%	-21.59%	0.54%

BP: Summary of Dividend Policy

	Summary of calculations			
	Average	*Standard Deviation*	*Maximum*	*Minimum*
Free CF to Equity	$571.10	$1,382.29	$3,764.00	($612.50)
Dividends	$1,496.30	$448.77	$2,112.00	$831.00
Dividends+Repurchases	$1,496.30	$448.77	$2,112.00	$831.00
Dividend Payout Ratio	84.77%			
Cash Paid as % of FCFE	262.00%			
ROE - Required return	-1.67%	11.49%	20.90%	-21.59%

BP: Just Desserts!

B.P.'s Shares Plummet After Dividend Is Slashed

By MATTHEW L. WALD

British Petroleum said yesterday that it would cut its dividend by 50 percent, take a pretax restructuring charge of $1.82 billion for the second quarter and lay off 11,700 employees, or 10 percent of its worldwide work force. The moves came five weeks after Robert B. Horton, B.P.'s chairman, resigned under pressure from the company's outside directors.

Analysts anticipated a dividend cut by the oil company, the world's third largest, but the one announced was at the low end of their expectations. In response, shares of the company's American depositary rights, each of which represents 12 shares of the London-based company, dropped $3.625, or 7.38 percent, to $45.375. It was the most active issue on the New York Stock Exchange, with 5.88 million shares traded.

The Royal Dutch/Shell group also reported a disappointing quarter yesterday, with earnings on a replacement cost basis — excluding gains or losses on inventory holdings — of $618 million, down 22 percent.

Quiet Recovery Seems Unlikely

Adding to the gloom at B.P., the new chief executive, David A.G. Simon, said the prospects for a quick recovery were poor. "External trading conditions are expected to remain difficult, particularly for the downstream oil and chemicals businesses, with growth prospects for the world's economies remaining uncertain," he said in a statement. Downstream oil is an industry term for refining and marketing operations, as distinct from oil production.

Downstream margins in the United States would be hurt later this year, he predicted, when clean air rules take effect and gasoline must be reformulated to reduce pollution. "In Europe, recovery will depend upon seasonal heating oil demand," Mr. Simon said.

The crude oil market, he predicted, would remain balanced unless Iraqi oil was allowed to re-enter the market. The company said it was well positioned to take advantage of any increase in oil prices, but the company's oil production in the United States is declining. B.P. is the largest producer in Alaska.

The giant British oil company bet on rising oil prices.

The market for petrochemicals in Europe remains weak.

B.P.'s second quarter profits, before one-time transactions, declined to $100 million from $515 million, valuing inventories on a replacement-cost basis. James J. Murchie, an analyst at Sanford C. Bernstein, estimated that after exceptional items, earnings per share fell to 36 cents in the second quarter, compared with 83 cents a year earlier.

Analysts attributed B.P.'s problems to the company's acquisitions in the last few years, and heavy capital expenditures. Summing up the company's recent history, Frank P. Knemeyer of Prudential Securities Research said, "Debt rose, interest expense rose, and profits have gone to hell."

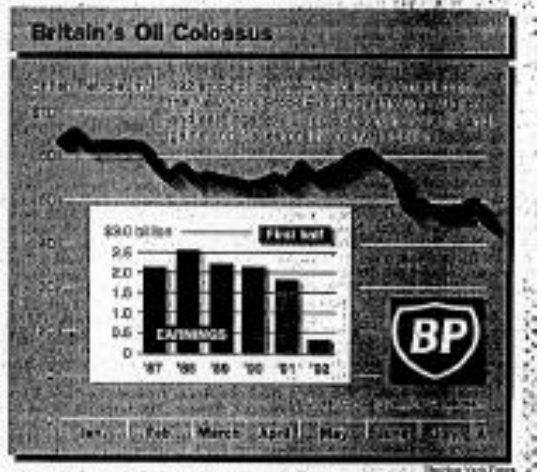
Mr. Murchie, who worked for Standard Oil of Ohio and then B.P. after B.P. acquired Sohio, said, "What you've got is a company that thought oil prices were going to go to $30 and spent like it, in terms of capital." If B.P.'s costs of finding oil are the same as the industry average, he said, then the company has been spending enough to replace 119 percent to 130 percent of its annual production, which is not a successful strategy if prices do not rise.

In addition, he said, the company had been spending twice as much as its refining and marketing operation as it was recording in depreciation.

Another analyst at a large stock brokerage house, who spoke on the condition of anonymity, said, "They took all the old Sohio stations and turned them into modern B.P. stations; they took all the B.P. stations and turned them into ultramodern stations."

The analyst said that while some of the cuts were obvious, some were

Continued on Page D2

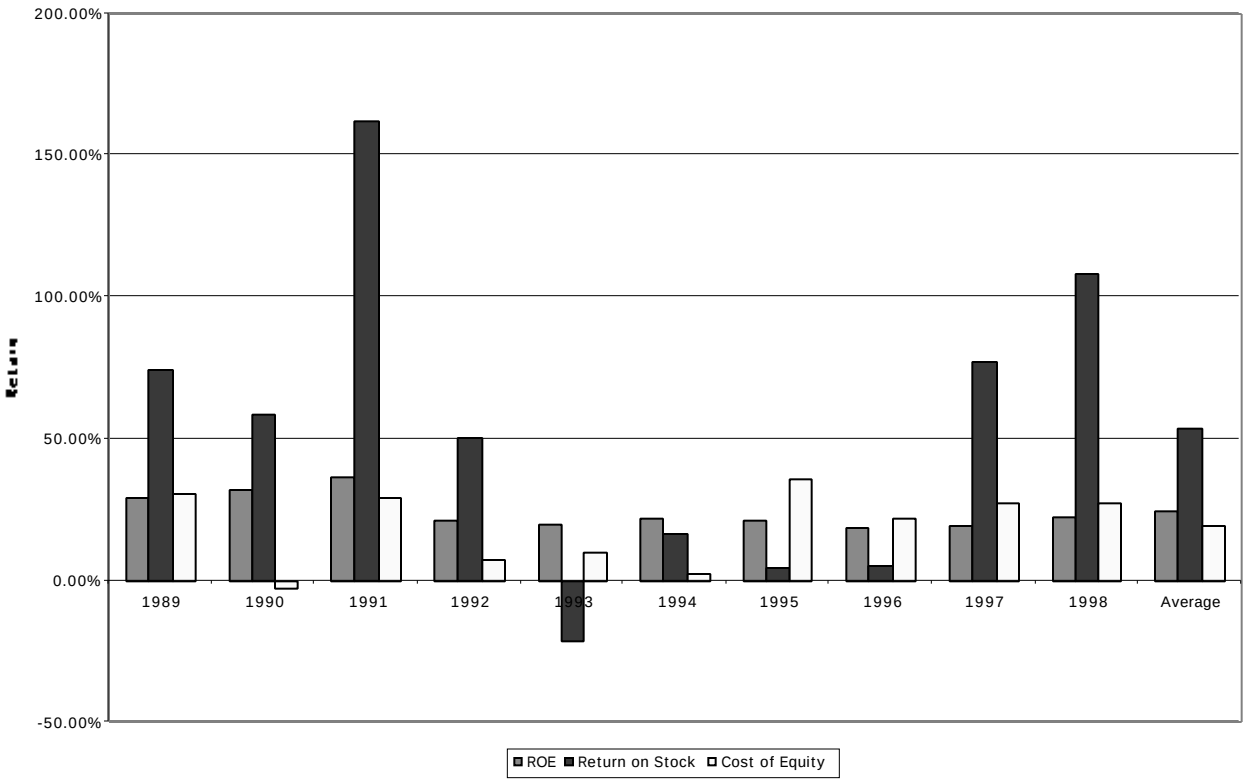


The Home Depot: Summary of Cash Returned and FCFE

Year	*Dividends*	*Earnings*	*Payout Ratio*	*Dividends + Stock Buybacks*	*FCFE*	*Cash to Stockholders/FCFE*
1	$8.39	$111.95	7.49%	$8.39	$118.51	7.08%
2	$12.84	$163.43	7.86%	$12.84	$17.70	72.54%
3	$22.45	$249.15	9.01%	$22.45	($179.31)	-12.52%
4	$35.82	$362.86	9.87%	$35.82	$709.68	5.05%
5	$50.34	$457.40	11.01%	$50.34	($472.12)	-10.66%
6	$67.79	$604.50	11.21%	$67.79	($474.00)	-14.30%
7	$89.75	$731.52	12.27%	$89.75	($115.57)	-77.66%
8	$110.21	$937.74	11.75%	$110.21	$321.65	34.26%
9	$139.00	$1,160.00	11.98%	$139.00	($454.00)	-30.62%
10	$168.00	$1,615.00	10.40%	$168.00	$36.00	466.67%
	$70.46	$639.36	11.02%	$70.46	($49.15)	-143.37%

Evaluating Project Quality at The Home Depot

Figure 22.4: The Home Depot: Project and Stock Returns: 1989-98



Growth Firms and Dividends

- High growth firms are sometimes advised to initiate dividends because its increases the potential stockholder base for the company (since there are some investors - like pension funds - that cannot buy stocks that do not pay dividends) and, by extension, the stock price. Do you agree with this argument?
  - Yes
  - No

Why?

The Home Depot: Looking Forward

	1999	*2000*	*2001*	*2001*	*2002*
Net Income	$1,857	$2,136	$2,456	$2,825	$3,248
- (Cap Ex - Deprec'n) (1 - DR)	$1,484	$1,632	$1,795	$1,975	$2,172
- Change in Working Capital (1 - DR)	$193	$213	$234	$257	$283
FCFE	$180	$291	$427	$592	$793
Expected Dividends	$193	$222	$256	$294	$338
Cash available for stock buybacks	($13)	$69	$171	$299	$455

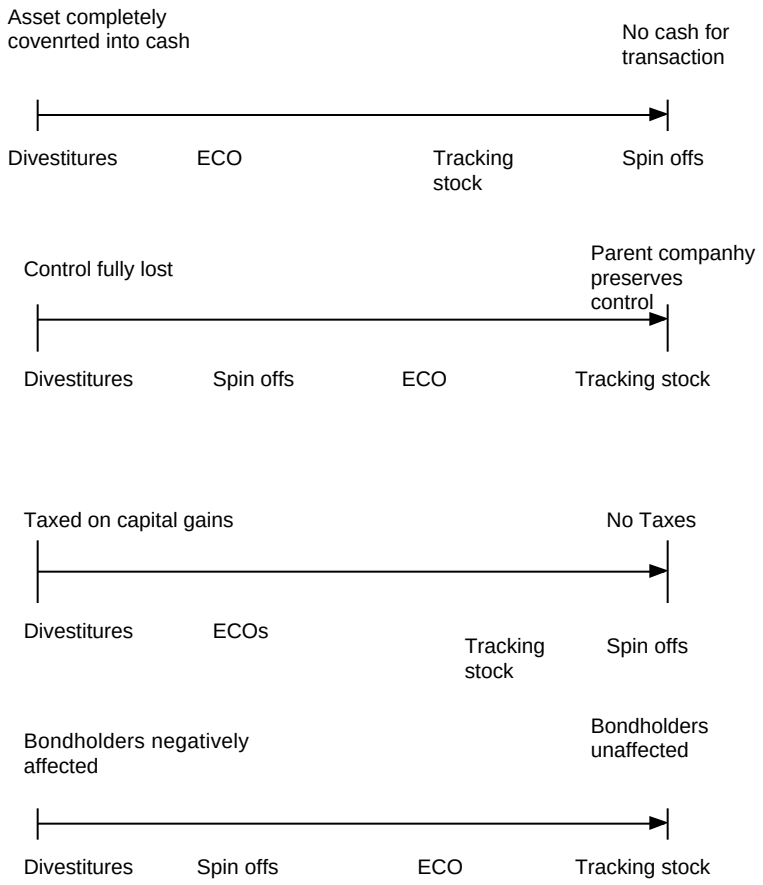
Application Test: Assessing your firm's dividend policy

- Compare your firm's dividends to its FCFE, looking at the last 5 years of information.
- Based upon your earlier analysis of your firm's project choices, would you encourage the firm to return more cash or less cash to its owners?
- If you would encourage it to return more cash, what form should it take (dividends versus stock buybacks)?

Other Actions that affect Stock Prices

- In the case of dividends and stock buybacks, firms change the value of the assets (by paying out cash) and the number of shares (in the case of buybacks).
- There are other actions that firms can take to change the value of their stockholder's equity.
  - Divestitures: They can sell assets to another firm that can utilize them more efficiently, and claim a portion of the value.
  - Spin offs: In a spin off, a division of a firm is made an independent entity. The parent company has to give up control of the firm.
  - Equity carve outs: In an ECO, the division is made a semi-independent entity. The parent company retains a controlling interest in the firm.
  - Tracking Stock: When tracking stock are issued against a division, the parent company retains complete control of the division. It does not have its own board of directors.

Differences in these actions



Measuring Investment Returns

Stern School of Business

First Principles

- Invest in projects that yield a **return** greater than the minimum acceptable hurdle rate.
  - The hurdle rate should be higher for riskier projects and reflect the financing mix used - owners' funds (equity) or borrowed money (debt)
  - **Returns on projects should be measured based on cash flows generated and the timing of these cash flows; they should also consider both positive and negative side effects of these projects.**
- Choose a financing mix that minimizes the hurdle rate and matches the assets being financed.
- If there are not enough investments that earn the hurdle rate, return the cash to stockholders.
  - The form of returns - dividends and stock buybacks - will depend upon the stockholders' characteristics.

Measures of return: earnings versus cash flows

- Principles Governing Accounting Earnings Measurement
  - Accrual Accounting: Show revenues when products and services are sold or provided, not when they are paid for. Show expenses associated with these revenues rather than cash expenses.
  - Operating versus Capital Expenditures: Only expenses associated with creating revenues in the current period should be treated as operating expenses. Expenses that create benefits over several periods are written off over multiple periods (as depreciation or amortization)
- To get from accounting earnings to cash flows:
  - you have to add back non-cash expenses (like depreciation)
  - you have to subtract out cash outflows which are not expensed (such as capital expenditures)
  - you have to make accrual revenues and expenses into cash revenues and expenses (by considering changes in working capital).

Measuring Returns Right: The Basic Principles

- Use cash flows rather than earnings. You cannot spend earnings.
- Use “incremental” cash flows relating to the investment decision, i.e., cashflows that occur as a consequence of the decision, rather than total cash flows.
- Use “time weighted” returns, i.e., value cash flows that occur earlier more than cash flows that occur later.

The Return Mantra: “Time-weighted, Incremental Cash Flow Return”

Earnings versus Cash Flows: A Disney Theme Park

- The theme parks to be built near Bangkok, modeled on Euro Disney in Paris, will include a “Magic Kingdom” to be constructed, beginning immediately, and becoming operational at the beginning of the second year, and a second theme park modeled on Epcot Center at Orlando to be constructed in the second and third year and becoming operational at the beginning of the fifth year.
- The earnings and cash flows are estimated in nominal U.S. Dollars.

Key Assumptions on Start Up and Construction

- Disney has already spent $ 500 million researching the location and getting the needed licenses for the park.
- The cost of constructing Magic Kingdom will be $ 3 billion, with $ 2 billion invested up front, and $ 1 billion at the end of year 1.
- The cost of constructing Epcot will be $ 1.5 billion, with $ 1 billion being spent in year 2 and $ 0.5 billion in year 3.

Key Revenue Assumptions

Revenue estimates for the parks and resort properties (in millions)

Year	Magic Kingdom	Epcot	Resort Hotels	Total Revenues
1	$0	$0	$0	$0
2	$1,000	$0	$200	$1,200
3	$1,400	$0	$250	$1,650
4	$1,700	$0	$300	$2,000
5	$2,000	$500	$375	$2,875
6	$2,200	$550	$688	$3,438
7	$2,420	$605	$756	$3,781
8	$2,662	$666	$832	$4,159
9	$2,928	$732	$915	$4,575
10 on	Grows at the inflation rate forever: 3%			

Key Expense Assumptions

- The operating expenses are assumed to be 60% of the revenues at the parks, and 75% of revenues at the resort properties.
- Disney will also allocate the following portion of its general and administrative expenses to the theme parks. It is worth noting that a recent analysis of these expenses found that only one-third of these expenses are variable (and a function of total revenue) and that two-thirds are fixed. (in millions)

Year	*G& A Costs*	*Year*	*G& A Costs*
1	$0	6	$ 293
2	$200	7	$ 322
3	$220	8	$354
4	$242	9	$390
5	$266	10 on	Grow at inflation rate of 3%

Depreciation and Capital Maintenance

Year	*Depreciation*	*Capital Expenditure*
1	$0	$0
2	$375	$150
3	$378	$206
4	$369	$250
5	$319	$359
6	$302	$344
7	$305	$303
8	$305	$312
9	$305	$343
10	$315	$315
After	Offsetting: Depreciation = Capital Maintenance	

Other Assumptions

- Disney will have to maintain net working capital (primarily consisting of inventory at the theme parks and the resort properties, netted against accounts payable) of 5% of revenues, with the investments in working capital being made at the end of each year.
- The income from the investment will be taxed at a marginal tax rate of 36%.

Earnings on Project

	0	1	2	3	4	5	6	7	8	9	10
Revenues											
Magic Kingdom			$1,000	$1,400	$1,700	$2,000	$2,200	$2,420	$2,662	$2,928	$3,016
Second Theme Park						$ 500	$ 550	$ 605	$ 666	$ 732	$ 754
Resort & Properties			$ 200	$ 250	$ 300	$ 375	$ 688	$ 756	$ 832	$ 915	$ 943
Total			$1,200	$1,650	$2,000	$2,875	$3,438	$3,781	$4,159	$4,575	$4,713
Operating Expenses											
Magic Kingdom			$ 600	$ 840	$1,020	$1,200	$1,320	$1,452	$1,597	$1,757	$1,810
Second Theme Park			$ -	$ -	$ -	$ 300	$ 330	$ 363	$ 399	$ 439	$ 452
Resort & Property			$ 150	$ 188	$ 225	$ 281	$ 516	$ 567	$ 624	$ 686	$ 707
Total			$ 750	$1,028	$1,245	$1,781	$2,166	$2,382	$2,620	$2,882	$2,969
Other Expenses											
Depreciation & Amortization			$ 375	$ 378	$ 369	$ 319	$ 302	$ 305	$ 305	$ 305	$ 315
Allocated G&A Costs			$ 200	$ 220	$ 242	$ 266	$ 293	$ 322	$ 354	$ 390	$ 401
Operating Income			$ (125)	$ 25	$ 144	$ 509	$ 677	$ 772	$ 880	$ 998	$1,028
Taxes			$ (45)	$ 9	$ 52	$ 183	$ 244	$ 278	$ 317	$ 359	$ 370
Operating Income after Taxes			$ (80)	$ 16	$ 92	$ 326	$ 433	$ 494	$ 563	$ 639	$ 658

And the Accounting View of Return

Year	EBIT(1-t)	Beg BV	Deprecn	Cap Ex	End BV	Avge Bv	ROC
0			$0	$2,500	$2,500		
1	$0	$2,500	$0	$1,000	$3,500	$3,000	
2	($80)	$3,500	$375	$1,150	$4,275	$3,888	-2.06%
3	$16	$4,275	$378	$706	$4,604	$4,439	0.36%
4	$92	$4,604	$369	$250	$4,484	$4,544	2.02%
5	$326	$4,484	$319	$359	$4,525	$4,505	7.23%
6	$433	$4,525	$302	$344	$4,567	$4,546	9.53%
7	$494	$4,567	$305	$303	$4,564	$4,566	10.82%
8	$563	$4,564	$305	$312	$4,572	$4,568	12.33%
9	$639	$4,572	$305	$343	$4,609	$4,590	13.91%
10	$658	$4,609	$315	$315	$4,609	$4,609	14.27%
Average							7.60%

Would lead use to conclude that...

- Do not invest in this park. The **return on capital of 7.60%** is lower than the **cost of capital for theme parks of 12.32%**; This would suggest that the project should not be taken.
- Given that we have computed the average over an arbitrary period of 10 years, while the theme park itself would have a life greater than 10 years, would you feel comfortable with this conclusion?
  - Yes
  - No

From Project to Firm Return on Capital: Disney in 1997

- Just as a comparison of project return on capital to the cost of capital yields a measure of whether the project is acceptable, a comparison can be made at the firm level, to judge whether the existing projects of the firm are adding or destroying value.
- Disney, in 1996, had earnings before interest and taxes of $5,559 million, had a book value of equity of $11,368 million and a book value of debt of $7,663 million. With a tax rate of 36%, we get

  Return on Capital = 5559 (1-.36) / (11,368+7,663) = 18.69%

  Cost of Capital for Disney= 12.22%

  Excess Return = 18.69% - 12.22% = 6.47%
- This can be converted into a dollar figure by multiplying by the capital invested, in which case it is called economic value added

  EVA = (.1869-.1222) (11,368+7,663) = $1,232 million

Application Test: Assessing Investment Quality

- For the most recent period for which you have data, compute the after-tax return on capital earned by your firm, where after-tax return on capital is computed to be

After-tax ROC = EBIT (1-tax rate)/ (BV of debt + BV of Equity)$_{\text{previous year}}$

- For the most recent period for which you have data, compute the return spread earned by your firm:

Return Spread = After-tax ROC - Cost of Capital

- For the most recent period, compute the EVA earned by your firm

EVA = Return Spread * ((BV of debt + BV of Equity)$_{\text{previous year}}$

The cash flow view of this project..

.	0	1	2	3	9	10
Operating Income after Taxes			$ (80)	$ 16	$ 639	$ 658
+ Depreciation & Amortization	$ -	$ -	$ 375	$ 378	$ 305	$ 315
- Capital Expenditures	$ 2,500	$ 1,000	$ 1,150	$ 706	$ 343	$ 315
- Change in Working Capital	$ -	$ -	$ 60	$ 23	$ 21	$ 7
Cash Flow on Project	$ (2,500)	$ (1,000)	$ (915)	$ (335)	$ 580	$ 651

To get from income to cash flow, we

- added back all non-cash charges such as depreciation
- subtracted out the capital expenditures
- subtracted out the change in non-cash working capital

The Depreciation Tax Benefit

- While depreciation reduces taxable income and taxes, it does not reduce the cash flows.
- The benefit of depreciation is therefore the tax benefit. In general, the tax benefit from depreciation can be written as:

  Tax Benefit = Depreciation * Tax Rate

- For example, in year 2, the tax benefit from depreciation to Disney from this project can be written as:

  Tax Benefit in year 2 = $ 375 million (.36) = $ 135 million

- **Proposition 1**: The tax benefit from depreciation and other non-cash charges is greater, the higher your tax rate.
- **Proposition 2**: Non-cash charges that are not tax deductible (such as amortization of goodwill) and thus provide no tax benefits have no effect on cash flows.

Depreciation Methods

- Broadly categorizing, depreciation methods can be classified as straight line or accelerated methods. In straight line depreciation, the capital expense is spread evenly over time, In accelerated depreciation, the capital expense is depreciated more in earlier years and less in later years. Assume that you made a large investment this year, and that you are choosing between straight line and accelerated depreciation methods. Which will result in higher net income this year?
  - Straight Line Depreciation
  - Accelerated Depreciation

Which will result in higher cash flows this year?

- Straight Line Depreciation
- Accelerated Depreciation

The Capital Expenditures Effect

- Capital expenditures are not treated as accounting expenses but they do cause cash outflows.
- Capital expenditures can generally be categorized into two groups
  - New (or Growth) capital expenditures are capital expenditures designed to create new assets and future growth
  - Maintenance capital expenditures refer to capital expenditures designed to keep existing assets.
- Both initial and maintenance capital expenditures reduce cash flows
- The need for maintenance capital expenditures will increase with the life of the project. In other words, a 25-year project will require more maintenance capital expenditures than a 2-year asset.

To cap ex or not to cap ex

- Assume that you run your own software business, and that you have an expense this year of $ 100 million from producing and distribution promotional CDs in software magazines. Your accountant tells you that you can expense this item or capitalize and depreciate. Which will have a more positive effect on income?
  - Expense it
  - Capitalize and Depreciate it

  Which will have a more positive effect on cash flows?
  - Expense it
  - Capitalize and Depreciate it

The Working Capital Effect

- Intuitively, money invested in inventory or in accounts receivable cannot be used elsewhere. It, thus, represents a drain on cash flows
- To the degree that some of these investments can be financed using suppliers credit (accounts payable) the cash flow drain is reduced.
- Investments in working capital are thus cash outflows
  - Any increase in working capital reduces cash flows in that year
  - Any decrease in working capital increases cash flows in that year
- To provide closure, working capital investments need to be salvaged at the end of the project life.
- **Proposition 1**: The failure to consider working capital in a capital budgeting project will overstate cash flows on that project and make it look more attractive than it really is.
- **Proposition 2**: Other things held equal, a reduction in working capital requirements will increase the cash flows on all projects for a firm.

The incremental cash flows on the project

	0	1	2	3	9	10
Cash Flow on Project	$ (2,500)	$ (1,000)	$ (915)	$ (335)	$ 580	$ 651
+ Sunk Costs	$ 500					
+ Non-incr. Alloc Cost (1-t)	$ -	$ -	$ 85	$ 94	$ 166	$ 171
Incremental Cash Flow on Project	$ (2,000)	$ (1,000)	$ (830)	$ (241)	$ 746	$ 822

To get from cash flow to incremental cash flows, we

- Taken out of the sunk costs from the initial investment
- Added back the non-incremental allocated costs (in after-tax terms)

Sunk Costs

- Any expenditure that has already been incurred, and cannot be recovered (even if a project is rejected) is called a sunk cost
- When analyzing a project, sunk costs should not be considered since they are incremental
- By this definition, market testing expenses and R&D expenses are both likely to be sunk costs before the projects that are based upon them are analyzed. If sunk costs are not considered in project analysis, how can a firm ensure that these costs are covered?

Allocated Costs

- Firms allocate costs to individual projects from a centralized pool (such as general and administrative expenses) based upon some characteristic of the project (sales is a common choice)
- For large firms, these allocated costs can result in the rejection of projects
- To the degree that these costs are not incremental (and would exist anyway), this makes the firm worse off.
  - Thus, it is only the incremental component of allocated costs that should show up in project analysis.
- How, looking at these pooled expenses, do we know how much of the costs are fixed and how much are variable?

The Incremental Cash Flows

	0	1	2	3	4	5	6	7	8	9	10
Operating Income after Taxes			$ (80)	$ 16	$ 92	$326	$433	$494	$563	$639	$658
+ Depreciation & Amortization			$ 375	$ 378	$369	$319	$302	$305	$305	$305	$315
- Capital Expenditures	$ 2,000	$ 1,000	$1,150	$ 706	$250	$359	$344	$303	$312	$343	$315
- Change in Working Capital			$ 60	$ 23	$ 18	$ 44	$ 28	$ 17	$ 19	$ 21	$ 7
+ Non-increm. Allocated Cost(1-t)			$ 85	$ 94	$103	$114	$125	$137	$151	$166	$171
Cashflow to Firm	$(2,000)	$(1,000)	$ (830)	$(241)	$297	$355	$488	$617	$688	$746	$822

To Time-Weighted Cash Flows

- Incremental cash flows in the earlier years are worth more than incremental cash flows in later years.
- In fact, cash flows across time cannot be added up. They have to be brought to the same point in time before aggregation.
- This process of moving cash flows through time is
  - discounting, when future cash flows are brought to the present
  - compounding, when present cash flows are taken to the future
- The discounting and compounding is done at a discount rate that will reflect
  - Expected inflation: Higher Inflation -> Higher Discount Rates
  - Expected real rate: Higher real rate -> Higher Discount rate
  - Expected uncertainty: Higher uncertainty -> Higher Discount Rate

Present Value Mechanics

Cash Flow Type	Discounting Formula	Compounding Formula
1. Simple CF	$CF_n / (1+r)^n$	$CF_0 (1+r)^n$
2. Annuity	$A\left[\frac{1 - \frac{1}{(1+r)^n}}{r}\right]$	$A\left[\frac{(1+r)^n - 1}{r}\right]$
3. Growing Annuity	$A(1+g)\left[\frac{1 - \frac{(1+g)^n}{(1+r)^n}}{r-g}\right]$	
4. Perpetuity	A/r	
5. Growing Perpetuity	Expected Cashflow next year/(r-g)	

Discounted cash flow measures of return

- **Net Present Value (NPV)**: The net present value is the sum of the present values of all cash flows from the project (including initial investment).

  NPV = Sum of the present values of all cash flows on the project, including the initial investment, with the cash flows being discounted at the appropriate hurdle rate (cost of capital, if cash flow is cash flow to the firm, and cost of equity, if cash flow is to equity investors)

  - Decision Rule: Accept if NPV > 0

- **Internal Rate of Return (IRR)**: The internal rate of return is the discount rate that sets the net present value equal to zero. It is the percentage rate of return, based upon incremental time-weighted cash flows.

  - Decision Rule: Accept if IRR > hurdle rate

Closure on Cash Flows

- In a project with a finite and short life, you would need to compute a **salvage value**, which is the expected proceeds from selling all of the investment in the project at the end of the project life. It is usually set equal to book value of fixed assets and working capital
- In a project with an infinite or very long life, we compute cash flows for a reasonable period, and then compute a **terminal value** for this project, which is the present value of all cash flows that occur after the estimation period ends..
- Assuming the project lasts forever, and that cash flows after year 9 grow 3% (the inflation rate) forever, the present value at the end of year 9 of cash flows after that can be written as:
  - Terminal Value = CF in year 10/(Cost of Capital - Growth Rate)
    = 822/(.1232-.03) = $ 8,821 million

  Note that this is the terminal value in year 9; So cash flow in year 10 is used.

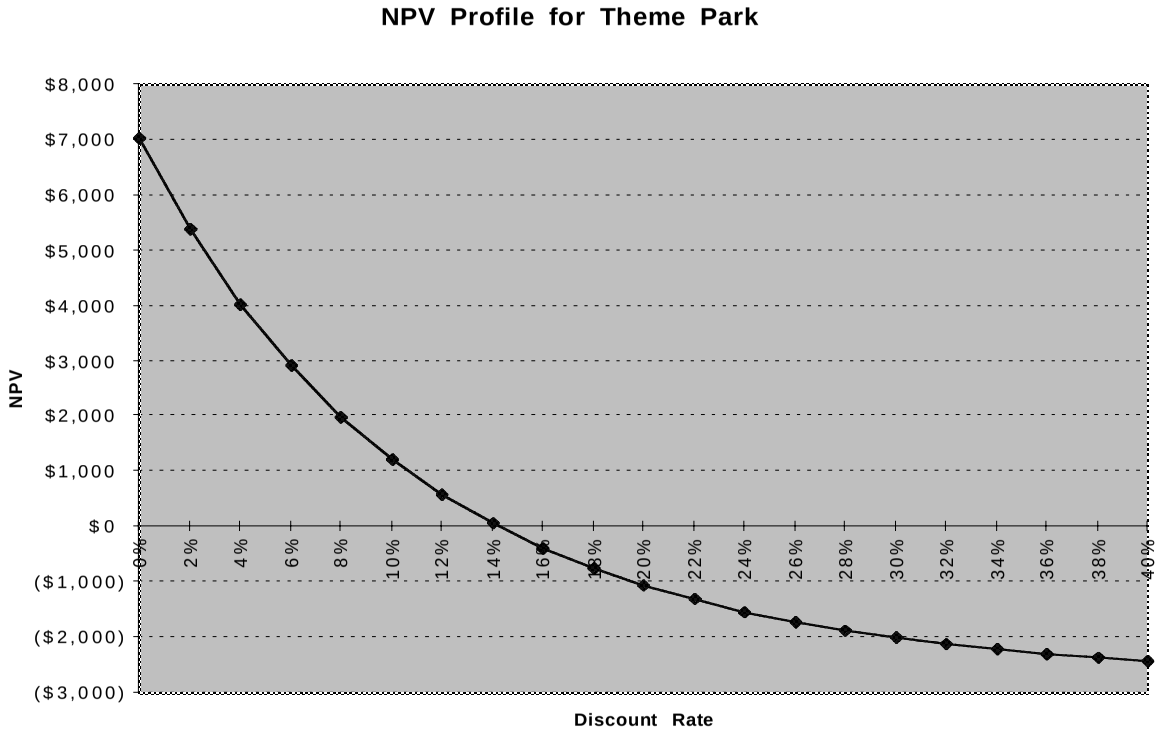
Which yields a NPV of..

Year	*Incremental CF*	*Terminal Value*	*PV at 12.32%*
0	$ (2,000)		$ (2,000)
1	$ (1,000)		$ (890)
2	$ (830)		$ (658)
3	$ (241)		$ (170)
4	$ 297		$ 187
5	$ 355		$ 198
6	$ 488		$ 243
7	$ 617		$ 273
8	$ 688		$ 272
9	$ 746	$ 8,821	$ 3,363
Net Present Value of Project =			**$ 818**

Which makes the argument that..

- **The project should be accepted**. The positive net present value suggests that the project will add value to the firm, and earn a return in excess of the cost of capital.
- By taking the project, Disney will increase its value as a firm by $818 million.

The IRR of this project



The IRR suggests..

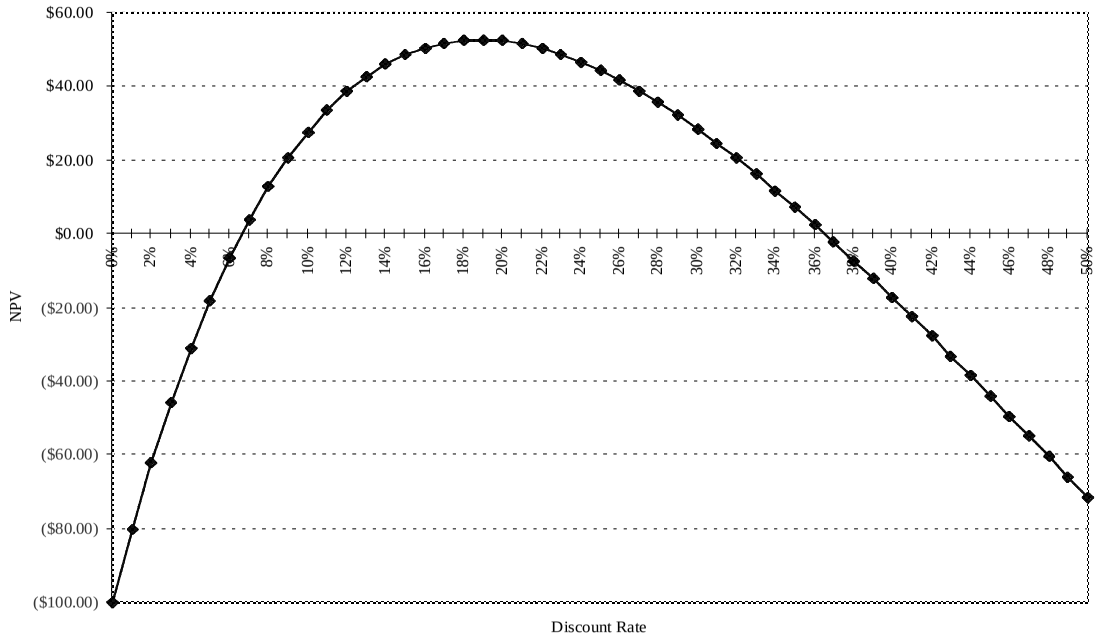
- **The project is a good one**. Using time-weighted, incremental cash flows, this project provides a return of 15.32%. This is greater than the cost of capital of 12.32%.
- The IRR and the NPV will yield **similar results** most of the time, though there are differences between the two approaches that may cause project rankings to vary depending upon the approach used.

Case 1: IRR versus NPV

- Consider a project with the following cash flows:

Year	*Cash Flow*
0	-1000
1	800
2	1000
3	1300
4	-2200

Project's NPV Profile



What do we do now?

- This project has two internal rates of return. The first is 6.60%, whereas the second is 36.55%.
- Why are there two internal rates of return on this project?

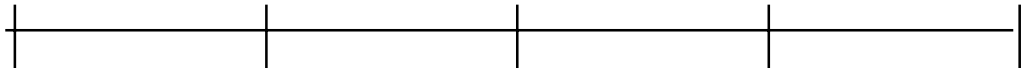
- If your cost of capital is 12.32%, would you accept or reject this project?
  - I would reject the project
  - I would accept this project

Explain.

Case 2: NPV versus IRR

Project A

Cash Flow $ 350,000 $ 450,000 $ 600,000 $ 750,000

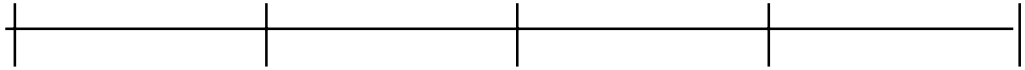


Investment $ 1,000,000

NPV = $467,937
IRR= 33.66%

Project B

Cash Flow $ 3,000,000 $ 3,500,000 $ 4,500,000 $ 5,500,000



Investment $ 10,000,000

NPV = $1,358,664
IRR=20.88%

Which one would you pick?

- Assume that you can pick only one of these two projects. Your choice will clearly vary depending upon whether you look at NPV or IRR. You have enough money currently on hand to take either. Which one would you pick?
  - Project A. It gives me the bigger bang for the buck and more margin for error.
  - Project B. It creates more dollar value in my business.

If you pick A, what would your biggest concern be?

If you pick B, what would your biggest concern be?

Capital Rationing, Uncertainty and Choosing a Rule

- If a business has limited access to capital, has a stream of surplus value projects and faces more uncertainty in its project cash flows, it is much more likely to use IRR as its decision rule.

  Small, high-growth companies and private businesses are much more likely to use IRR.

- If a business has substantial funds on hand, access to capital, limited surplus value projects, and more certainty on its project cash flows, it is much more likely to use NPV as its decision rule.

  As firms go public and grow, they are much more likely to gain from using NPV.

An Alternative to IRR with Capital Rationing

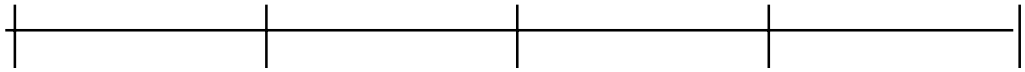
- The problem with the NPV rule, when there is capital rationing, is that it is a dollar value. It measures success in absolute terms.
- The NPV can be converted into a relative measure by dividing by the initial investment. This is called the profitability index.
  - Profitability Index (PI) = NPV/Initial Investment
- In the example described, the PI of the two projects would have been:
  - PI of Project A = $467,937/1,000,000 = 46.79%
  - PI of Project B = $1,358,664/10,000,000 = 13.59%

  Project A would have scored higher.

Case 3: NPV versus IRR

Project A

Cash Flow $ 5,000,000 $ 4,000,000 $ 3,200,000 $ 3,000,000

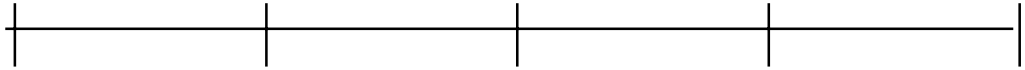


Investment $ 10,000,000

NPV = $1,191,712
IRR=21.41%

Project B

Cash Flow $ 3,000,000 $ 3,500,000 $ 4,500,000 $ 5,500,000



Investment $ 10,000,000

NPV = $1,358,664
IRR=20.88%

Why the difference?

These projects are of the same scale. Both the NPV and IRR use time-weighted cash flows. Yet, the rankings are different. Why?

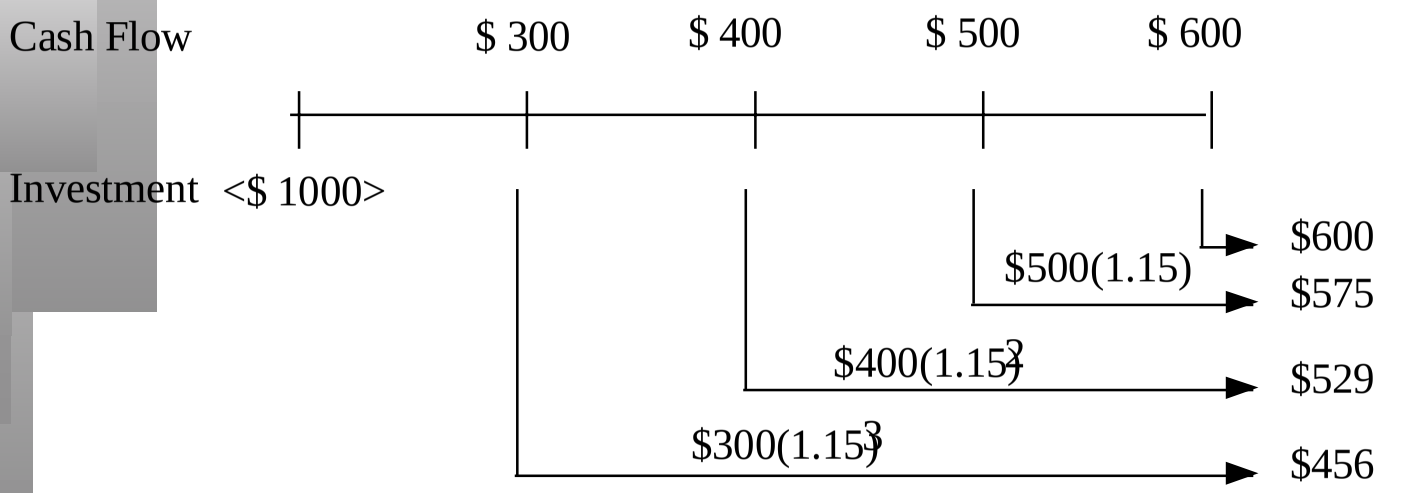
Which one would you pick?

- Project A. It gives me the bigger bang for the buck and more margin for error.
- Project B. It creates more dollar value in my business.

NPV, IRR and the Reinvestment Rate Assumption

- The NPV rule assumes that intermediate cash flows on the project get reinvested at the hurdle rate (which is based upon what projects of comparable risk should earn).
- The IRR rule assumes that intermediate cash flows on the project get reinvested at the IRR. Implicit is the assumption that the firm has an infinite stream of projects yielding similar IRRs.
- Conclusion: When the IRR is high (the project is creating significant surplus value) and the project life is long, the IRR will overstate the true return on the project.

Solution to Reinvestment Rate Problem



Terminal Value = $2160

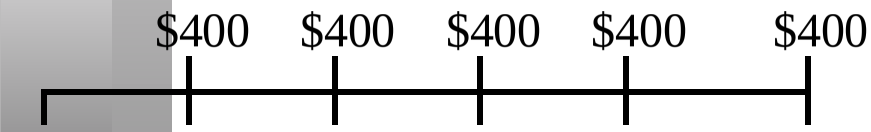
Internal Rate of Return = 24.89%
Modified Internal Rate of Return = 21.23%

Why NPV and IRR may differ..

- A project can have only one NPV, whereas it can have more than one IRR.
- The NPV is a dollar surplus value, whereas the IRR is a percentage measure of return. The NPV is therefore likely to be larger for “large scale” projects, while the IRR is higher for “small-scale” projects.
- The NPV assumes that intermediate cash flows get reinvested at the “hurdle rate”, which is based upon what you can make on investments of comparable risk, while the IRR assumes that intermediate cash flows get reinvested at the “IRR”.

Case: NPV and Project Life

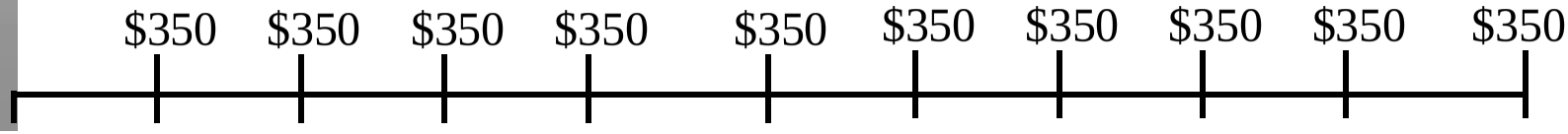
Project A



-$1000

NPV of Project A = $ 442

Project B



-$1500

NPV of Project B = $ 478

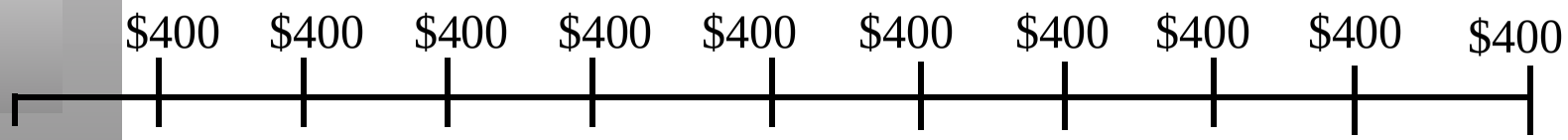
Hurdle Rate for Both Projects = 12%

Choosing Between Mutually Exclusive Projects

- The net present values of mutually exclusive projects with different lives cannot be compared, since there is a bias towards longer-life projects.
- To do the comparison, we have to
  - replicate the projects till they have the same life (or)
  - convert the net present values into annuities

Solution 1: Project Replication

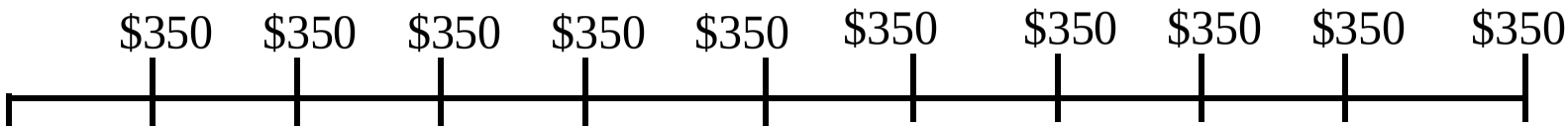
Project A: Replicated



-$1000 -$1000 (Replication)

NPV of Project A replicated = $ 693

Project B



-$1500

NPV of Project B= $ 478

Solution 2: Equivalent Annuities

- Equivalent Annuity for 5-year project
  = $442 * PV(A,12%,5 years)
  = $ 122.62
- Equivalent Annuity for 10-year project
  = $478 * PV(A,12%,10 years)
  = $ 84.60

What would you choose as your investment tool?

- Given the advantages/disadvantages outlined for each of the different decision rules, which one would you choose to adopt?
- Return on Investment (ROE, ROC)
- Payback or Discounted Payback
- Net Present Value
- Internal Rate of Return
- Profitability Index

What firms actually use ..

Decision Rule	*% of Firms using as primary decision rule in*	
	1976	1986
IRR	53.6%	49.0%
Accounting Return	25.0%	8.0%
NPV	9.8%	21.0%
Payback Period	8.9%	19.0%
Profitability Index	2.7%	3.0%

The Disney Theme Park: The Risks of International Expansion

- The cash flows on the Bangkok Disney park will be in Thai Baht. This will expose Disney to exchange rate risk. In addition, there are political and economic risks to consider in an investment in Thailand. The discount rate of 12.32% that we used is a cost of capital for U.S. theme parks. Would you use a higher rate for this project?
  - Yes
  - No

Should there be a risk premium for foreign projects?

- The exchange rate risk may be diversifiable risk (and hence should not command a premium) if
  - the company has projects is a large number of countries (or)
  - the investors in the company are globally diversified.

  For Disney, this risk should not affect the cost of capital used.
- The same diversification argument can also be applied against political risk, which would mean that it too should not affect the discount rate. It may, however, affect the cash flows, by reducing the expected life or cash flows on the project.

  For Disney, this risk too is assumed to not affect the cost of capital

Domestic versus international expansion

- The analysis was done in dollars. Would the conclusions have been any different if we had done the analysis in Thai Baht?
  - Yes
  - No

The “Consistency Rule” for Cash Flows

- The cash flows on a project and the discount rate used should be defined in the same terms.
  - If cash flows are in dollars (baht), the discount rate has to be a dollar (baht) discount rate
  - If the cash flows are nominal (real), the discount rate has to be nominal (real).
- If consistency is maintained, the project conclusions should be identical, no matter what cash flows are used.

Disney Theme Park: Project Analysis in Baht

- The inflation rates were assumed to be 15% in Thailand and 3% in the United States. The Baht/dollar rate at the time of the analysis was 35 BT/dollar.
- The expected exchange rate was derived assuming purchasing power parity.

  Expected Exchange Rate$_t$ = Exchange Rate today * $(1.15/1.03)^t$
- The expected growth rate after year 9 is still expected to be the inflation rate, but it is the 15% Thai inflation rate.
- The cost of capital in Baht was derived from the cost of capital in dollars and the differences in inflation rates:

  Baht Cost of Capital =(1 + $ Cost of Capital)*(1.15/1.03) - 1

  = (1.1232) (1.15/1.03) - 1 =.2541 or 25.41%

Disney Theme Park: The Baht NPV

Year	$ Cash Flows	Exchange Rate	BT Cash Flows	Terminal Value	Total FCFF	PV of FCFF
0	$ (2,000.00)	35.00	($70,000 Bt)		($70,000 Bt)	(70,000 Bt)
1	$ (890.31)	39.08	($39,078 Bt)		($39,078 Bt)	(31,161 Bt)
2	$ (657.64)	43.63	($36,199 Bt)		($36,199 Bt)	(23,017 Bt)
3	$ (170.35)	48.71	($11,759 Bt)		($11,759 Bt)	(5,962 Bt)
4	$ 186.63	54.39	16,155 Bt		16,155 Bt	6,532 Bt
5	$ 198.49	60.73	21,548 Bt		21,548 Bt	6,947 Bt
6	$ 243.21	67.80	33,109 Bt		33,109 Bt	8,512 Bt
7	$ 273.49	75.70	46,692 Bt		46,692 Bt	9,572 Bt
8	$ 271.69	84.52	58,169 Bt		58,169 Bt	9,509 Bt
9	$ 746.27	94.37	70,423 Bt	832,421 Bt	902,843 Bt	117,694 Bt
NPV					28,626 Bt	

NPV = 28,626 Bt/35 Bt = $ 818 Million

NPV is equal to NPV in dollar terms

Dealing with Inflation

- In our analysis, we used nominal dollars and Bt. Would the NPV have been different if we had used real cash flows instead of nominal cash flows?
- It would be much lower, since real cash flows are lower than nominal cash flows
- It would be much higher
- It should be unaffected

Disney Theme Park

- The nominal cash flows in Bt are deflated first at the inflation rate:
  - Real Cash Flows$_t$ = Nominal Cash Flow$_t$/(1+Inflation Rate)^t
- The real cost of capital is obtained by deflating the nominal discount rate at the inflation rate.
  - Real Cost of Capital = (1+Nominal Cost of Capital)/(1+Inflation Rate) - 1
  - For the theme park, this would be:

  Real Cost of Capital = 1.25411/1.15 -1 = 9.05%

Disney Theme Park: Real NPV

Year	Nominal CF (Bt)	Real CF	PV at
0	(70,000 Bt)	(70,000 Bt)	(70,000 Bt)
1	(39,078 Bt)	(33,981 Bt)	(31,161 Bt)
2	(36,199 Bt)	(27,371 Bt)	(23,017 Bt)
3	(11,759 Bt)	(7,731 Bt)	(5,962 Bt)
4	16,155 Bt	9,237 Bt	6,532 Bt
5	21,548 Bt	10,713 Bt	6,947 Bt
6	33,109 Bt	14,314 Bt	8,512 Bt
7	46,692 Bt	17,553 Bt	9,572 Bt
8	58,169 Bt	19,015 Bt	9,509 Bt
9	902,843 Bt	256,644 Bt	117,694 Bt
NPV of Project =			**28,626 Bt**

Equity Analysis: The Parallels

- The investment analysis can be done entirely in equity terms, as well. The returns, cashflows and hurdle rates will all be defined from the perspective of equity investors.
- If using accounting returns,
  - Return will be Return on Equity (ROE) = Net Income/BV of Equity
  - ROE has to be greater than cost of equity
- If using discounted cashflow models,
  - Cashflows will be cashflows after debt payments to equity investors
  - Hurdle rate will be cost of equity

A Brief Example: A Paper Plant for Aracruz - Investment Assumptions

The plant is expected to have a capacity of 750,000 tons and will have the following characteristics:

- It will require an initial investment of 250 Million BR. At the end of the fifth year, an additional investment of 50 Million BR will be needed to update the plant.
- Aracruz plans to borrow 100 Million BR, at a real interest rate of 5.5%, using a 10-year term loan (where the loan will be paid off in equal annual increments).
- The plant will have a life of 10 years. During that period, the plant (and the additional investment in year 5) will be depreciated using double declining balance depreciation, with a life of 10 years.

Operating Assumptions

- The plant will be partly in commission in a couple of months, but will have a capacity of only 650,000 tons in the first year, 700,000 tons in the second year before getting to its full capacity of 750,000 tons in the third year. The capacity utilization rate will be 90% for the first 3 years, and rise to 95% after that. The investment will be salvaged at book value at the end of year 10.
- The price per ton of linerboard is currently $400, and is expected to keep pace with inflation for the life of the plant.
- The variable cost of production, primarily labor and material, is expected to be 55% of total revenues; there is a fixed cost of 50 Million BR, which will grow at the inflation rate.
- The working capital requirements are estimated to be 15% of total revenues, and the investments have to be made at the beginning of each year. At the end of the tenth year, it is anticipated that the entire working capital will be salvaged.

The Hurdle Rate

- The analysis is done in real, equity terms. Thus, the hurdle rate has to be a real cost of equity
- The real cost of equity for Aracruz, based upon
  - the beta estimate of 0.71,
  - the real riskless rate of 5% (using the real growth rate in Brazil as proxy)
  - and the risk premium for Brazil of 7.5% (based upon country rating spread over U.S premium of 5.5%)

  Real Cost of Equity = 5% + 0.71 (7.5%) = 10.33%

A ROE Analysis

Year	Net Income	Depreciation	Cap Exp	Ending BV: Assets	Debt	BV: Equity	Avge BV	ROE
0		0 BR	250,000 BR	250,000 BR	100,000 BR	150,000 BR		
1	(1,289 BR)	50,000 BR	0 BR	200,000 BR	92,233 BR	107,767 BR	128,883 BR	-1.00%
2	7,371 BR	40,000 BR	0 BR	160,000 BR	84,039 BR	75,961 BR	91,864 BR	8.02%
3	15,122 BR	32,000 BR	0 BR	128,000 BR	75,395 BR	52,605 BR	64,283 BR	23.52%
4	21,526 BR	25,600 BR	0 BR	102,400 BR	66,275 BR	36,125 BR	44,365 BR	48.52%
5	24,234 BR	20,480 BR	50,000 BR	131,920 BR	56,653 BR	75,267 BR	55,696 BR	43.51%
6	21,864 BR	26,384 BR	0 BR	105,536 BR	46,502 BR	59,034 BR	67,151 BR	32.56%
7	24,684 BR	21,107 BR	0 BR	84,429 BR	35,793 BR	48,636 BR	53,835 BR	45.85%
8	27,036 BR	16,886 BR	0 BR	67,543 BR	24,495 BR	43,048 BR	45,842 BR	58.98%
9	29,020 BR	13,509 BR	0 BR	54,034 BR	12,575 BR	41,459 BR	42,254 BR	68.68%
10	30,715 BR	10,807 BR	0 BR	43,228 BR	(0 BR)	43,228 BR	42,343 BR	72.54%
								40.12%

Real ROE of 40.12% is greater than

Real Cost of Equity of 10.33%

From Project ROE to Firm ROE

- As with the earlier analysis, where we used return on capital and cost of capital to measure the overall quality of projects at Disney, we can compute return on equity and cost of equity at Aracruz to pass judgment on whether Aracruz is creating value to its equity investors
- In 1996, Aracruz had net income of 47 million BR on book value of equity of 2,115 million BR, yielding a return on equity of:

  ROE = 47/2115 = 2.22% (Real because book value is inflation adjusted)

  Cost of Equity = 10.33%

  Excess Return = 2.22% - 10.33% = -8.11%
- This can be converted into a dollar value by multiplying by the book value of equity, to yield a equity economic value added

  Equity EVA = (2.22% - 10.33%) (2,115 Million) = -171 Million BR

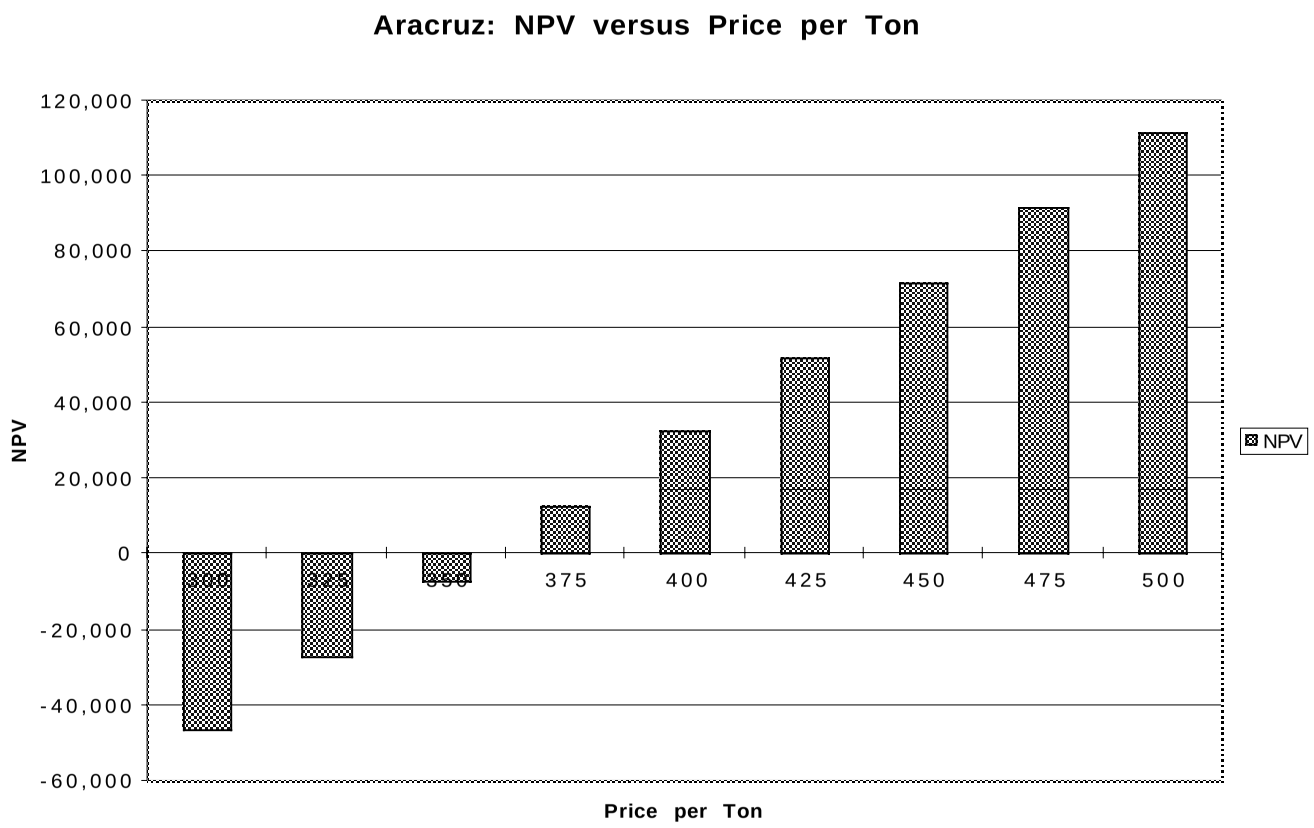
An Incremental CF Analysis

Year	FCFE	PV of FCFE (at 10.33%)
0	(185,100 BR)	(185,100 BR)
1	38,244 BR	34,663 BR
2	36,477 BR	29,966 BR
3	36,227 BR	26,974 BR
4	38,006 BR	25,649 BR
5	(14,907 BR)	(9,119 BR)
6	38,097 BR	21,122 BR
7	35,082 BR	17,629 BR
8	32,624 BR	14,859 BR
9	30,609 BR	12,636 BR
10	114,925 BR	43,001 BR
NPV		32,280 BR

The Role of Sensitivity Analysis

- Our conclusions on a project are clearly conditioned on a large number of assumptions about revenues, costs and other variables over very long time periods.
- To the degree that these assumptions are wrong, our conclusions can also be wrong.
- One way to gain confidence in the conclusions is to check to see how sensitive the decision measure (NPV, IRR..) is to changes in key assumptions.

Viability of Paper Plant: Sensitivity to Price per Ton



What does sensitivity analysis tell us?

Assume that the manager at Aracruz who has to decide on whether to take this plant is very conservative. She looks at the sensitivity analysis and decides not to take the project because the NPV would turn negative if the price drops below $360 per ton. (Though the expected price per ton is $400, there is a significant probability of the price dropping below $360.)Is this the right thing to do?

- Yes
- No

Explain.

Side Costs and Benefits

- Most projects considered by any business create side costs and benefits for that business.
- The side costs include the costs created by the use of resources that the business already owns (opportunity costs) and lost revenues for other projects that the firm may have.
- The benefits that may not be captured in the traditional capital budgeting analysis include project synergies (where cash flow benefits may accrue to other projects) and options embedded in projects (including the options to delay, expand or abandon a project).
- The returns on a project should incorporate these costs and benefits.

Opportunity Cost

- An opportunity cost arises when a project uses a resource that may already have been paid for by the firm.
- When a resource that is already owned by a firm is being considered for use in a project, this resource has to be priced on its next best alternative use, which may be
  - a sale of the asset, in which case the opportunity cost is the expected proceeds from the sale, net of any capital gains taxes
  - renting or leasing the asset out, in which case the opportunity cost is the expected present value of the after-tax rental or lease revenues.
  - use elsewhere in the business, in which case the opportunity cost is the cost of replacing it.

Case 1: Opportunity Costs

- Assume that Disney owns land in Bangkok already. This land is undeveloped and was acquired several years ago for $ 5 million for a hotel that was never built. It is anticipated, if this theme park is built, that this land will be used to build the offices for Disney Bangkok. The land currently can be sold for $ 40 million, though that would create a capital gain (which will be taxed at 20%). In assessing the theme park, which of the following would you do:
  - Ignore the cost of the land, since Disney owns its already
  - Use the book value of the land, which is $ 5 million
  - Use the market value of the land, which is $ 40 million
  - Other:

Case 2: Excess Capacity

- In the Aracruz example, assume that the firm will use its existing distribution system to service the production out of the new paper plant. The new plant manager argues that there is no cost associated with using this system, since it has been paid for already and cannot be sold or leased to a competitor (and thus has no competing current use). Do you agree?
  - Yes
  - No

Estimating the Cost of Excess Capacity

- Existing Capacity = 100,000 units
- Current Usage = 50,000 (50% of Capacity); 50% Excess Capacity;
- New Product will use 30% of Capacity; Sales growth at 5% a year; CM per unit = $5/unit
- Book Value = $1,000,000
- Cost of a building new capacity = $1,500,000; Cost of Capital = 12%
- Current product sales growing at 10% a year. CM per unit = $4/unit
- Basic Framework
  - If I do not take this product, when will I run out of capacity?
  - If I take thisproject, when will I run out of capacity
  - When I run out of capacity, what will I do?
    - cut back on production: cost is PV of after-tax cash flows from lost sales
    - buy new capacity: cost is difference in PVbetween earlier & later investment

Opportunity Cost of Excess Capacity

Year	Old	New	Old + New	Lost ATCF	PV(ATCF)
1	50.00%	30.00%	80.00%	$0	
2	55.00%	31.50%	86.50%	$0	
3	60.50%	33.08%	93.58%	$0	
4	66.55%	34.73%	101.28%	$5,115	$ 3,251
5	73.21%	36.47%	109.67%	$38,681	$ 21,949
6	80.53%	38.29%	118.81%	$75,256	$ 38,127
7	88.58%	40.20%	128.78%	$115,124	$ 52,076
8	97.44%	42.21%	139.65%	$158,595	$ 64,054
9	107.18%	44.32%	151.50%	$ 206,000	$ 74,286
10	117.90%	46.54%	164.44%	$ 257,760	$ 82,992
				PV(LOST SALES)=	**$ 336,734**

- PV (Building Capacity In Year 3 Instead Of Year 8) = $1{,}500{,}000/1.12^3 - 1{,}500{,}000/1.12^8 = \$\ 461{,}846$
- Opportunity Cost of Excess Capacity = $ 336,734

Product and Project Cannibalization: A Real Cost?

Assume that in the Disney theme park example, 20% of the revenues at the Bangkok Disney park are expected to come from people who would have gone to Disneyland in Anaheim, California. In doing the analysis of the park, would you

- Look at only incremental revenues (i.e. 80% of the total revenue)
- Look at total revenues at the park
- Choose an intermediate number

Would your answer be different if you were analyzing whether to introduce a new show on the Disney cable channel on Saturday mornings that is expected to attract 20% of its viewers from ABC (which is also owned by Disney)?

- Yes
- No

Project Synergies

- A project may provide benefits for other projects within the firm. If this is the case, these benefits have to be valued and shown in the initial project analysis.
- Consider, for instance, a typical Disney animated movie. Assume that it costs $ 50 million to produce and promote. This movie, in addition to theatrical revenues, also produces revenues from
  - the sale of merchandise (stuffed toys, plastic figures, clothes ..)
  - increased attendance at the theme parks
  - stage shows (see “Beauty and the Beast” and the “Lion King”)
  - television series based upon the movie

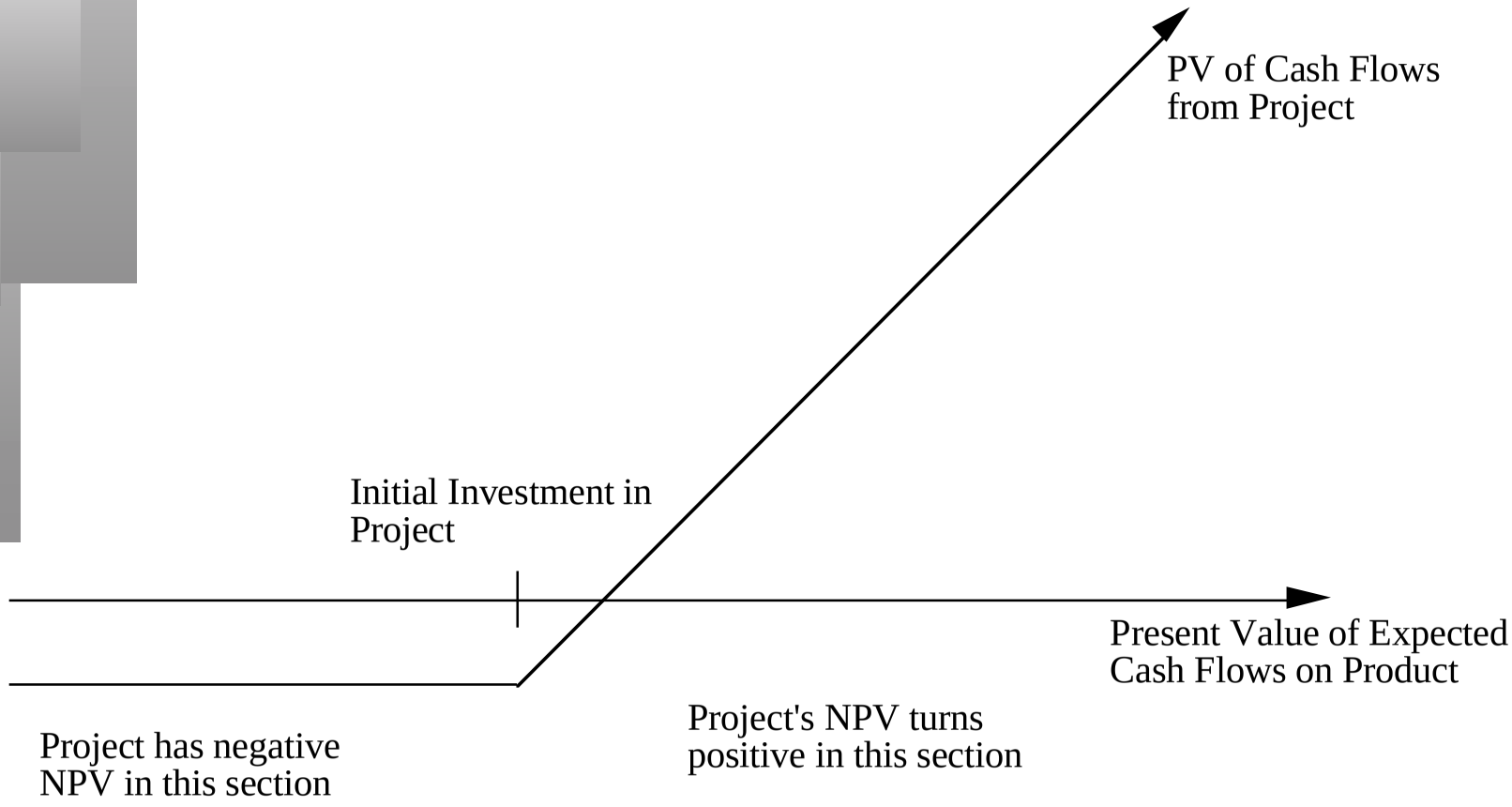
Project Options

- 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 project, when a firm has exclusive rights to it, until a later date.
  - The second of these options is taking one project may allow us to take advantage of other opportunities (projects) in the future
  - The last option that is embedded in projects is the option to abandon a project, if the cash flows do not measure up.
- These options all add value to projects and may make a “bad” project (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



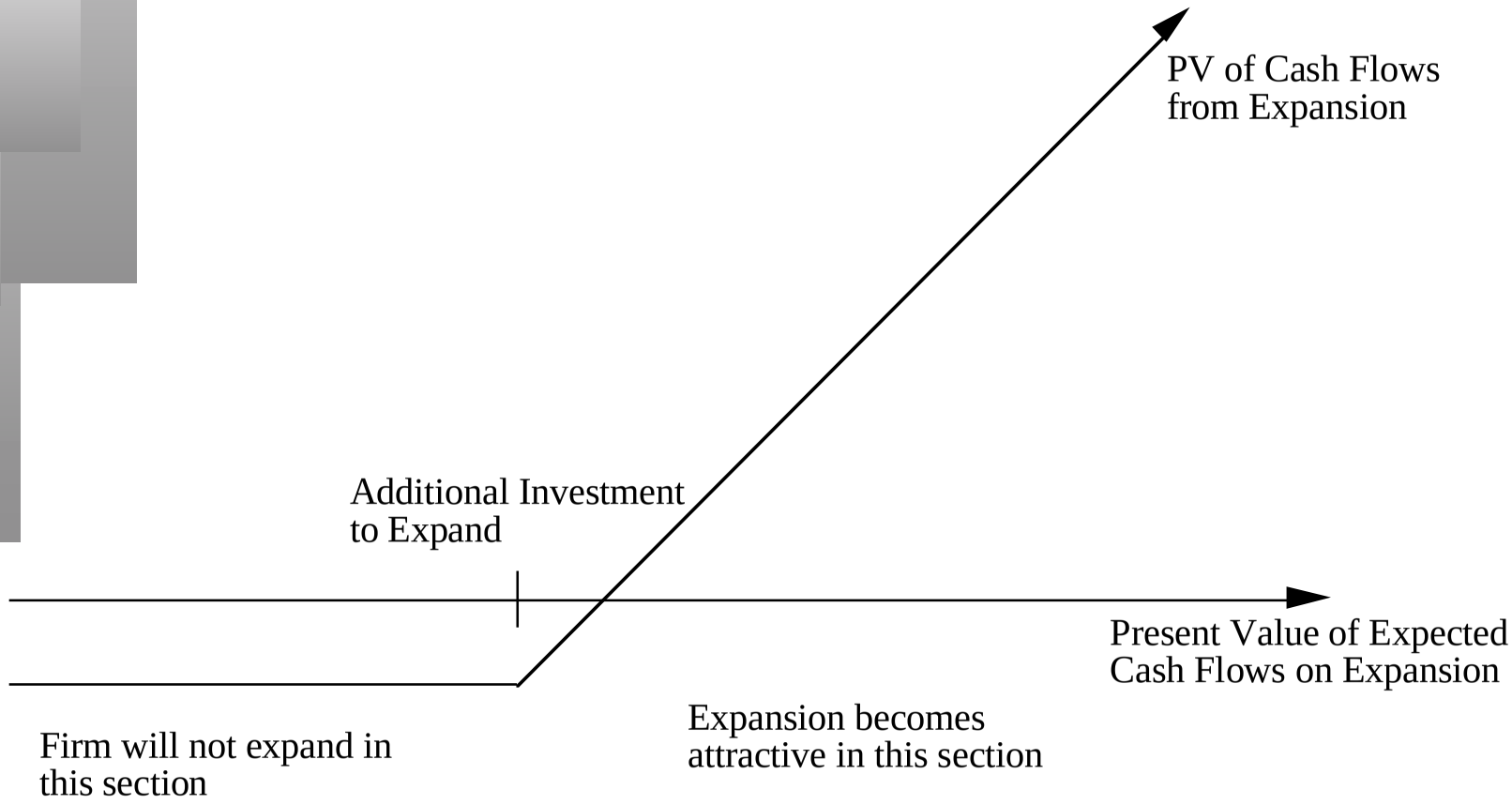
Insights for Investment Analyses

- Having the exclusive rights to a product or project is valuable, even if the product or project is not viable today.
- The value of these rights increases with the volatility of the underlying business.
- The cost of acquiring these rights (by buying them or spending money on development - R&D, for instance) has to be weighed off against these benefits.

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

- Disney is considering investing $ 100 million to create a Spanish version of the Disney channel to serve the growing Mexican market.
- A financial analysis of the cash flows from this investment suggests that the present value of the cash flows from this investment to Disney will be only $ 80 million. Thus, by itself, the new channel has a **negative NPV of $ 20 million**.
- If the market in Mexico turns out to be more lucrative than currently anticipated, Disney **could expand** its reach to all of Latin America with **an additional investment of $ 150 million** any time over the next 10 years. While the current expectation is that the cash flows from having a Disney channel in Latin America is only $ 100 million, there is considerable uncertainty about both the potential for such an channel and the shape of the market itself, leading to significant variance in this estimate.

Valuing the Expansion Option

- Value of the Underlying Asset (S) = PV of Cash Flows from Expansion to Latin America, if done now =$ 100 Million
- Strike Price (K) = Cost of Expansion into Latin American = $ 150 Million
- We estimate the variance in the estimate of the project value by using the annualized variance in firm value of publicly traded entertainment firms in the Latin American markets, which is approximately 10%.
  - Variance in Underlying Asset's Value = 0.10
- Time to expiration = Period for which expansion option applies = 10 years

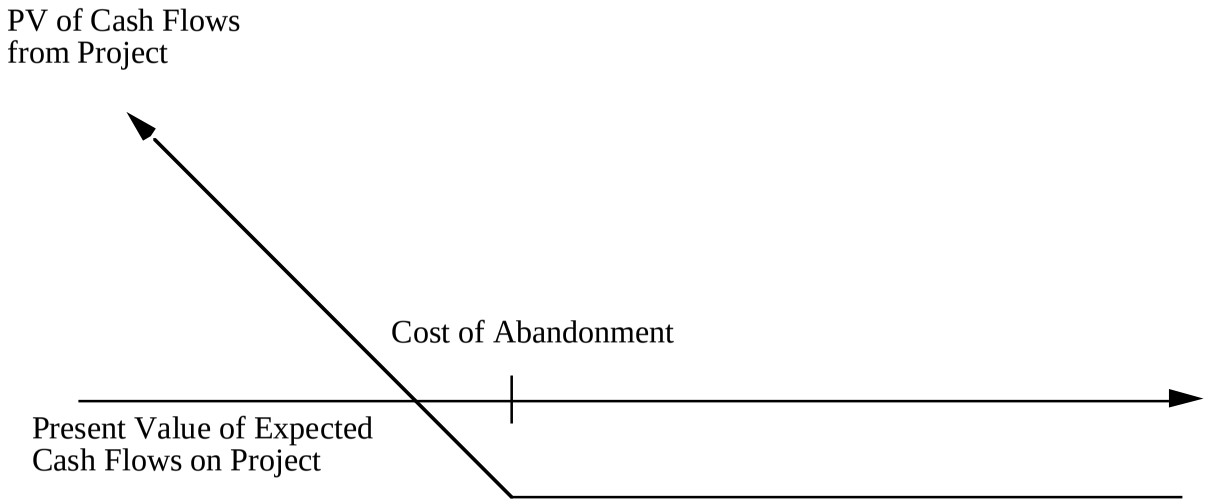
Call Value= $ 45.9 Million

Considering the Project with Expansion Option

- NPV of Disney Channel in Mexico = $ 80 Million - $ 100 Million = - $ 20 Million
- Value of Option to Expand = $ 45.9 Million
- NPV of Project with option to expand
  = - $ 20 million + $ 45.9 million
  = $ 25.9 million
- **Take the project**

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

- Disney is considering taking a 25-year project which
  - requires an initial investment of $ 250 million in an real estate partnership to develop time share properties with a South Florida real estate developer,
  - has a present value of expected cash flows is $ 254 million.
- While the net present value of $ 4 million is small, assume that Disney has the option to abandon this project anytime by selling its share back to the developer in the next 5 years for $ 150 million.
- 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 0.09.

Project with Option to Abandon

- Value of the Underlying Asset (S) = PV of Cash Flows from Project = $ 254 million
- Strike Price (K) = Salvage Value from Abandonment = $ 150 million
- Variance in Underlying Asset's Value = 0.09
- Time to expiration = Life of the Project =5 years
- Dividend Yield = 1/Life of the Project = 1/25 = 0.04 (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 7%. The value of the put option can be estimated as follows:

Should Disney take this project?

- Call Value = 254 exp(-0.04)(5) (0.9105) -150 (exp(-0.07)(5) (0.7496) = $ 110.12 million
- Put Value= $ 110.12 - 254 exp(-0.04)(5) +150 (exp(-0.07)(5) = $ 7.86 million
- The value of this abandonment option has to be added on to the net present value of the project of $ 4 million, yielding a total net present value with the abandonment option of $ 11.86 million.

The Objective in Corporate Finance

Aswath Damodaran

Stern School of Business

First Principles

- Invest in projects that yield a return greater than the minimum acceptable hurdle rate.
  - The hurdle rate should be higher for riskier projects and reflect the financing mix used - owners' funds (equity) or borrowed money (debt)
  - Returns on projects should be measured based on cash flows generated and the timing of these cash flows; they should also consider both positive and negative side effects of these projects.
- Choose a financing mix that minimizes the hurdle rate and matches the assets being financed.
- If there are not enough investments that earn the hurdle rate, return the cash to stockholders.
  - The form of returns - dividends and stock buybacks - will depend upon the stockholders' characteristics.

Objective: Maximize the Value of the Firm

Why do we need an objective?

- An objective specifies what a decision maker is trying to accomplish and by so doing, provides measures that can be used to choose between alternatives.
- Why do we need an objective?
  - If an objective is not chosen, there is no systematic way to make the decisions that every business will be confronted with at some point in time.
  - A theory developed around multiple objectives of equal weight will create quandaries when it comes to making decisions.
  - The costs of choosing the wrong objective can be significant.

Characteristics of a Good Objective Function

- It is *clear and unambiguous*
- It comes with a *clear and timely measure* that can be used to evaluate the success or failure of decisions.
- It *does not create costs for other entities or groups* that erase firm-specific benefits and leave society worse off overall. As an example, assume that a tobacco company defines its objective to be revenue growth.

The Objective in Decision Making

- In traditional corporate finance, the objective in decision making is to maximize the value of the firm.
- A narrower objective is to maximize stockholder wealth. When the stock is traded and markets are viewed to be efficient, the objective is to maximize the stock price.
- All other goals of the firm are intermediate ones leading to firm value maximization, or operate as constraints on firm value maximization.

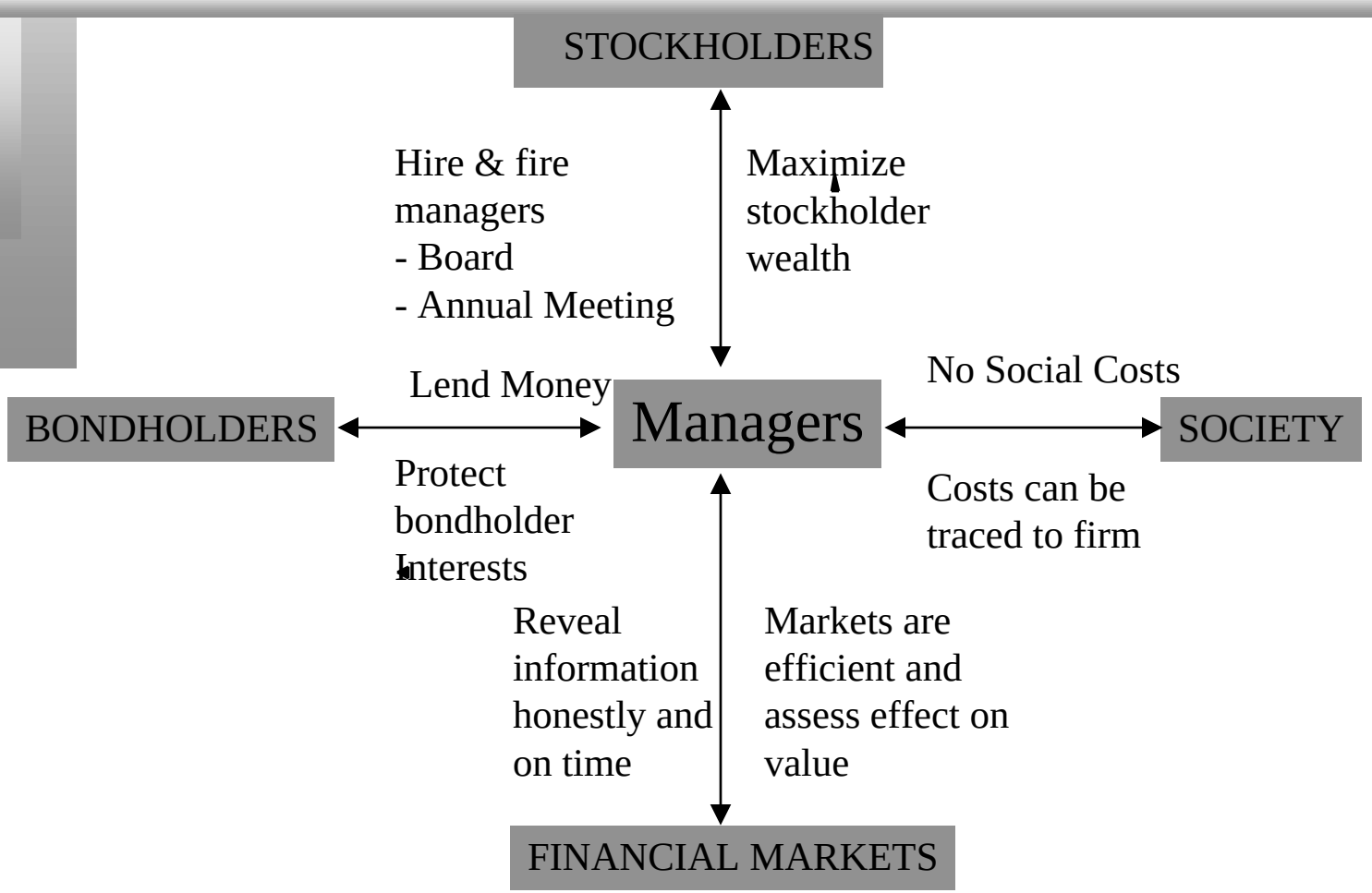
Why traditional corporate financial theory often focuses on maximizing stock prices as opposed to firm value

- Stock price is easily observable and constantly updated (unlike other measures of performance, which may not be as easily observable, and certainly not updated as frequently).
- If investors are rational (are they?), stock prices reflect the wisdom of decisions, short term and long term, instantaneously.
- The stock price is a real measure of stockholder wealth, since stockholders *can sell their stock and receive the price now.*

Maximize stock prices as the only objective function

- For stock price maximization to be the only objective in decision making, we have to assume that
  - The decision makers (managers) are responsive to the owners (stockholders) of the firm
  - Stockholder wealth is not being increased at the expense of bondholders and lenders to the firm; only then is stockholder wealth maximization consistent with firm value maximization.
  - Markets are efficient; only then will stock prices reflect stockholder wealth.
  - There are no significant social costs; only then will firms maximizing value be consistent with the welfare of all of society.

The Classical Objective Function



Another Way of Presenting this is...

Why Stock Price Maximization Works

Stockholders hire managers to run their firms for them

↓ *Because stockholders have absolute power to hire and fire managers*

Managers set aside their interests and maximize stock prices

↓ *Because markets are efficient*

Stockholder wealth is maximized

↓ *Because lenders are fully protected from stockholder actions*

Firm Value is maximized

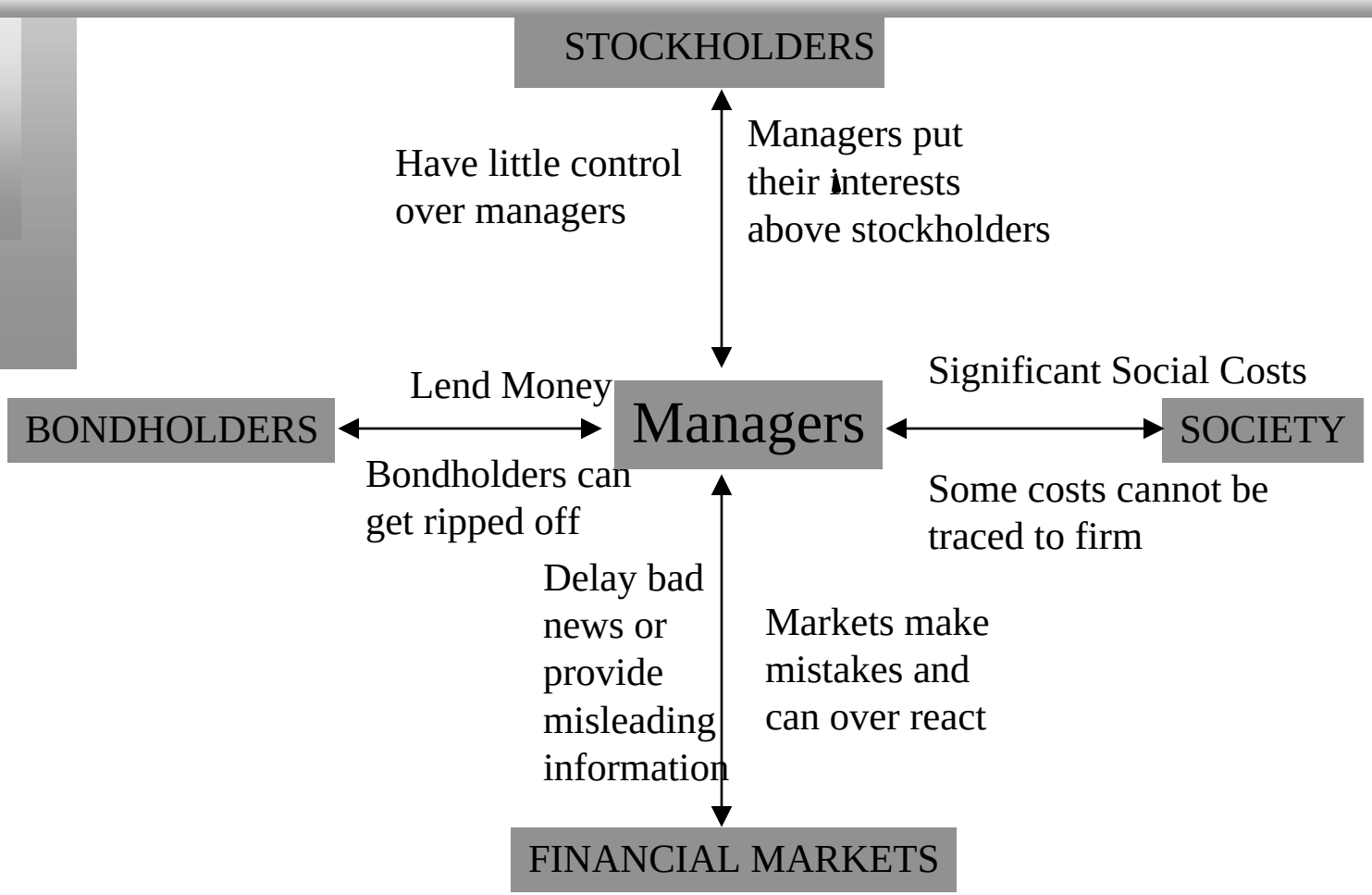
↓ *Because there are no costs created for society*

Societal wealth is maximized

The Agency Cost Problem

- The interests of managers, stockholders, bondholders and society can diverge. What is good for one group may not necessarily for another.
  - Managers may have other interests (job security, perks, compensation) that they put over stockholder wealth maximization.
  - Actions that make stockholders better off (increasing dividends, investing in risky projects) may make bondholders worse off.
  - Actions that increase stock price may not necessarily increase stockholder wealth, if markets are not efficient or information is imperfect.
  - Actions that makes firms better off may create such large social costs that they make society worse off.
- Agency costs refer to the conflicts of interest that arise between all of these different groups.

What can go wrong?



I. Stockholder Interests vs. Management Interests

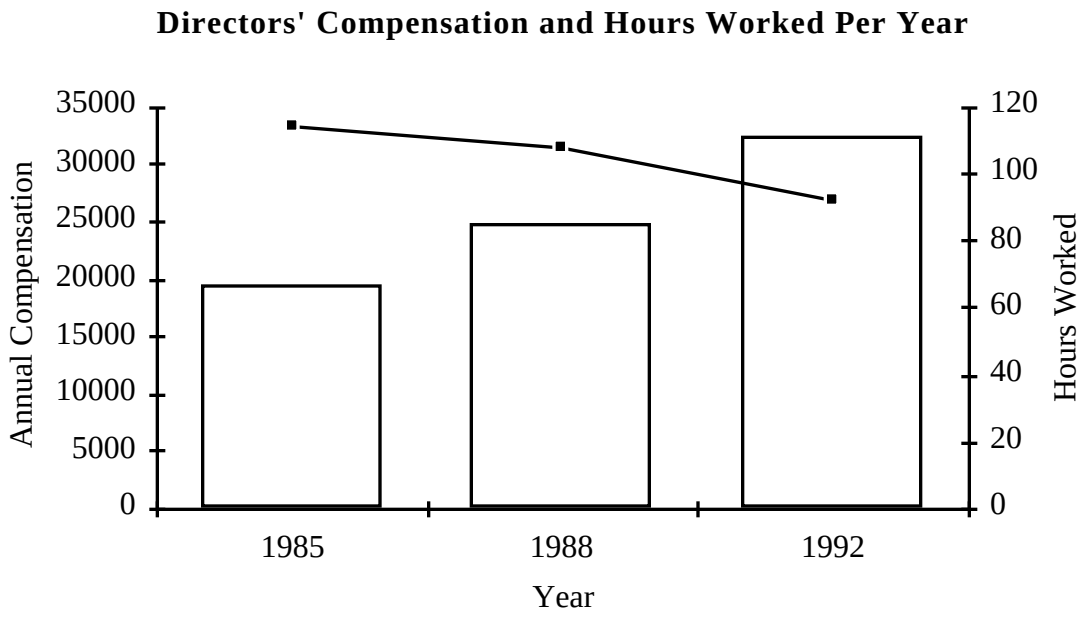
- **Theory**: The stockholders have significant control over management. The mechanisms for disciplining management are the annual meeting and the board of directors.
- **Practice**: Neither mechanism is as effective in disciplining management as theory posits.

The Annual Meeting as a disciplinary venue

- The power of stockholders to act at annual meetings is diluted by three factors
  - Most small stockholders do not go to meetings because the cost of going to the meeting exceeds the value of their holdings.
  - Incumbent management starts off with a clear advantage when it comes to the exercising of proxies. Proxies that are not voted becomes votes for incumbent management.
  - For large stockholders, the path of least resistance, when confronted by managers that they do not like, is to vote with their feet.

Board of Directors as a disciplinary mechanism

- Directors, for the most part, are well compensated and underworked



The CEO hand-picks most directors..

- The 1992 survey by Korn/Ferry revealed that 74% of companies relied on recommendations from the CEO to come up with new directors; Only 16% used an outside search firm.
- Directors often hold only token stakes in their companies. The Korn/Ferry survey found that 5% of all directors in 1992 owned less than five shares in their firms.
- Many directors are themselves CEOs of other firms.

Directors lack the expertise to ask the necessary tough questions..

- The CEO sets the agenda, chairs the meeting and controls the information.
- The search for consensus overwhelms any attempts at confrontation.

The Best Boards ...

THE BEST BOARDS OF DIRECTORS

BW RANK	OVERALL SCORE	SURVEY SCORE	ANALYSIS SCORE	DETAILS	BOARD PERFORMANCE POLL: SHAREHOLDER ACCOUNTABILITY	BOARD QUALITY	BOARD INDEPENDENCE	CORPORATE PERFORMANCE	GOVERNANCE GUIDELINE ANALYSIS: SHAREHOLDER ACCOUNTABILITY	BOARD QUALITY	BOARD INDEPENDENCE
1. CAMPBELL SOUP	87.1	43.1	44.0	Board involvement in recent CEO change rewrites the book on how to do it	9.7	9.0	9.1	9.2	9.2	6.0	10.0
2. GENERAL ELECTRIC	74.7	45.7	29.0	Won most votes in poll for best board; outside directors own lots of GE stock	8.6	8.6	6.8	9.1	6.0	7.6	4.8
3. COMPAQ COMPUTER	72.8	28.3	44.5	Model board with nonexecutive chair has delivered big results for investors	9.6	9.2	8.8	10.0	9.2	8.4	9.0
4. MICROSOFT	69.1	36.6	32.5	Small board wins praise from investors who don't worry about CEO succession	8.0	8.3	7.0	9.2	7.2	6.0	6.4
5. IBM	68.0	30.5	37.5	Turnaround by board-recruited CEO keeps major shareholders happy	8.5	8.1	7.4	7.8	9.2	6.8	8.0
6. CHRYSLER	67.8	27.3	40.5	Leader in many governance practices, though many directors on too many boards	9.0	8.7	8.2	8.5	10.0	3.6	9.4
7. GENERAL MOTORS	67.2	26.2	41.0	Among first to publish guidelines; only weakness: overextended directors	7.0	7.2	6.7	5.7	10.0	2.8	10.0
8. INTEL	67.1	27.5	32.0	Board gains high marks from investors; directors own lots of stock	9.1	8.4	6.4	9.3	6.4	7.6	8.8
9. COLGATE PALMOLIVE	66.9	26.4	40.5	All directors own significant stock; only one insider on board: the CEO	8.5	9.3	9.0	9.3	8.0	8.4	8.0
10. TEXAS INSTRUMENTS	64.9	26.4	38.5	Pays half of retainer in stock; outsiders average more than $400K of stock	9.5	9.0	8.8	8.8	8.0	6.8	8.0

And the Worst Boards are ..

THE WORST BOARDS OF DIRECTORS

BW RANK	OVERALL SCORE	SURVEY SCORE	ANALYSIS SCORE	DETAILS	BOARD PERFORMANCE POLL: SHAREHOLDER ACCOUNTABILITY	BOARD PERFORMANCE POLL: BOARD QUALITY	BOARD PERFORMANCE POLL: BOARD INDEPENDENCE	BOARD PERFORMANCE POLL: CORPORATE PERFORMANCE	GOVERNANCE GUIDELINE ANALYSIS: SHAREHOLDER ACCOUNTABILITY	GOVERNANCE GUIDELINE ANALYSIS: BOARD QUALITY	GOVERNANCE GUIDELINE ANALYSIS: BOARD INDEPENDENCE
1. DISNEY	10.3	1.8	8.5	Investors decry board for conflicts; many directors own little if any stock	3.3	4.3	2.0	5.8	−0.4	2.8	2.2
2. AT&T	10.9	−16.6	27.5	Investors scorn board for failing to control succession, not ousting CEO	3.0	4.2	3.5	2.8	2.0	5.2	7.4
3. H.J. HEINZ	15.4	−1.1	16.5	Longtime CEO dominates insider-filled board; resists investor calls for change	2.8	3.7	2.0	4.7	4.4	6.0	1.4
4. ARCHER DANIELS MIDLAND	16.8	−12.2	29.0	Board changes fail to satisfy investors, who say directors still lack independence	2.3	2.1	1.3	3.5	5.6	7.6	5.0
5. DOW JONES	21.1	1.6	19.5	Investors disenchanted with performance; weakest attendance record of any board	2.6	4.6	2.8	2.6	6.0	0.0	5.8
6. DILLARD'S	22.0	5.0	17.0	Board loaded with insiders; lacks an outsider with retail expertise or CEO	2.0	3.0	2.0	3.5	6.4	3.2	2.0
7. ROLLINS INTERNATIONAL	22.7	1.7	21.0	Board dominated by family members and insiders; lacks nominating panel	1.0	1.0	0.0	2.0	4.0	7.6	4.4
8. OCCIDENTAL PETROLEUM	24.0	−1.5	25.5	Investors outraged over $95 million payout to CEO by cozy, aging board	1.3	2.0	1.1	2.0	2.8	6.0	5.8
9. OGDEN	27.2	4.2	23.0	Board has three consultants and a lawyer who do business with company	2.0	1.5	2.0	2.5	2.0	8.4	4.0
10. MAXXAM	28.3	4.3	24.5	Tiny board with little business experience dominated by CEO	1.5	2.0	1.0	3.5	3.6	2.0	6.0

Business Week's Worst and the Best: Disney vs. Campbell Soup

BEST PRACTICES	*CAMPBELL SOUP*	*DISNEY*
Majority of outside directors	Only one insider among 15 directors	7 of 17 members are insiders
Bans insiders on nominating committee	Yes	No: CEO is chairman of panel
Bans former execs from board	Yes	No
Mandatory retirement age	70, with none over 64	None
Outside directors meet w/o CEO	Annually	Never
Appointment of 'lead director"	Yes	No
Governance committee	Yes	No
Self-evaluation of effectiveness	Every two years	None
Director pensions	None	Yes
Share-ownership requirement	3,000 shares	None

Who's on Board? Boeing and The Home Depot

	Boeing	*Home Depot*
Board Size	15 directors	11 directors
Board Independence	High - 1 insider - No other connections	Low - 4 insiders - Business connections
Accountability to Stockholders	All but one own more than $ 10,000 of stock	All own more than $10,000 of stock
Quality of Directors	Tough to gauge	Tough to gauge

⌛Application Test: Who's on board?

- Look at the board of directors for your firm. Analyze
  - How many of the directors are inside directors (Employees of the firm, ex-managers)?
  - Is there any information on how independent the directors in the firm are from the managers?

So what next? When the cat is idle, the mice will play ....

■ When managers do not fear stockholders, they will often put their interests over stockholder interests

No stockholder approval needed.... Stockholder Approval needed

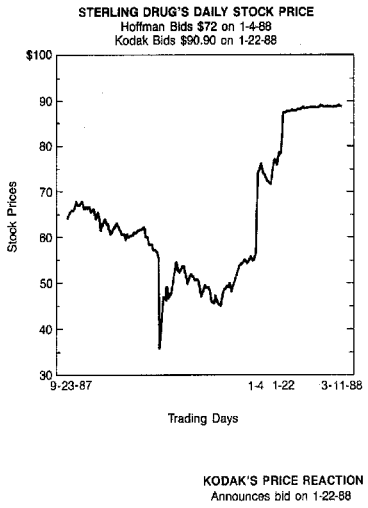
- **Greenmail**: The (managers of) target of a hostile takeover buy out the potential acquirer's existing stake, at a price much greater than the price paid by the raider, in return for the signing of a 'standstill' agreement.
- **Golden Parachutes**: Provisions in employment contracts, that allows for the payment of a lump-sum or cash flows over a period, if managers covered by these contracts lose their jobs in a takeover.
- **Poison Pills**: A security, the rights or cashflows on which are triggered by an outside event, generally a hostile takeover, is called a poison pill.
- **Shark Repellents**: Anti-takeover amendments are also aimed at dissuading hostile takeovers, but differ on one very important count. They require the assent of stockholders to be instituted.
- **Overpaying on takeovers**

Overpaying on takeovers

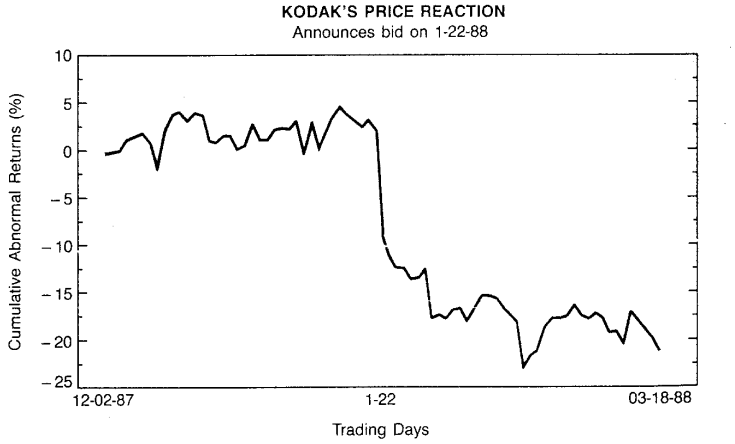
- The quickest and perhaps the most decisive way to impoverish stockholders is to overpay on a takeover.
- The stockholders in acquiring firms do not seem to share the enthusiasm of the managers in these firms. Stock prices of bidding firms decline on the takeover announcements a significant proportion of the time.
- Many mergers do not work, as evidenced by a number of measures.
  - The profitability of merged firms relative to their peer groups, does not increase significantly after mergers.
  - An even more damning indictment is that a large number of mergers are reversed within a few years, which is a clear admission that the acquisitions did not work.

A Case Study: Kodak - Sterling Drugs

- Eastman Kodak's Great Victory



KODAK'S PRICE REACTION
Announces bid on 1-22-88

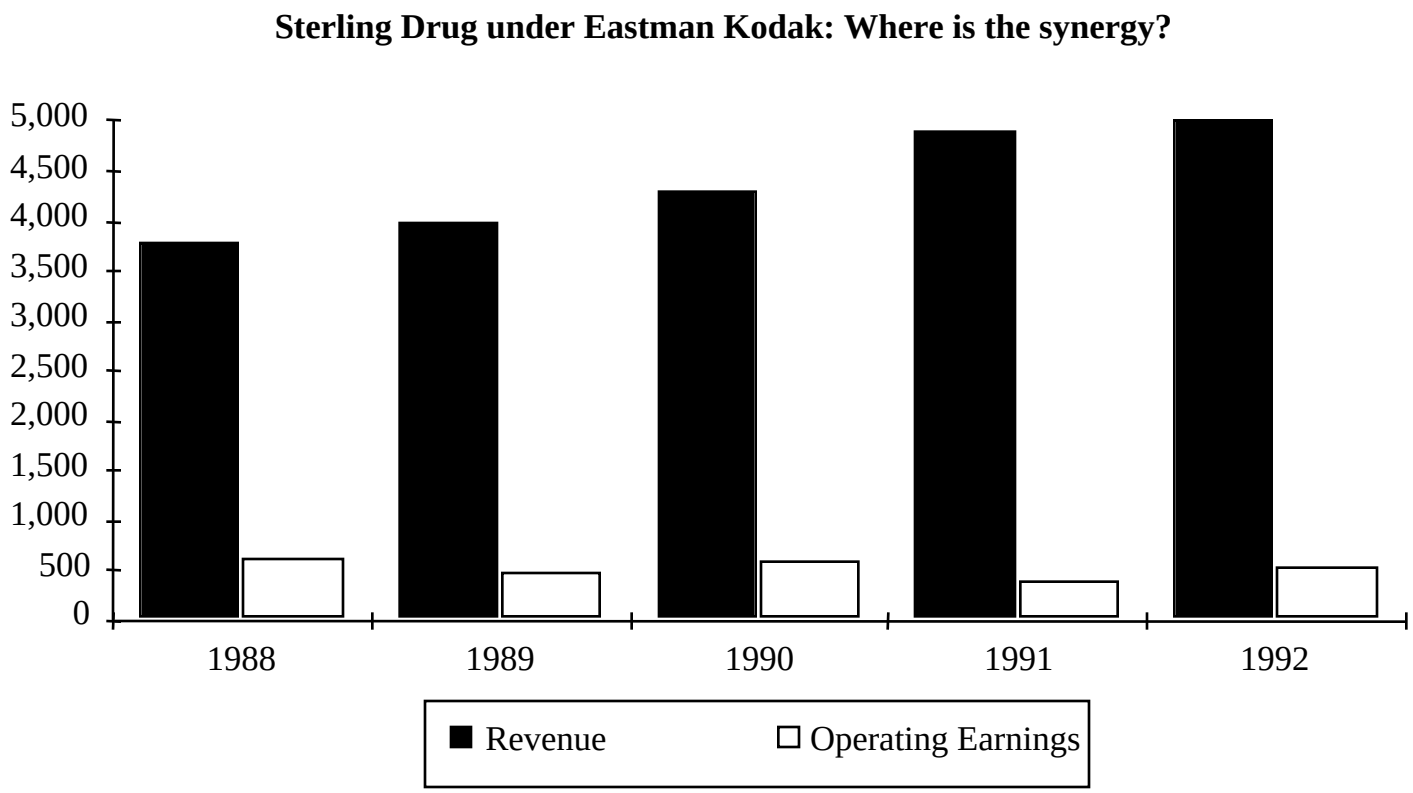


Kodak's market reaction indicates that investors expected no synergies:

Kodak's bid =	$5.1 billion
Sterling's market value 30 days prior to announcement =	3.0 billion
Premium bid	$2.1 billion
Decrease in Kodak's market value =	$2.2 billion

SOURCE: The Alcar Group, Inc.

Earnings and Revenues at Sterling Drugs



Kodak Says Drug Unit Is Not for Sale (NYTimes, 8/93)

- Eastman Kodak officials say they have no plans to sell Kodak's Sterling Winthrop drug unit.
- Louis Mattis, Chairman of Sterling Winthrop, dismissed the rumors as "massive speculation, which flies in the face of the stated intent of Kodak that it is committed to be in the health business."

But did they really mean it?

- Taking a stride out of the drug business, Eastman Kodak said that the Sanofi Group, a French pharmaceutical company, agreed to buy the prescription drug business of Sterling Winthrop for **$1.68 billion.**
  - Shares of Eastman Kodak rose 75 cents yesterday, closing at $47.50 on the New York Stock Exchange.
  - Samuel D. Isaly an analyst , said the announcement was “very good for Sanofi and very good for Kodak.”
  - “When the divestitures are complete, Kodak will be entirely focused on imaging,” said George M. C. Fisher, the company's chief executive.
- Smithkline Beecham agreed to buy Eastman Kodak’s Sterling Winthrop Inc. for **$2.9 billion.**
  - For Kodak, the sale almost completes a restructuring intended to refocus the company on its photography business.

Application Test: Who owns/runs your firm?

Looking at the top 15 stockholders in your firm, consider the following:

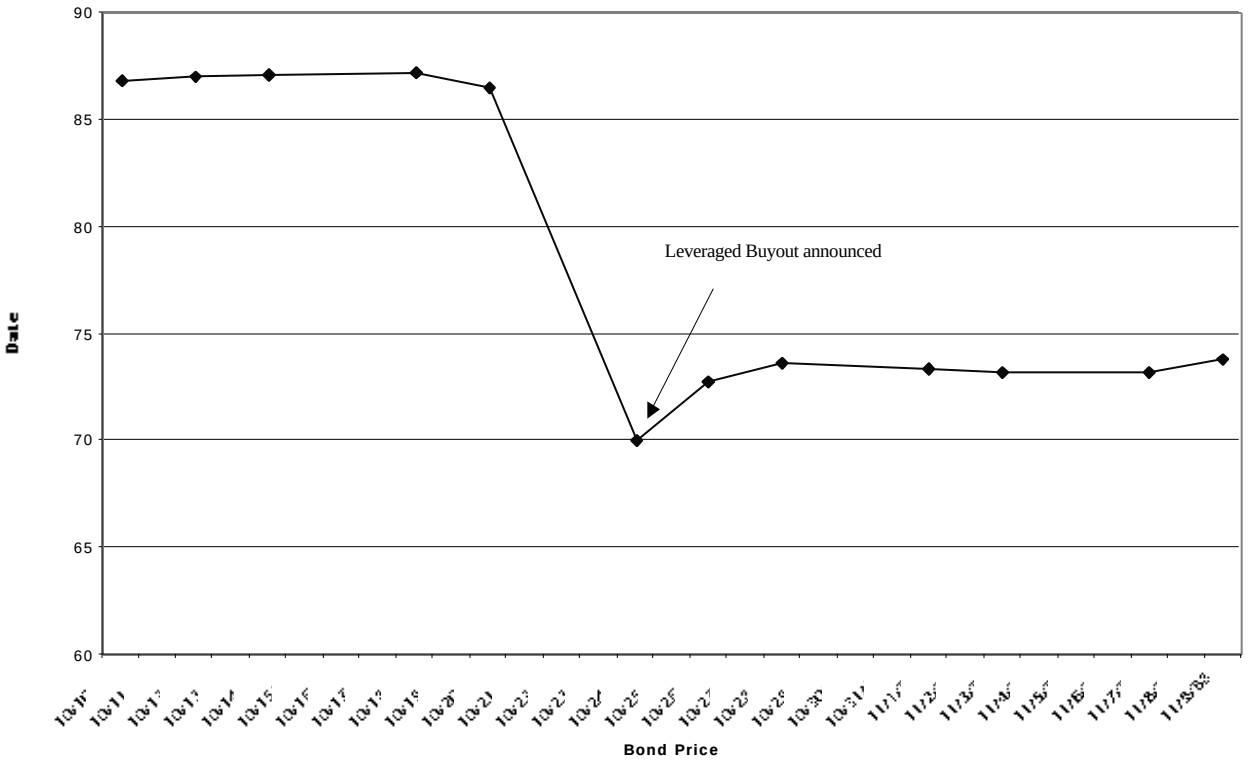
- How many of the top 15 investors are institutional investors?
- How many of the top 15 investors are individual investors?
- Are managers significant stockholders in the firm?

II. Stockholders' objectives vs. Bondholders' objectives

- In theory: there is no conflict of interests between stockholders and bondholders.
- In practice: Stockholders may maximize their wealth at the expense of bondholders.
  - Increasing dividends significantly: When firms pay cash out as dividends, lenders to the firm are hurt and stockholders may be helped. This is because the firm becomes riskier without the cash.
  - Taking riskier projects than those agreed to at the outset: Lenders base interest rates on their perceptions of how risky a firm's investments are. If stockholders then take on riskier investments, lenders will be hurt.
  - Borrowing more on the same assets: If lenders do not protect themselves, a firm can borrow more money and make all existing lenders worse off.

Unprotected Lenders? The Case of Nabisco

Figure 2.4: Nabisco Bond Price



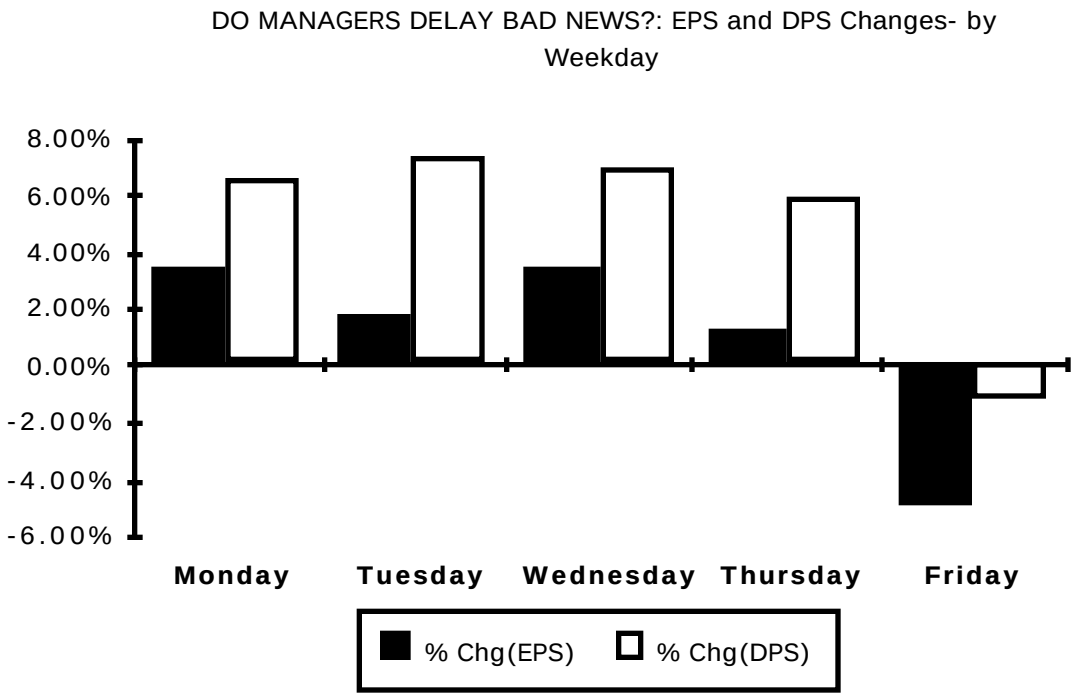
III. Firms and Financial Markets

- **In theory:** Financial markets are efficient. Managers convey information honestly and truthfully to financial markets, and financial markets make reasoned judgments of 'true value'. As a consequence-
  - A company that invests in good long term projects will be rewarded.
  - Short term accounting gimmicks will not lead to increases in market value.
  - Stock price performance is a good measure of management performance.
- **In practice**: There are some holes in the 'Efficient Markets' assumption.

Managers control the release of information to the general public

- There is evidence that
  - they suppress information, generally negative information
  - they delay the releasing of bad news
    - bad earnings reports
    - other news
  - they sometimes reveal fraudulent information

Evidence that managers delay bad news..



Even when information is revealed to financial markets, the market value that is set by demand and supply may contain errors.

- Prices are much more volatile than justified by the underlying fundamentals
  - Eg. Did the true value of equities really decline by 20% on October 19, 1987?
- Financial markets overreact to news, both good and bad
- Financial markets are short-sighted, and do not consider the long-term implications of actions taken by the firm
  - Eg. the focus on next quarter's earnings
- Financial markets are manipulated by insiders; Prices do not have any relationship to value.

Are Markets Short term?

Focusing on market prices will lead companies towards short term decisions at the expense of long term value.

- I agree with the statement
- I do not agree with this statement

Are Markets Short Sighted? Some evidence that they are not..

- There are hundreds of start-up and small firms, with no earnings expected in the near future, that raise money on financial markets
- If the evidence suggests anything, it is that markets do not value current earnings and cashflows enough and value future earnings and cashflows too much.
  - Low PE stocks are underpriced relative to high PE stocks
- The market response to research and development and investment expenditure is generally positive

Market Reaction to Investment Announcements

Type of Announcement	*Abnormal Returns on*	
	Announcement Day	*Announcement Month*
Joint Venture Formations	0.399%	1.412%
R&D Expenditures	0.251%	1.456%
Product Strategies	0.440%	-0.35%
Capital Expenditures	0.290%	1.499%
All Announcements	0.355%	0.984%

IV. Firms and Society

- **In theory**: There are no costs associated with the firm that cannot be traced to the firm and charged to it.
- **In practice**: Financial decisions can create social costs and benefits.
  - A social cost or benefit is a cost or benefit that accrues to society as a whole and NOT to the firm making the decision.
    - -environmental costs (pollution, health costs, etc..)
    - Quality of Life' costs (traffic, housing, safety, etc.)
  - Examples of social benefits include:
    - creating employment in areas with high unemployment
    - supporting development in inner cities
    - creating access to goods in areas where such access does not exist

Social Costs and Benefits are difficult to quantify because ..

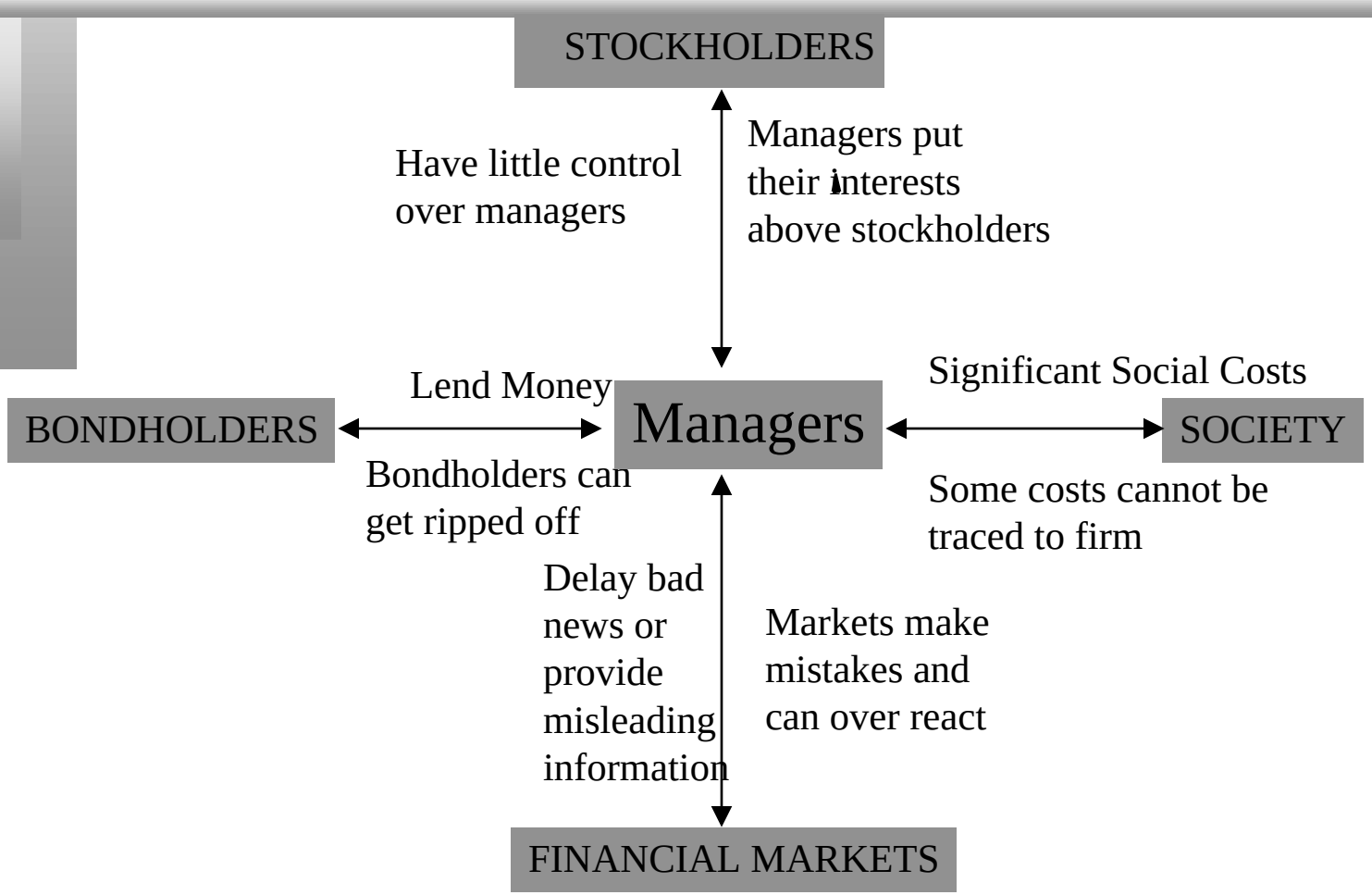
- they might not be known at the time of the decision (Example: Manville and asbestos)
- they are 'person-specific' (different decision makers weight them differently)
- they can be paralyzing if carried to extremes

A Hypothetical Example

Assume that you work for The Home Depot and that you have an opportunity to open a store in an inner-city neighborhood. The store is expected to lose about $100,000 a year, but it will create much-needed employment in the area, and may help revitalize it.

- Questions:
  - Would you open the store?
    - Yes
    - No
  - If yes, would you tell your stockholders and let them vote on the issue?
    - Yes
    - No
  - If no, how would you respond to a stockholder query on why you were not living up to your social responsibilities?

So this is what can go wrong...



Traditional corporate financial theory breaks down when ...

- The interests/objectives of the decision makers in the firm conflict with the interests of stockholders.
- Bondholders (Lenders) are not protected against expropriation by stockholders.
- Financial markets do not operate efficiently, and stock prices do not reflect the underlying value of the firm.
- Significant social costs can be created as a by-product of stock price maximization.

When traditional corporate financial theory breaks down, the solution is:

- To choose a different mechanism for corporate governance
- To choose a different objective:
- To maximize stock price, but reduce the potential for conflict and breakdown:
  - Making managers (decision makers) and employees into stockholders
  - By providing information honestly and promptly to financial markets

An Alternative Corporate Governance System

- Germany and Japan developed a different mechanism for corporate governance, based upon corporate cross holdings.
  - In Germany, the banks form the core of this system.
  - In Japan, it is the keiretsus
  - Other Asian countries have modeled their system after Japan, with family companies forming the core of the new corporate families
- At their best, the most efficient firms in the group work at bringing the less efficient firms up to par. They provide a corporate welfare system that makes for a more stable corporate structure
- At their worst, the least efficient and poorly run firms in the group pull down the most efficient and best run firms down. The nature of the cross holdings makes its very difficult for outsiders (including investors in these firms) to figure out how well or badly the group is doing.

Choose a Different Objective Function

- Firms can always focus on a different objective function. Examples would include
  - maximizing earnings
  - maximizing revenues
  - maximizing firm size
  - maximizing market share
  - maximizing EVA
- The key thing to remember is that these are intermediate objective functions.
  - To the degree that they are correlated with the long term health and value of the company, they work well.
  - To the degree that they do not, the firm can end up with a disaster

Maximize Stock Price, subject to ..

- The strength of the stock price maximization objective function is its internal self correction mechanism. Excesses on any of the linkages lead, if unregulated, to counter actions which reduce or eliminate these excesses
- In the context of our discussion,
  - managers taking advantage of stockholders has lead to a much more active market for corporate control.
  - stockholders taking advantage of bondholders has lead to bondholders protecting themselves at the time of the issue.
  - firms revealing incorrect or delayed information to markets has lead to markets becoming more “skeptical” and “punitive”
  - firms creating social costs has lead to more regulations, as well as investor and customer backlashes.

The Stockholder Backlash

- Institutional investors such as CalPERS and the Lens Funds have become much more active in monitoring companies that they invest in and demanding changes in the way in which business is done
- Individuals like Michael Price specialize in taking large positions in companies which they feel need to change their ways (Chase, Dow Jones, Readers' Digest) and push for change
- At annual meetings, stockholders have taken to expressing their displeasure with incumbent management by voting against their compensation contracts or their board of directors

The Hostile Acquisition Threat

- The typical target firm in a hostile takeover has
  - a return on equity almost 5% lower than its peer group
  - had a stock that has significantly under performed the peer group over the previous 2 years
  - has managers who hold little or no stock in the firm
- In other words, the best defense against a hostile takeover is to run your firm well and earn good returns for your stockholders
- Conversely, when you do not allow hostile takeovers, this is the firm that you are most likely protecting (and not a well run or well managed firm)

The Bondholders' Defense Against Stockholder Excesses

- More restrictive covenants on investment, financing and dividend policy have been incorporated into both private lending agreements and into bond issues, to prevent future "Nabiscos".
- New types of bonds have been created to explicitly protect bondholders against sudden increases in leverage or other actions that increase lender risk substantially. Two examples of such bonds
  - Puttable Bonds, where the bondholder can put the bond back to the firm and get face value, if the firm takes actions that hurt bondholders
  - Ratings Sensitive Notes, where the interest rate on the notes adjusts to that appropriate for the rating of the firm
- More hybrid bonds (with an equity component, usually in the form of a conversion option or warrant) have been used. This allows bondholders to become equity investors, if they feel it is in their best interests to do so.

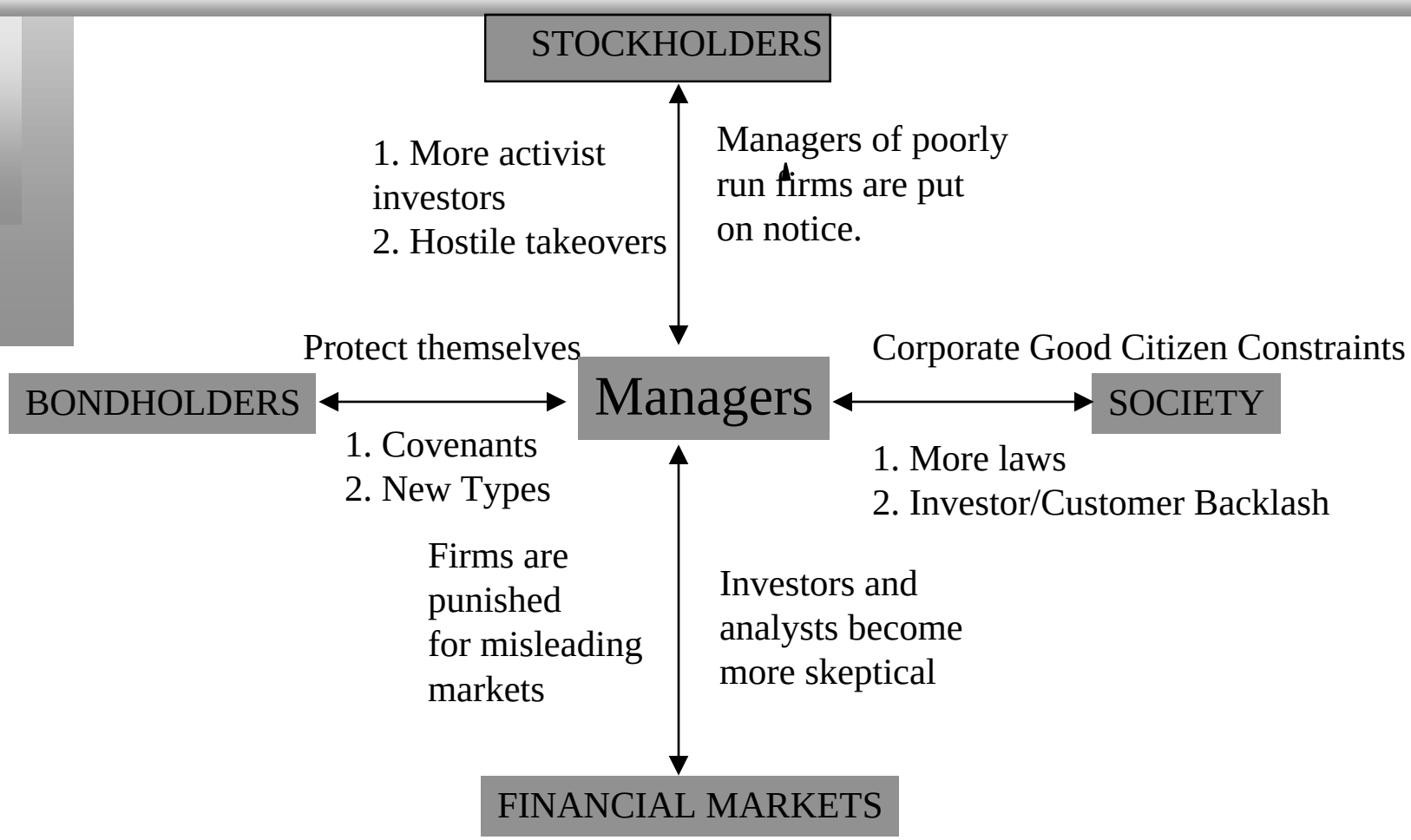
The Financial Market Response

- While analysts are more likely still to issue buy rather than sell recommendations, the payoff to uncovering negative news about a firm is large enough that such news is eagerly sought and quickly revealed (at least to a limited group of investors)
- As information sources to the average investor proliferate, it is becoming much more difficult for firms to control when and how information gets out to markets.
- As option trading has become more common, it has become much easier to trade on bad news. In the process, it is revealed to the rest of the market (See Scholastic)
- When firms mislead markets, the punishment is not only quick but it is savage.

The Societal Response

- If firms consistently flout societal norms and create large social costs, the governmental response (especially in a democracy) is for laws and regulations to be passed against such behavior.
  - e.g.: Laws against using underage labor in the United States
- For firms catering to a more socially conscious clientele, the failure to meet societal norms (even if it is legal) can lead to loss of business and value
  - e.g. Specialty retailers being criticized for using under age labor in other countries (where it might be legal)
- Finally, investors may choose not to invest in stocks of firms that they view as social outcasts.
  - e.g.. Tobacco firms and the growth of “socially responsible” funds (Calvert..)

The Counter Reaction



So what do you think?

- At this point in time, the following statement best describes where I stand in terms of the right objective function for decision making in a business
- Maximize stock price or stockholder wealth, with no constraints
- Maximize stock price or stockholder wealth, with constraints on being a good social citizen.
- Maximize profits or profitability
- Maximize market share
- Maximize Revenues
- Maximize social good
- None of the above

The Modified Objective Function

- For publicly traded firms in reasonably efficient markets, where bondholders (lenders) are protected:
  - Maximize Stock Price: This will also maximize firm value
- For publicly traded firms in inefficient markets, where bondholders are protected:
  - Maximize stockholder wealth: This will also maximize firm value, but might not maximize the stock price
- For publicly traded firms in inefficient markets, where bondholders are not fully protected
  - Maximize firm value, though stockholder wealth and stock prices may not be maximized at the same point.
- For private firms, maximize stockholder wealth (if lenders are protected) or firm value (if they are not)

Option Pricing Theory and Applications

Aswath Damodaran

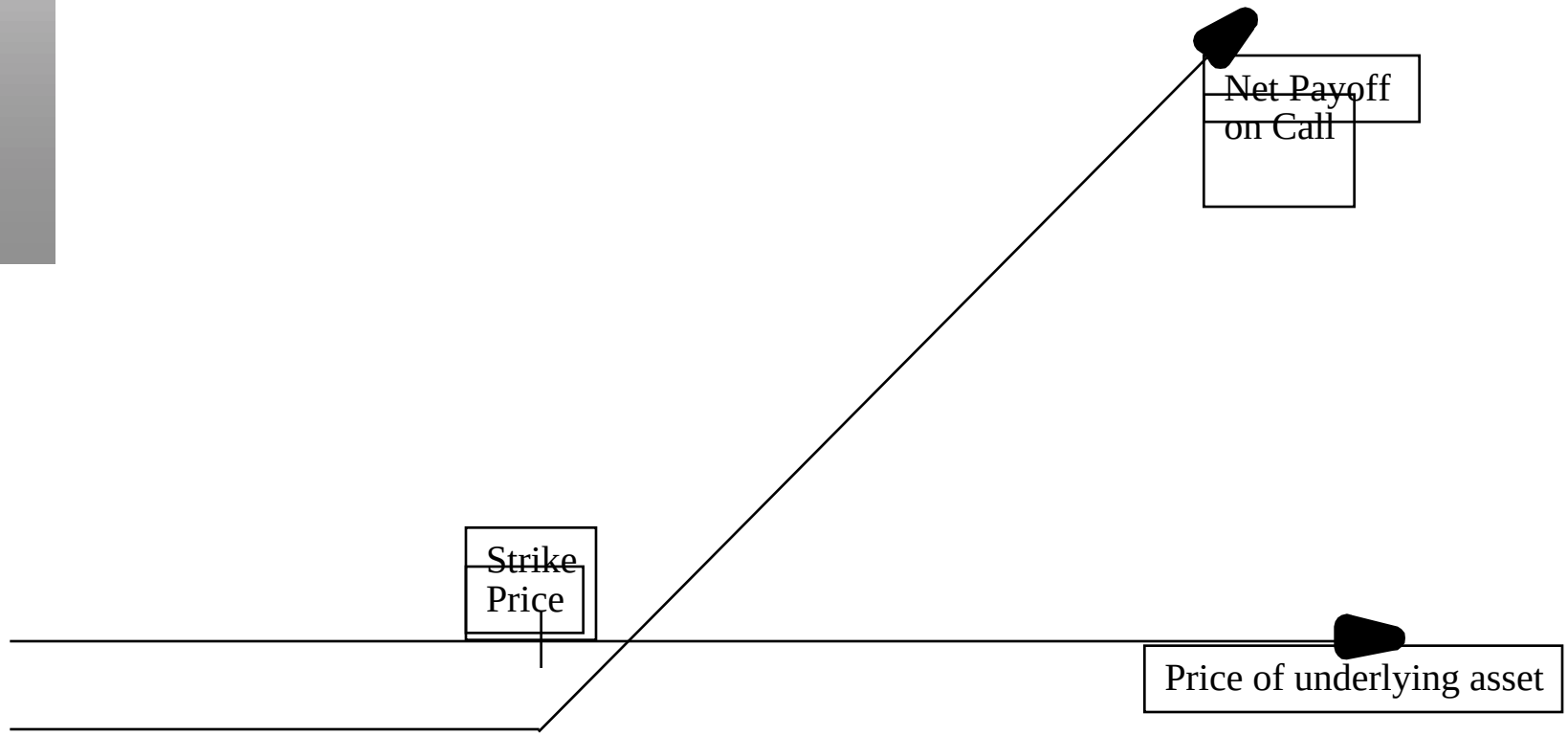
What is an option?

- 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.
- Since it is a right and **not an obligation**, the holder can choose not to exercise the right and allow the option to expire.
- There are two types of options - **call** options (right to buy) and **put** options (right to sell).

Call Options

- A call option gives the buyer of the option the right to buy the underlying asset at a fixed price (strike price or K) at any time prior to the expiration date of the option. The buyer pays a price for this right.
- At expiration,
  - If the value of the underlying asset (S) > Strike Price(K)
    - Buyer makes the difference: S - K
  - If the value of the underlying asset (S) < Strike Price (K)
    - Buyer does not exercise
- More generally,
  - the value of a call increases as the value of the underlying asset increases
  - the value of a call decreases as the value of the underlying asset decreases

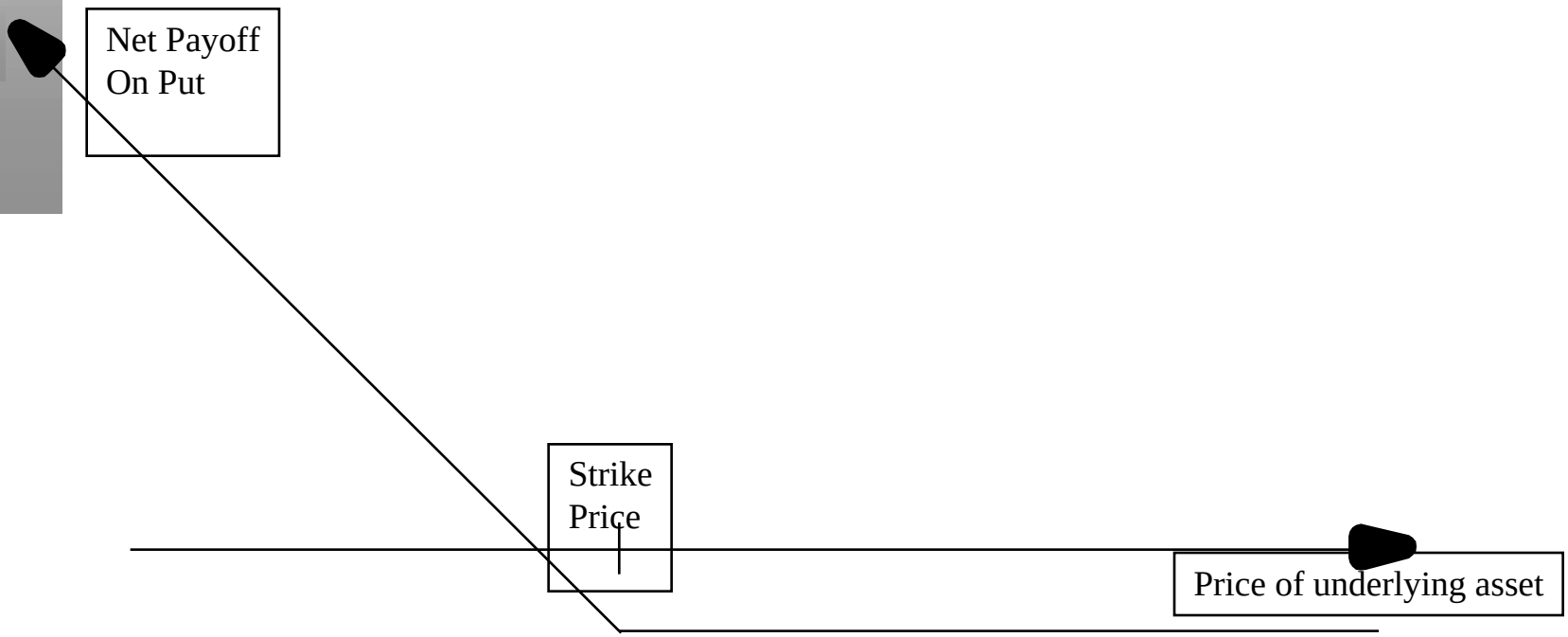
Payoff Diagram on a Call



Put Options

- A put option gives the buyer of the option the right to sell the underlying asset at a fixed price at any time prior to the expiration date of the option. The buyer pays a price for this right.
- At expiration,
  - If the value of the underlying asset (S) < Strike Price(K)
    - Buyer makes the difference: K-S
  - If the value of the underlying asset (S) > Strike Price (K)
    - Buyer does not exercise
- More generally,
  - the value of a put decreases as the value of the underlying asset increases
  - the value of a put increases as the value of the underlying asset decreases

Payoff Diagram on Put Option



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.

American versus European options: Variables relating to early exercise

- An American option **can be exercised at any time prior** to its expiration, while a European option can be exercised only at expiration.
  - The possibility of early exercise makes **American options more valuable** than otherwise similar European options.
  - However, in most cases, the **time premium** associated with the remaining life of an option makes **early exercise sub-optimal**.
- While early exercise is generally not optimal, there are two exceptions:
  - One is where the underlying asset **pays large dividends**, thus reducing the value of the asset, and of call options on it. In these cases, call options may be exercised just before an ex-dividend date, if the time premium on the options is less than the expected decline in asset value.
  - The other is when an investor holds both the underlying asset and deep in-the-money puts on that asset, at a time when **interest rates are high**. The time premium on the put may be less than the potential gain from exercising the put early and earning interest on the exercise price.

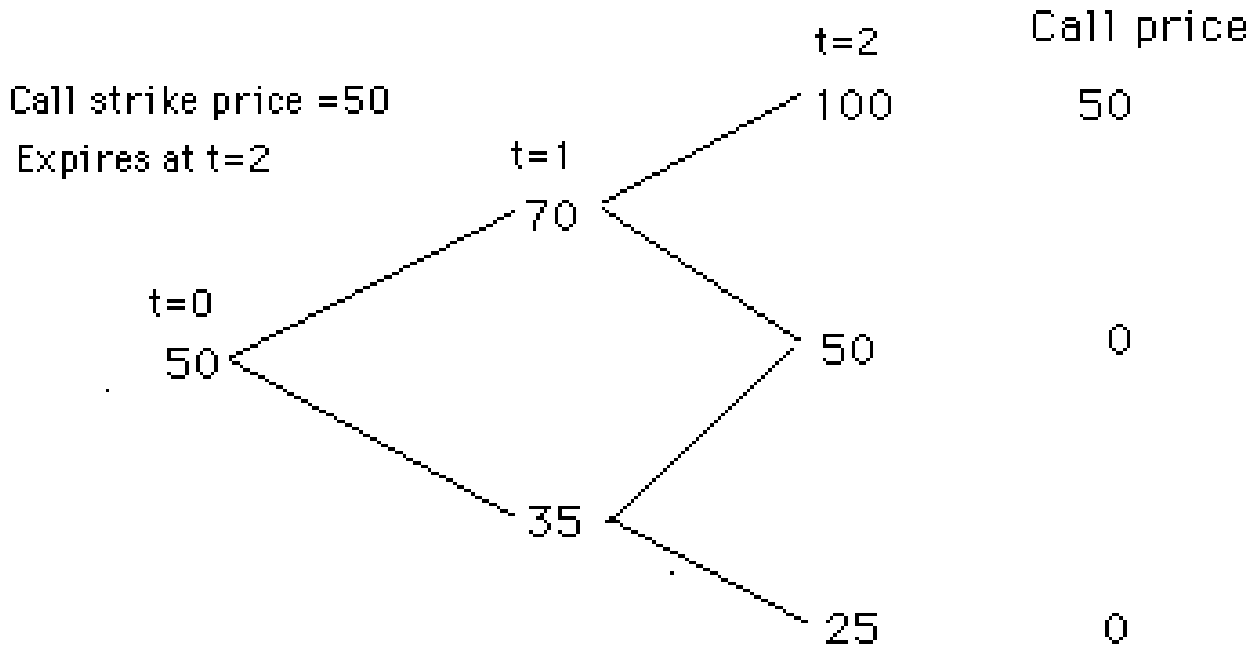
A Summary of the Determinants of Option Value

Factor	*Call Value*	*Put Value*
Increase in Stock Price	Increases	Decreases
Increase in Strike Price	Decreases	Increases
Increase in variance of underlying asset	Increases	Increases
Increase in time to expiration	Increases	Increases
Increase in interest rates	Increases	Decreases
Increase in dividends paid	Decreases	Increases

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.

The Black-Scholes Model

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

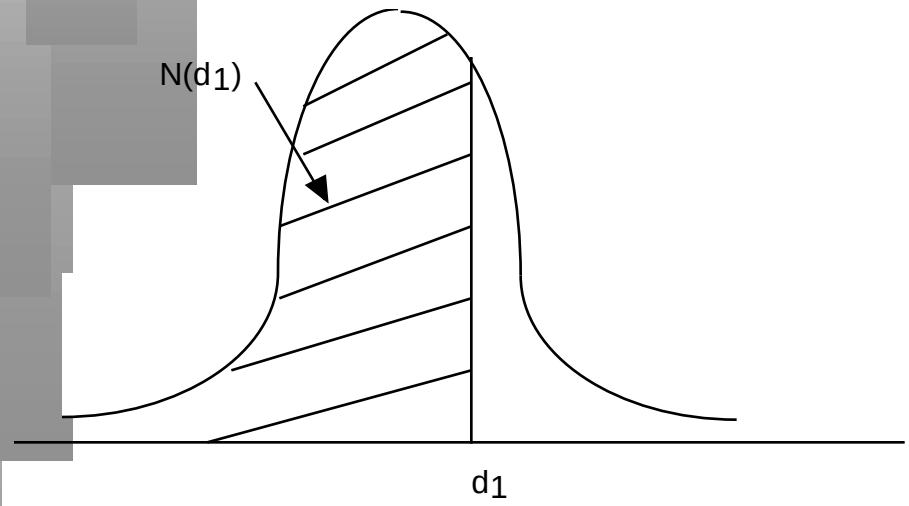
where,

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

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

- 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:

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

Problems with Real Option Pricing Models

1. The underlying asset may not be traded, which makes it difficult to estimate value and variance for the underlying asset.
2. The price of the asset may not follow a continuous process, which makes it difficult to apply option pricing models (like the Black Scholes) that use this assumption.
3. The variance may not be known and may change over the life of the option, which can make the option valuation more complex.
4. Exercise may not be instantaneous, which will affect the value of the option.
5. Some real options are complex and their exercise creates other options (compound) or involve learning (learning options)

Option Pricing Applications in Investment/Strategic Analysis

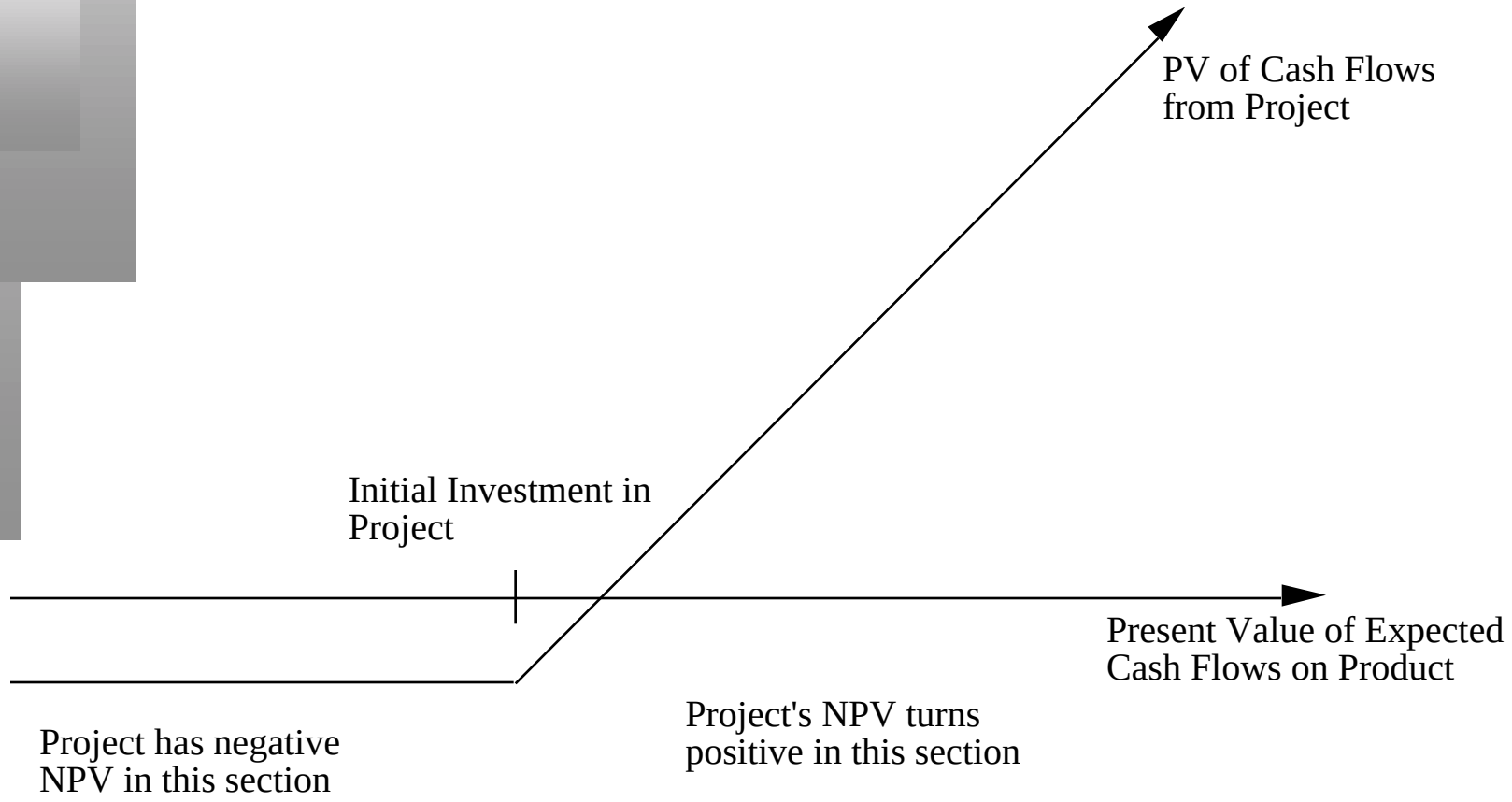
Options in Projects/Investments/Acquisitions

- 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



Insights for Investment Analyses

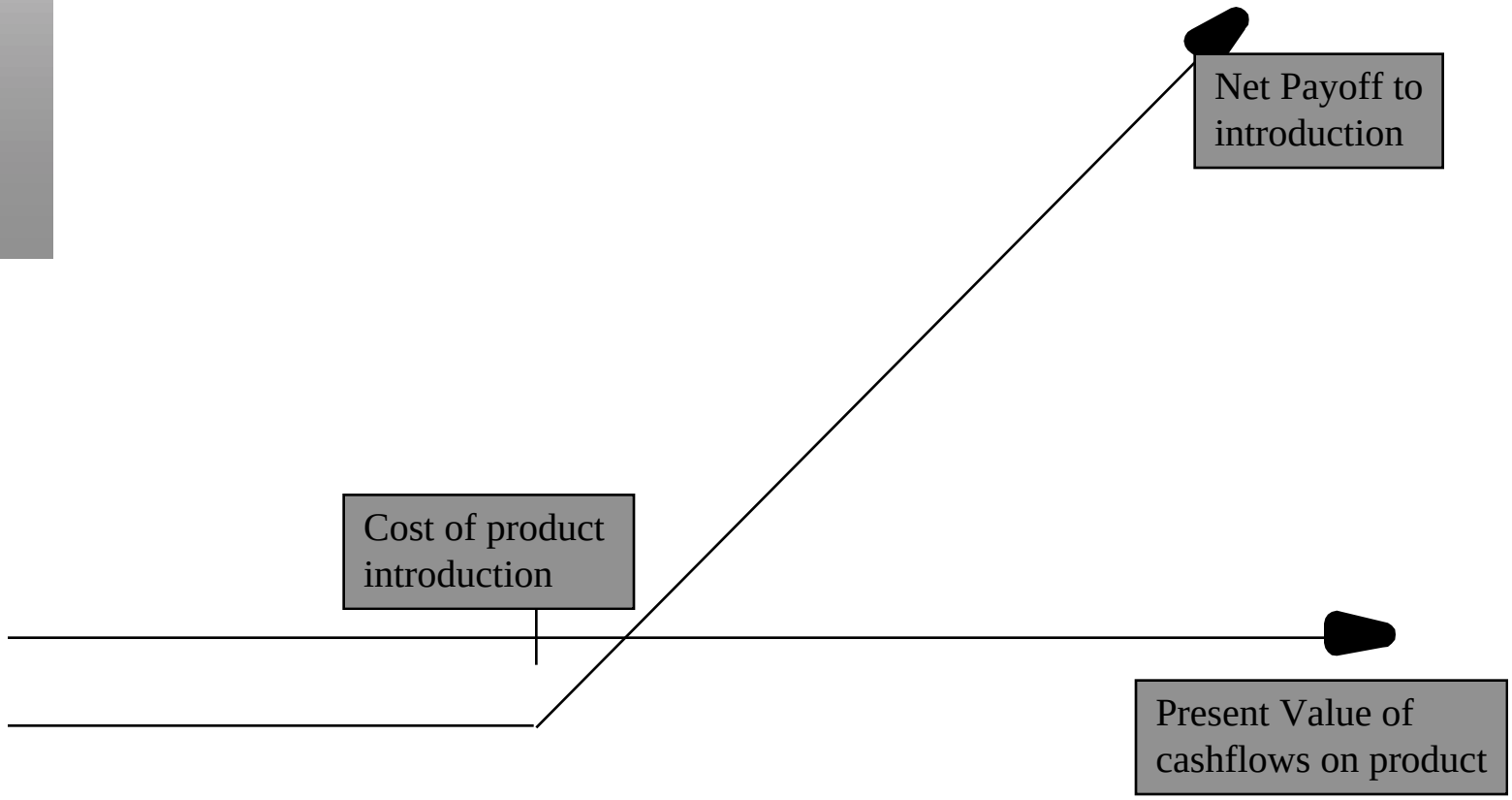
- Having the exclusive rights to a product or project is valuable, even if the product or project is not viable today.
- The value of these rights increases with the volatility of the underlying business.
- The cost of acquiring these rights (by buying them or spending money on development, for instance) has to be weighed off against these benefits.

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

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 riskless rate of 6.7% was used:

Present Value of License Fees = $ 50 million $(1 - (1.067)^{-12})/.067$

= $ 403.56 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

= $ 403.56 million + $ 907 million + $ 318.30 million

= $1628.86 million

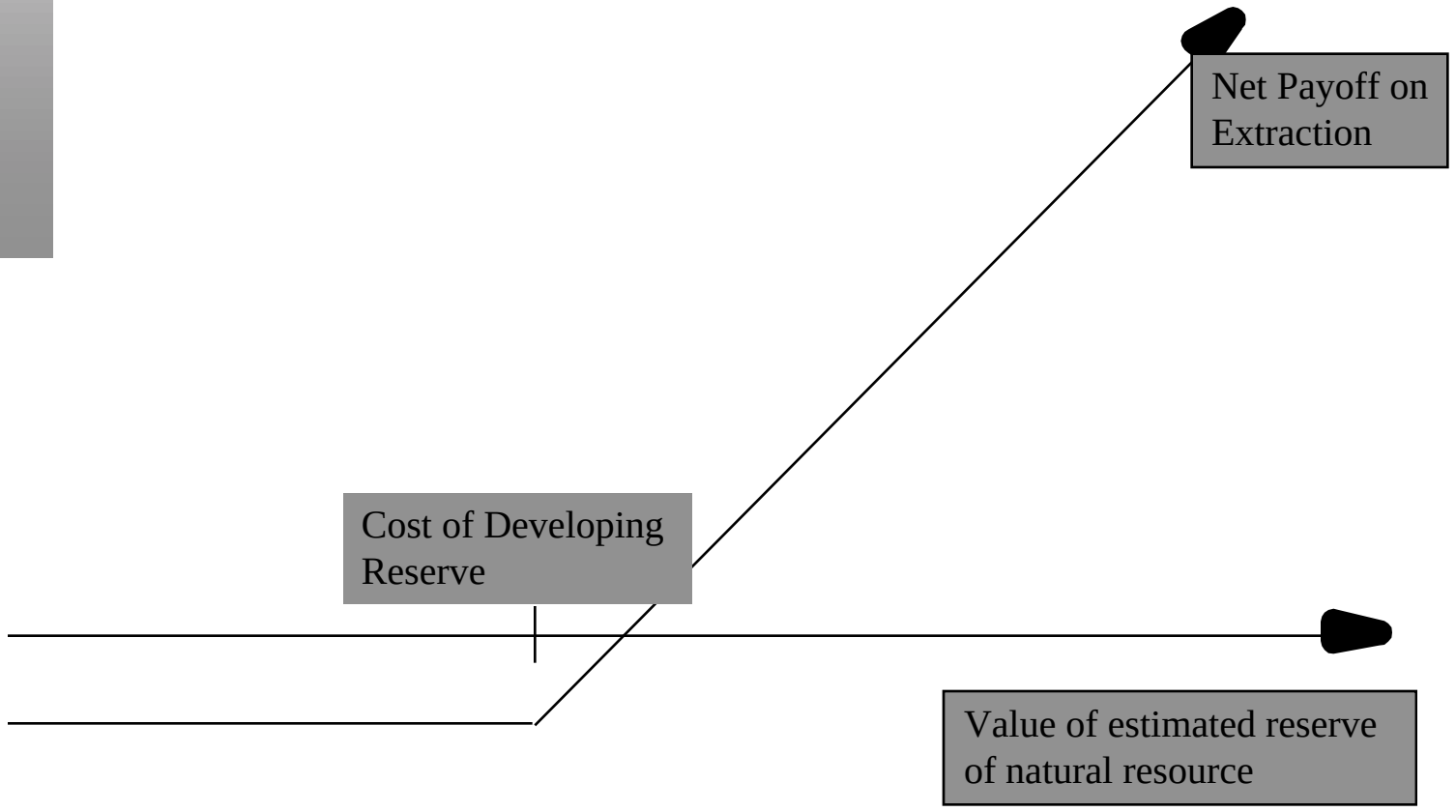
- Since Biogen had no debt outstanding, this value was divided by the number of shares outstanding (35.50 million) to arrive at a value per share:

Value per share = $ 1,628.86 million / 35.5 = $ 45.88

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.

Inputs to the Model

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

Valuing Gulf Oil

- Gulf Oil was the target of a takeover in early 1984 at $70 per share (It had 165.30 million shares outstanding, and total debt of $9.9 billion).
- It had estimated reserves of 3038 million barrels of oil and the average cost of developing these reserves was estimated to be $10 a barrel in present value dollars (The development lag is approximately two years).
- The average relinquishment life of the reserves is 12 years.
- The price of oil was $22.38 per barrel, and the production cost, taxes and royalties were estimated at $7 per barrel.
- The bond rate at the time of the analysis was 9.00%.
- Gulf was expected to have net production revenues each year of approximately 5% of the value of the developed reserves. The variance in oil prices is 0.03.

Valuing Undeveloped Reserves

- 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

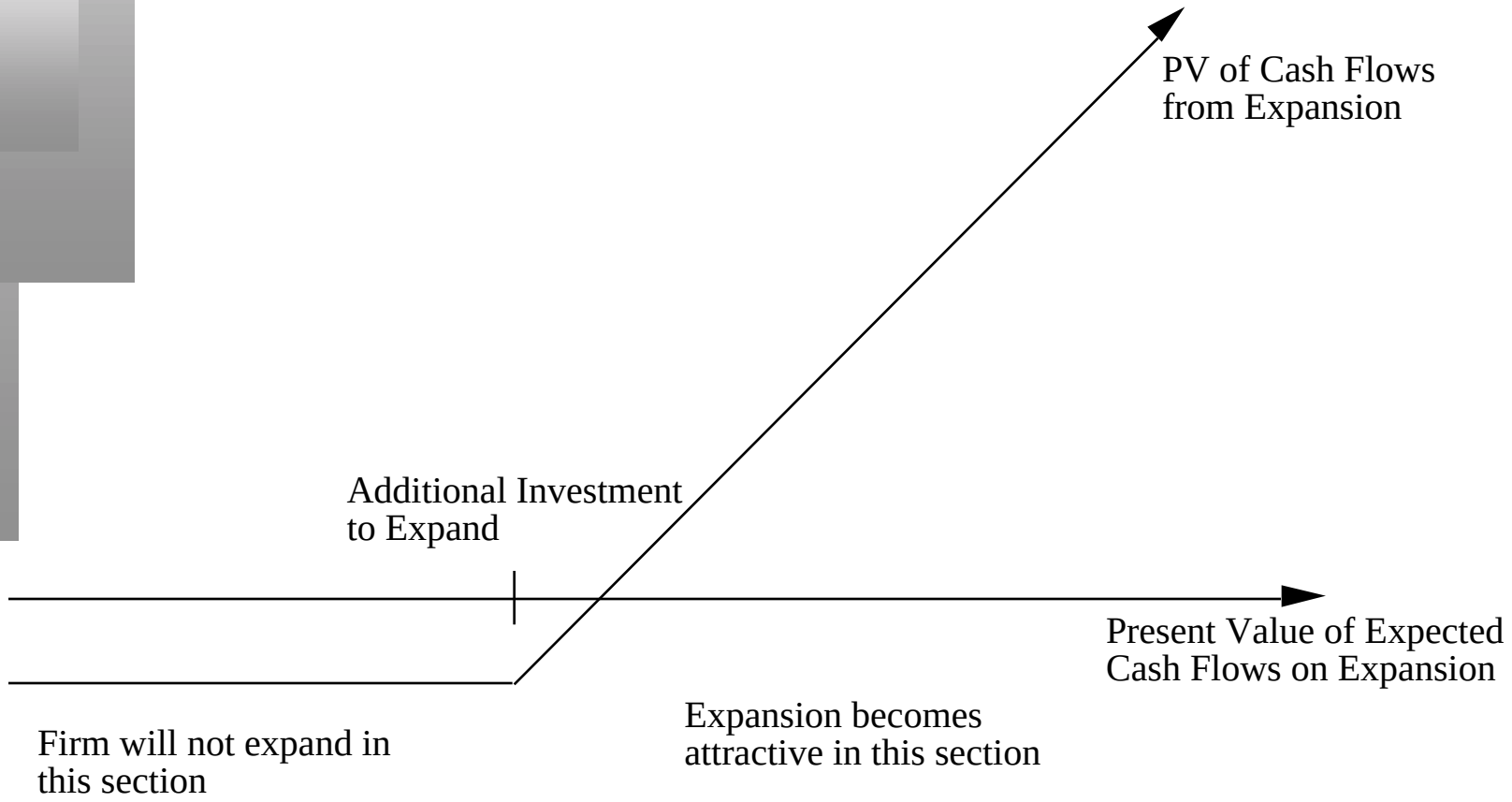
- In addition, Gulf Oil had free cashflows to the firm from its oil and gas production of $915 million from already developed reserves and these cashflows are likely to continue for ten years (the remaining lifetime of developed reserves).
- The present value of these developed reserves, discounted at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

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

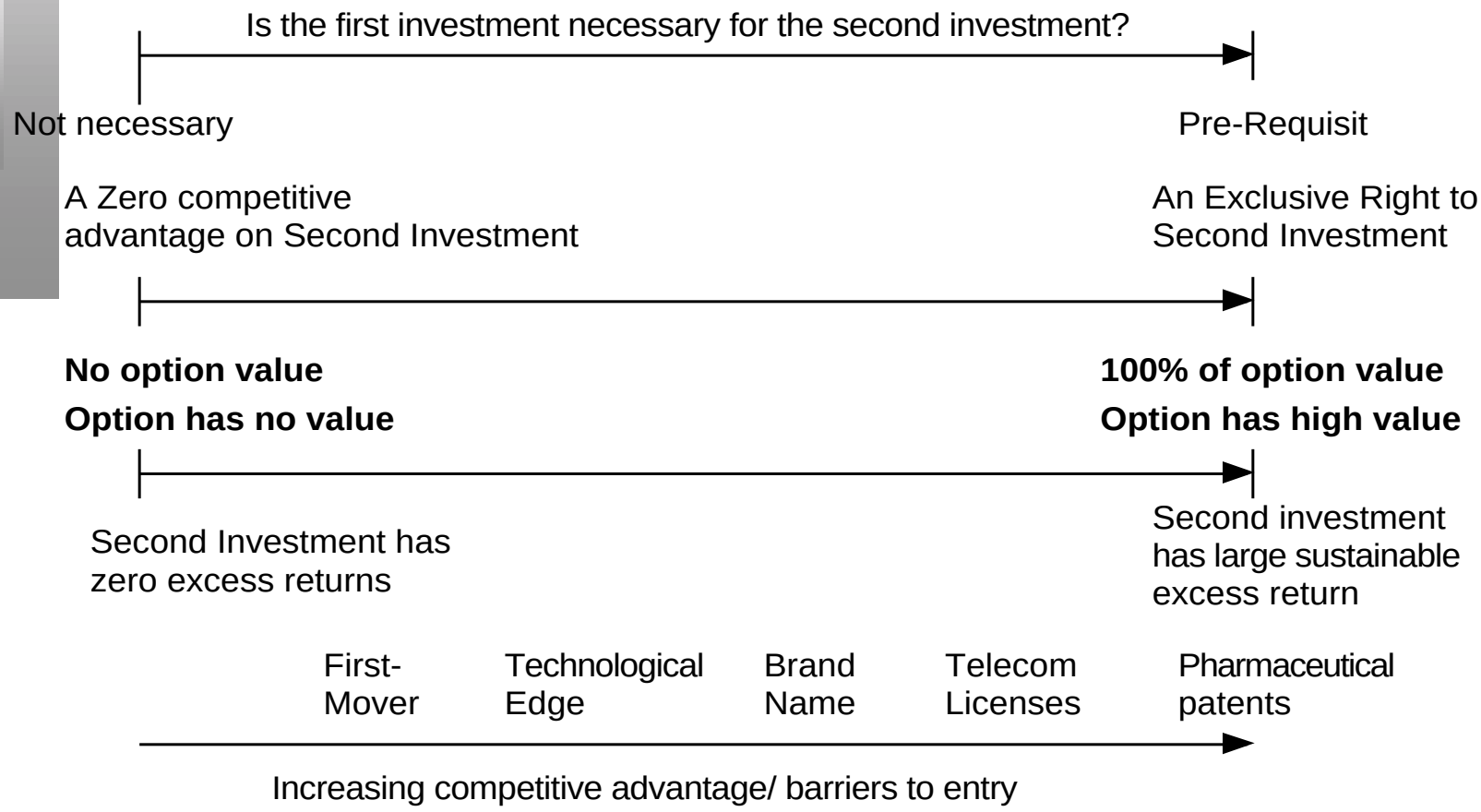
Considering the Project with Expansion Option

- 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**

The Link to Strategy

- In many investments, especially acquisitions, strategic options or considerations are used to take investments that otherwise do not meet financial standards.
- These strategic options or considerations are usually related to the expansion option described here. The key differences are as follows:
  - Unlike “strategic options” which are usually qualitative and not valued, expansion options can be assigned a quantitative value and can be brought into the investment analysis.
  - Not all “strategic considerations” have option value. For an expansion option to have value, the first investment (acquisition) must be necessary for the later expansion (investment). If it is not, there is no option value that can be added on to the first investment.

The Exclusivity Requirement in Option Value



The Determinants of Real Option Value

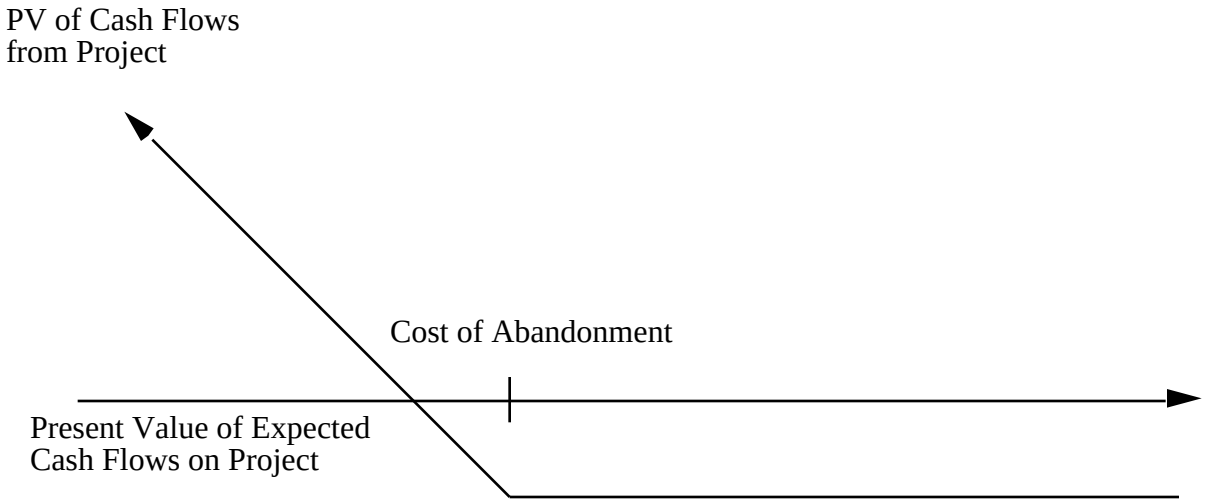
- Does taking on the first investment/expenditure provide the firm with an exclusive advantage on taking on the second investment?
  - If yes, the firm is entitled to consider 100% of the value of the real option
  - If no, the firm is entitled to only a portion of the value of the real option, with the proportion determined by the degree of exclusivity provided by the first investment?
- Is there a possibility of earning significant and sustainable excess returns on the second investment?
  - If yes, the real option will have significant value
  - If no, the real option has no value

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 $= Ke^{-rt} (1-N(d2)) - Se^{-yt} (1-N(d1))$

  $= 400 (\exp^{(-0.06)(5)} (1-0.7882) - 480 \exp^{(-0.033)(5)} (1-0.4624)$

  = $ 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

- Having a option to abandon a project can make otherwise unacceptable projects acceptable.
- Actions that increase the value of the abandonment option include
  - 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
  - Finding partners in the investment, who are willing to acquire your investment in the future
- 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.

Determinants of Value of Flexibility Option

- *Quality of the Firm's Projects*: It is the excess return that the firm earns on its projects that provides the value to flexibility. Other things remaining equal, firms operating in businesses where projects earn substantially higher returns than their hurdle rates should value flexibility more than those that operate in stable businesses where excess returns are small.
- *Uncertainty about Future Projects*: If flexibility is viewed as an option, its value will increase when there is greater uncertainty about future projects; thus, firms with predictable capital expenditures and excess returns should value flexibility less than those with high variability in both of those variables.

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 can raise L from internal cash flows and its normal access to capital markets. (Normal access refers to the external financing that is used by a firm each year)
- 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:

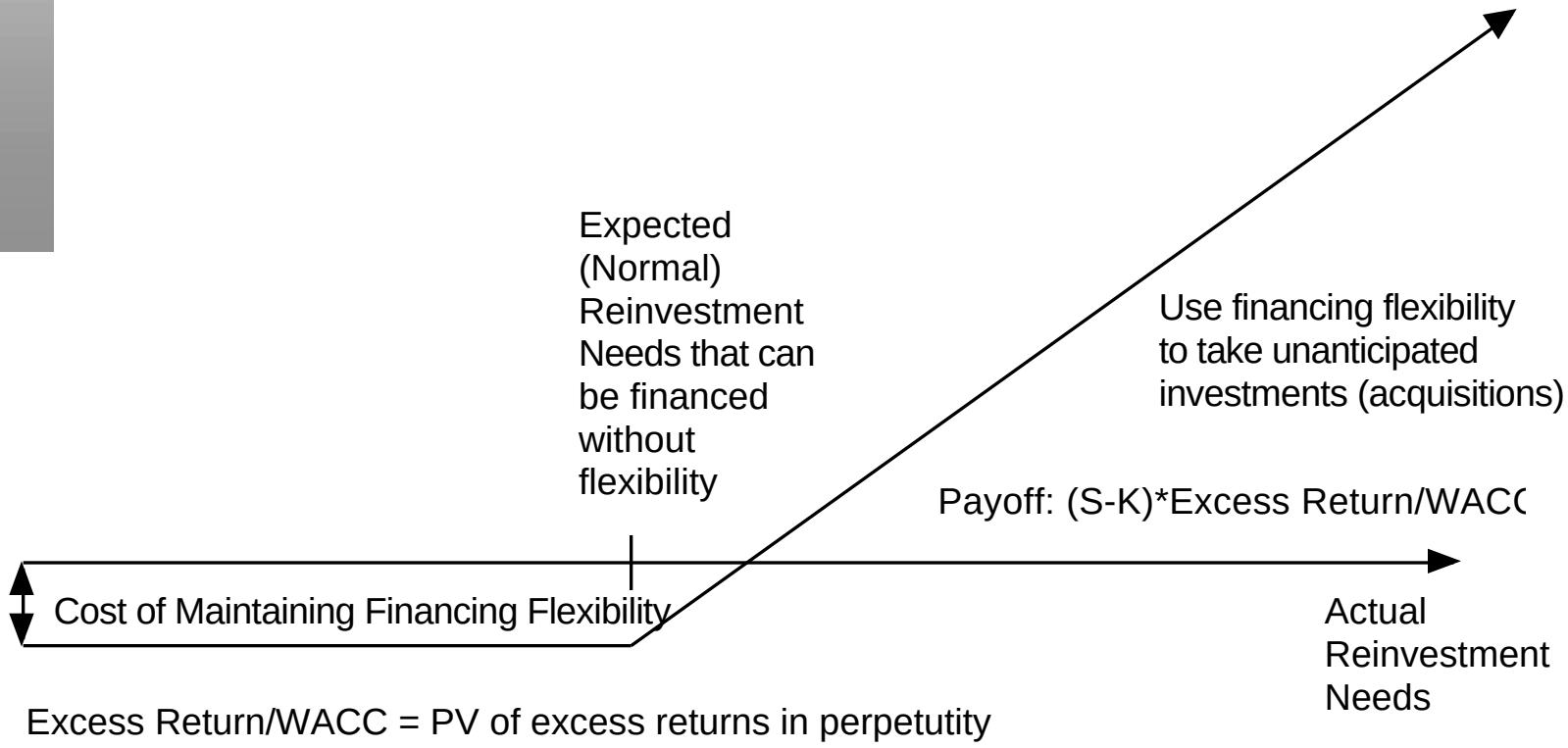
  Value of investment = (ROC - Cost of capital)/ Cost of capital

- 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



Excess Return/WACC = PV of excess returns in perpetutity

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

- One way to think about firms that preserve debt capacity because they want flexibility is that they are foregoing use this debt to invest in existing projects at existing excess returns because they think that they might have an increase in either investment needs or excess returns.
- To value flexibility as a percent of firm value (as an annual cost), these would be the inputs to the model:
  - S = Expected Reinvestment needs as percent of Firm Value
  - K = Expected Reinvestment needs that can be financed without financing flexibility
  - t = 1 year

  σ^2 = Variance in ln(Net Capital Expenditures)
- Once this option has been valued, estimate the present value of the excess returns that will be gained by taking the additional investments by multiplying by (ROC - WACC)/WACC

The Inputs for Disney

- Expected reinvestment needs as a percent of firm value:
  - Over the last 5 years, reinvestment (net cap ex, acquisitions and changes in working capital) has been approximately 5.3% of firm value
  - I am assuming that this is the expected reinvestment need; the variance in ln(reinvestment) over the last 5 years is 0.375
- Reinvestment needs that can be financed without flexibility.
  - We looked at *internal funds*, after debt payments but before reinvestment needs, as a percent of firm value over the last 5 years. (Internal funds = (Net Income + Depreciation)/Market Value of the Firm)
  - We looked at *net debt financing* each period, as a percent of firm value (as a measure of access to external financing each year). (New Debt - Debt Repaid)/Market Value of Firm)
  - Reinvestment needs that can be financed without flexibility = (Net Income + Depreciation + Net Debt Issued)/Market Value of Firm
  - This number has averaged 4.8%, over the last 5 years

Valuing Flexibility at Disney

The value of flexibility as a percentage of firm value can be estimated as follows:

- S = 5.3%
- K = 4.8%
- t = 1 year
- σ^2 = 0.375 (Variance in ln(Reinvestment Needs/Firm Value))

The value of an option with these characteristics is 1.6092%

- Disney earns 18.69% on its projects has a cost of capital of 12.22%. *The excess return (annually) is 6.47%.*

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

- Capacity to raise funds to meet financing needs: 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,

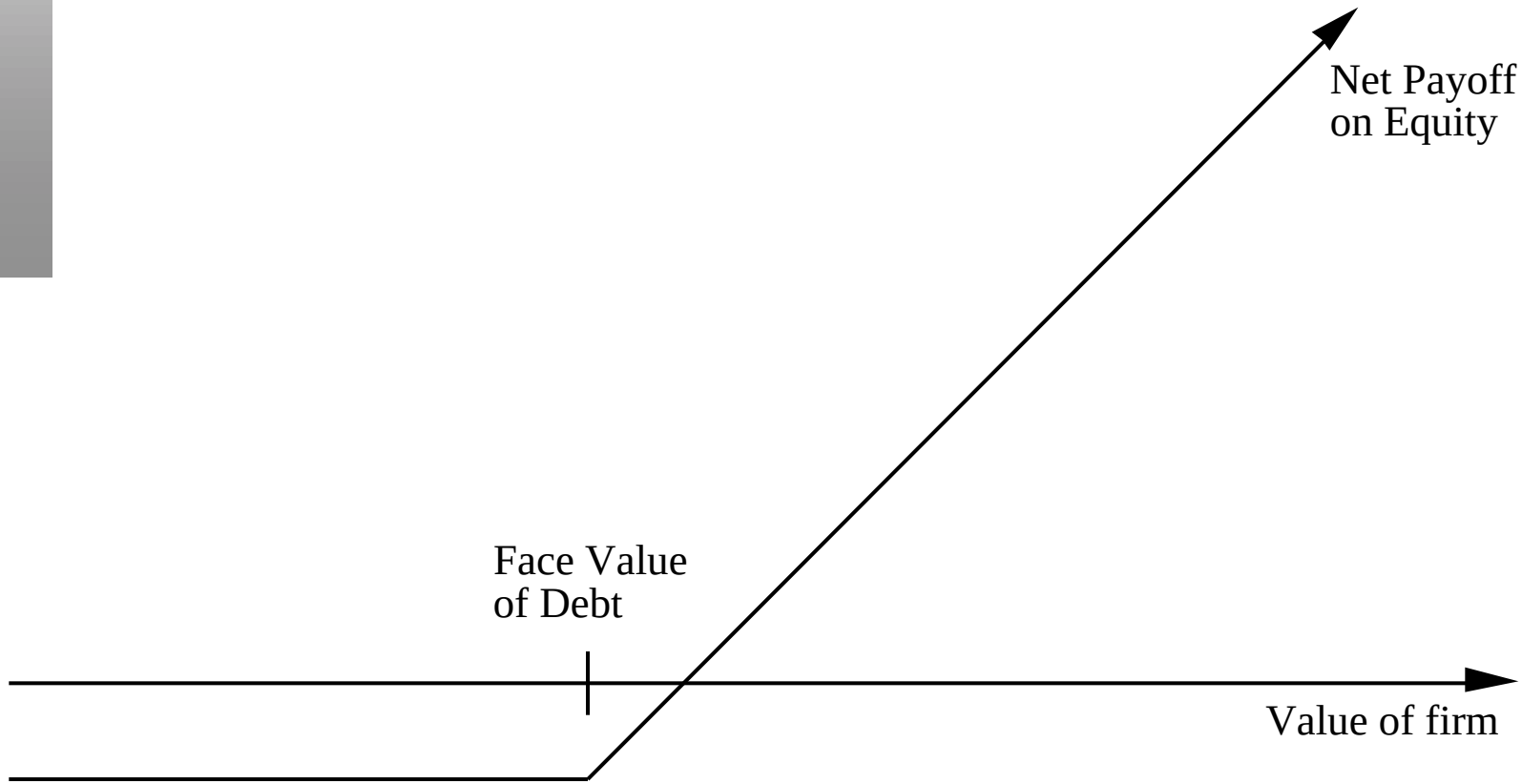
V = Value of the firm

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%

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

Illustration : Value of a troubled firm

- Assume now that, in the previous example, the value of the firm were reduced to $ 50 million while keeping the face value of the debt at $80 million.
- This firm could be viewed as troubled, since it owes (at least in face value terms) more than it owns.
- The equity in the firm will still have value, however.

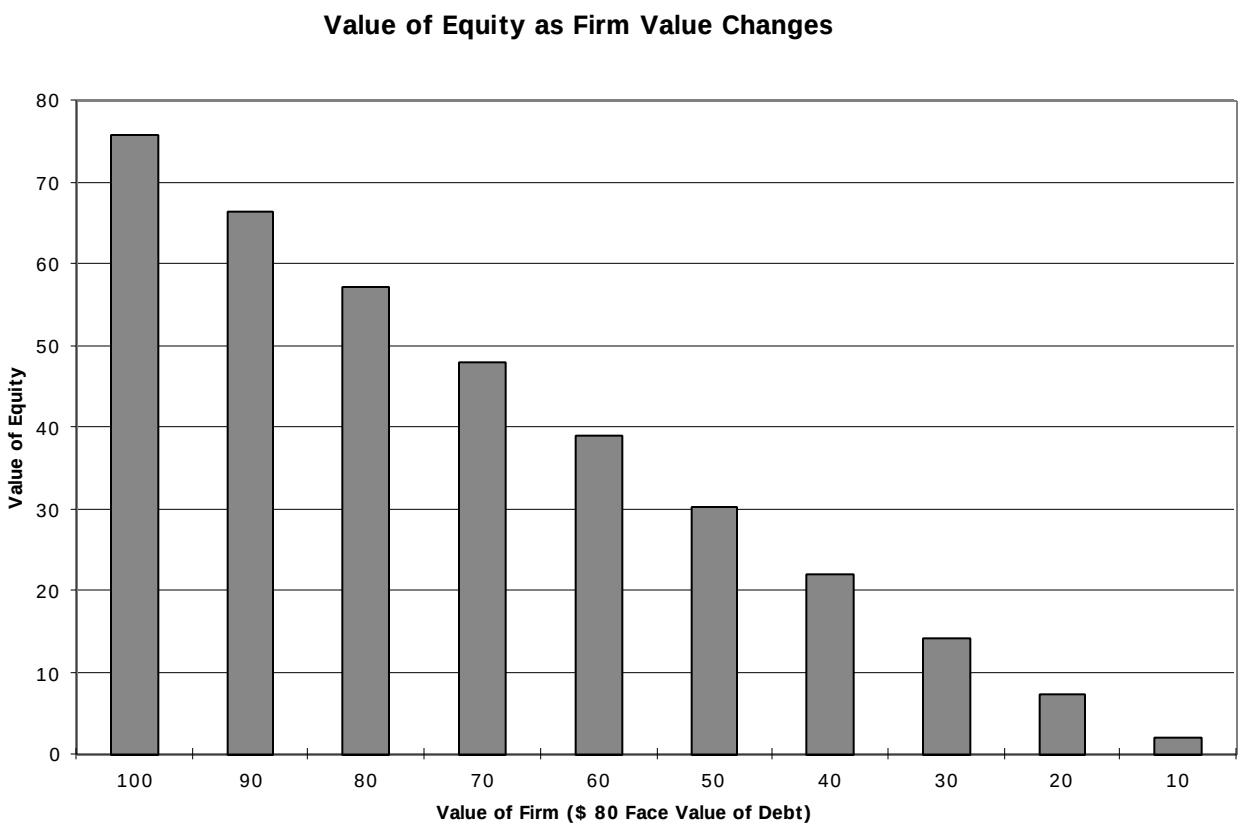
Valuing Equity in the Troubled Firm

- 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 ..



Valuing equity in a troubled firm

- The first implication is that **equity will have value**, even if the **value of the firm** falls well **below the face value of the outstanding debt**.
- Such a firm will be viewed as **troubled** by investors, accountants and analysts, but that **does not mean that its equity is worthless**.
- Just as deep out-of-the-money traded options command value because of the possibility that the value of the underlying asset may increase above the strike price in the remaining lifetime of the option, **equity will command value because of the time premium on the option** (the time until the bonds mature and come due) and the possibility that the value of the assets may increase above the face value of the bonds before they come due.

The Conflict between bondholders and stockholders

- Stockholders and bondholders have different objective functions, and this can lead to conflicts between the two.
- For instance, stockholders have an incentive to take riskier projects than bondholders do, and to pay more out in dividends than bondholders would like them to.
- This conflict between bondholders and stockholders can be illustrated dramatically using the option pricing model.
  - Since equity is a call option on the value of the firm, **an increase in the variance in the firm value, other things remaining equal, will lead to an increase in the value of equity**.
  - It is therefore conceivable that stockholders can take risky projects with **negative net present values**, which while making them better off, may make the bondholders and the firm less valuable. This is illustrated in the following example.

Illustration: Effect on value of 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%.

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

II. 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	$ 80 million	$ 50 million (Zero-coupon debt)
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 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%

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%

Present Value

Aswath Damodaran

Intuition Behind Present Value

- There are three reasons why a dollar tomorrow is worth less than a dollar today
  - Individuals prefer present consumption to future consumption. To induce people to give up present consumption you have to offer them more in the future.
  - When there is monetary inflation, the value of currency decreases over time. The greater the inflation, the greater the difference in value between a dollar today and a dollar tomorrow.
  - If there is any uncertainty (risk) associated with the cash flow in the future, the less that cash flow will be valued.
- Other things remaining equal, the value of cash flows in future time periods will decrease as
  - the preference for current consumption increases.
  - expected inflation increases.
  - the uncertainty in the cash flow increases.

Discounting and Compounding

- The mechanism for factoring in these elements is the discount rate.
- **Discount Rate:** The discount rate is a rate at which present and future cash flows are traded off. It incorporates -
  (1) Preference for current consumption (Greater ....Higher Discount Rate)
  (2) expected inflation (Higher inflation .... Higher Discount Rate)
  (3) the uncertainty in the future cash flows (Higher Risk....Higher Discount Rate)
- A higher discount rate will lead to a lower value for cash flows in the future.
- The discount rate is also an opportunity cost, since it captures the returns that an individual would have made on the next best opportunity.
- Discounting future cash flows converts them into cash flows in present value dollars. Just a discounting converts future cash flows into present cash flows,
- Compounding converts present cash flows into future cash flows.

Present Value Principle 1

- Cash flows at different points in time cannot be compared and aggregated. All cash flows have to be brought to the same point in time, before comparisons and aggregations are made.

Cash Flow Types and Discounting Mechanics

- There are five types of cash flows -
  - simple cash flows,
  - annuities,
  - growing annuities
  - perpetuities and
  - growing perpetuities

I.Simple Cash Flows

- A simple cash flow is a single cash flow in a specified future time period.

Cash Flow: CF_t

Time Period: t

- *The present value of this cash flow is-*

$$\text{PV of Simple Cash Flow} = CF_t / (1+r)^t$$

- *The future value of a cash flow is -*

$$\text{FV of Simple Cash Flow} = CF_0 (1+ r)^t$$

Application 1: The power of compounding - Stocks, Bonds and Bills

- Ibbotson and Sinquefield, in a study of returns on stocks and bonds between 1926-92 found that stocks on the average made 12.4%, treasury bonds made 5.2% and treasury bills made 3.6%.
- The following table provides the future values of $ 100 invested in each category at the end of a number of holding periods - 1, 5 , 10 , 20, 30 and 40 years.

Holding Period	Stocks	T. Bonds	T.Bills
1	$112.40	$105.20	$103.60
5	$179.40	$128.85	$119.34
10	$321.86	$166.02	$142.43
20	$1,035.92	$275.62	$202.86
30	$3,334.18	$457.59	$288.93
40	$10,731.30	$759.68	$411.52

Concept Check

- Most pension plans allow individuals to decide where their pensions funds will be invested - stocks, bonds or money market accounts.
- Where would you choose to invest your pension funds?
  - Predominantly or all equity
  - Predominantly or all bonds and money market accounts
  - A Mix of Bonds and Stocks
- Will your allocation change as you get older?
  - Yes
  - No

The Frequency of Compounding

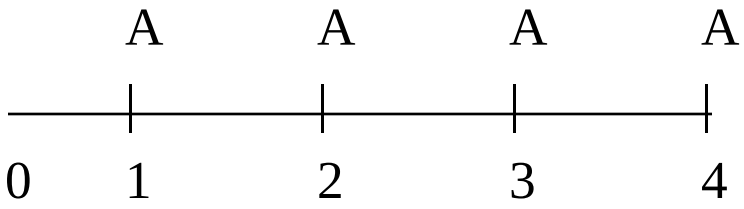
- The frequency of compounding affects the future and present values of cash flows. The stated interest rate can deviate significantly from the true interest rate –
  - For instance, a 10% annual interest rate, if there is semiannual compounding, works out to-

Effective Interest Rate = $1.05^2 - 1 = .10125$ or 10.25%

Frequency	Rate	t	Formula	Effective Annual Rate
Annual	10%	1	r	10.00%
Semi-Annual	10%	2	$(1+r/2)^2-1$	10.25%
Monthly	10%	12	$(1+r/12)^{12}-1$	10.47%
Daily	10%	365	$(1+r/365)^{365}-1$	10.5156%
Continuous	10%		$\exp^r-1$	10.5171%

II. Annuities

- An annuity is a constant cash flow that occurs at regular intervals for a fixed period of time. Defining A to be the annuity,



Present Value of an Annuity

- The present value of an annuity can be calculated by taking each cash flow and discounting it back to the present, and adding up the present values. Alternatively, there is a short cut that can be used in the calculation [A = Annuity; r = Discount Rate; n = Number of years]

$$PV \text{ of an Annuity} = PV(A, r, n) = A\left[\frac{1 - \frac{1}{(1+r)^n}}{r}\right]$$

Example: PV of an Annuity

- The present value of an annuity of \$1,000 for the next five years, assuming a discount rate of 10% is -

$$PV \text{ of \$1000 each year for next 5 years} = \$1000 \left[\frac{1 - \frac{1}{(1.10)^5}}{.10}\right] = \$3,791$$

- The notation that will be used in the rest of these lecture notes for the present value of an annuity will be PV(A,r,n).

Annuity, given Present Value

- The reverse of this problem, is when the present value is known and the annuity is to be estimated - A(PV,r,n).

$$\text{Annuity given Present Value} = A(PV, r, n) = PV \left[\frac{r}{1 - \frac{1}{(1+r)^n}} \right]$$

Future Value of an Annuity

- The future value of an end-of-the-period annuity can also be calculated as follows-

$$\text{FV of an Annuity} = FV(A_{r,,n}) = A\left[\frac{(1+r^{n})-1}{r}\right]$$

An Example

- Thus, the future value of $1,000 each year for the next five years, at the end of the fifth year is (assuming a 10% discount rate) -

$$FV \text{ of \$1,000 each year for next 5 years} = \$1000 \left[\frac{(1.10)^5 - 1}{.10}\right] = \$6,105$$

- The notation that will be used for the future value of an annuity will be FV(A,r,n).

Annuity, given Future Value

- if you are given the future value and you are looking for an annuity - A(FV,r,n) in terms of notation -

$$\text{Annuity given Future Value} = A(FV,r,n) = FV \left[\frac{r}{(1+r)^n - 1} \right]$$

Application 2: Saving for College Tuition

- Assume that you want to send your newborn child to a private college (when he gets to be 18 years old). The tuition costs are $ 16000/year now and that these costs are expected to rise 5% a year for the next 18 years. Assume that you can invest, after taxes, at 8%.
  - Expected tuition cost/year 18 years from now = $16000*(1.05)^{18} = \$38,506$
  - PV of four years of tuition costs at $38,506/year = $38,506 * PV(A ,8%,4 years)= $127,537
- If you need to set aside a lump sum now, the amount you would need to set aside would be -
  - Amount one needs to set apart now = $127,357/(1.08)^{18} = \$31,916$
- If set aside as an annuity each year, starting one year from now -
  - If set apart as an annuity = $127,537 * A(FV,8%,18 years) = $3,405

Application 3: How much is an MBA worth?

- Assume that you were earning $40,000/year before entering program and that tuition costs are $16000/year. Expected salary is $ 54,000/year after graduation. You can invest money at 8%.

  For simplicity, assume that the first payment of $16,000 has to be made at the start of the program and the second payment one year later.

  - PV Of Cost Of MBA = $16,000+16,000/1.08 + 40000 * PV(A,8%,2 years) = $102,145

- *Assume that you will work 30 years after graduation, and that the salary differential ($14000 = $54000-$40000) will continue through this period.*

  - PV of Benefits Before Taxes = $14,000 * PV(A,8%,30 years) = $157,609
  - This has to be discounted back two years - $157,609/$1.08^2$ = $135,124
  - The present value of getting an MBA is = $135,124 - $102,145 = $32,979

Some Follow-up Questions

1. How much would your salary increment have to be for you to break even on your MBA?
2. Keeping the increment constant, how many years would you have to work to break even?

Application 4: Savings from Refinancing Your Mortgage

- Assume that you have a thirty-year mortgage for $200,000 that carries an interest rate of 9.00%. The mortgage was taken three years ago. Since then, assume that interest rates have come down to 7.50%, and that you are thinking of refinancing. The cost of refinancing is expected to be 2.50% of the loan. (This cost includes the points on the loan.) Assume also that you can invest your funds at 6%.

  Monthly payment based upon 9% mortgage rate (0.75% monthly rate)

  = $200,000 * A(PV,0.75%,360 months)

  = $1,609

  Monthly payment based upon 7.50% mortgage rate (0.625% monthly rate)

  = $200,000 * A(PV,0.625%,360 months)

  = $1,398

- Monthly Savings from refinancing = $1,609 - $1,398 = $211

Refinancing: The Trade Off

- *If you plan to remain in this house indefinitely,*

Present Value of Savings (at 6% annually; 0.5% a month)

= $211 * PV(A,0.5%,324 months)

= $33,815

  - The savings will last for 27 years - the remaining life of the existing mortgage.
  - You will need to make payments for three additional years as a consequence of the refinancing -

Present Value of Additional Mortgage payments - years 28,29 and 30

= $1,398 * PV(A,0.5%,36 months)/1.06^{27}

= $9,532

- Refinancing Cost = 2.5% of $200,000 = $5,000
- Total Refinancing Cost = $9,532 + $5,000 = $14,532
- Net Effect = $ 33,815 - $ 9,532 - $ 14,532 = $9,751: Refinance

Follow-up Questions

1. How many years would you have to live in this house for you break even on this refinancing?
2. We've ignored taxes in this analysis. How would it impact your decision?

Application 5: Valuing a Straight Bond

- You are trying to value a straight bond with a fifteen year maturity and a 10.75% coupon rate. The current interest rate on bonds of this risk level is 8.5%.

  PV of cash flows on bond = 107.50* PV(A,8.5%,15 years) + $1000/1.085^{15}$ = $ 1186.85

- If interest rates rise to 10%,

  PV of cash flows on bond = 107.50* PV(A,10%,15 years)+ $1000/1.10^{15}$ = $1,057.05

  Percentage change in price = -10.94%

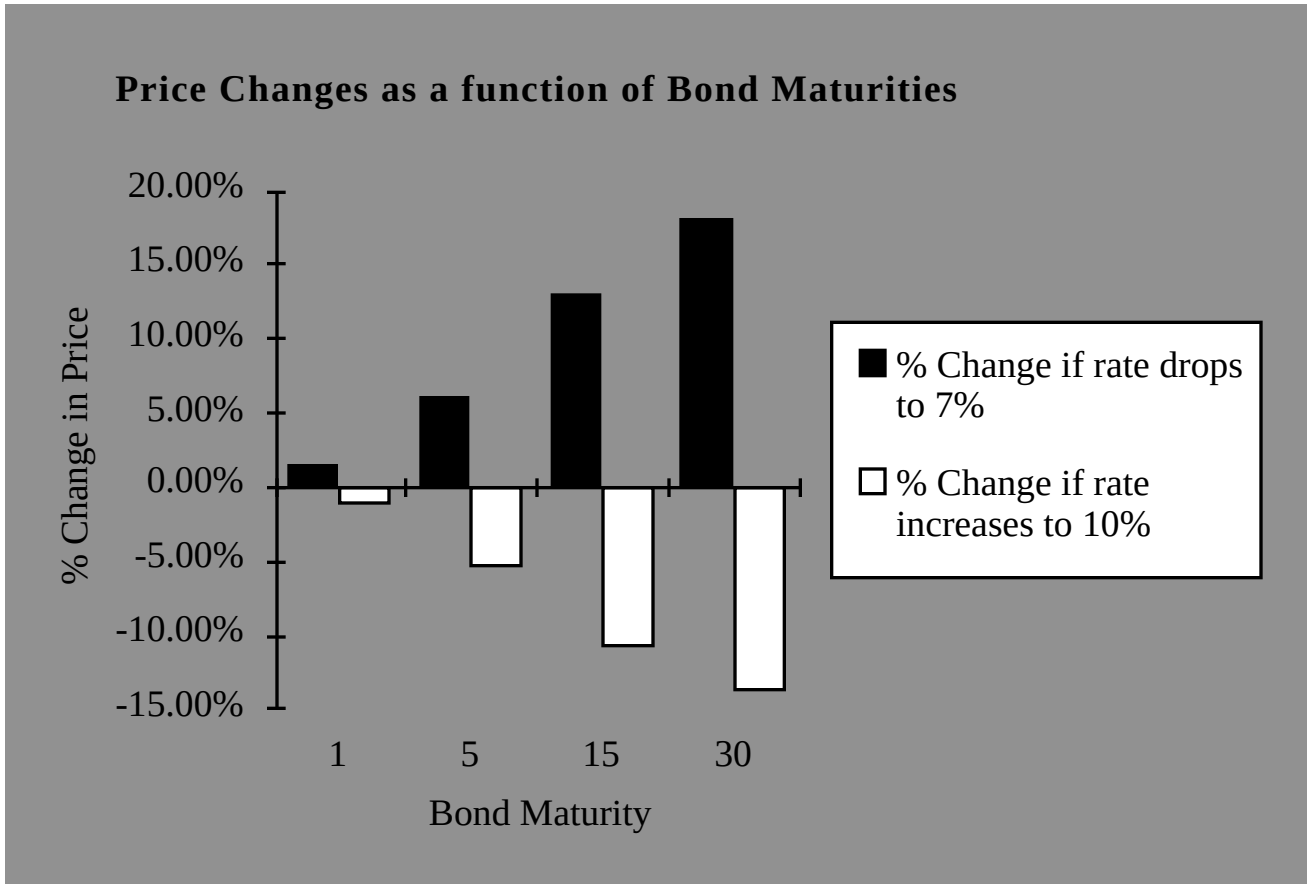
- If interest rate fall to 7%,

  PV of cash flows on bond = 107.50* PV(A,7%,15 years)+ $1000/1.07^{15}$ = $1,341.55

  Percentage change in price = +13.03%

- This asymmetric response to interest rate changes is called **convexity**.

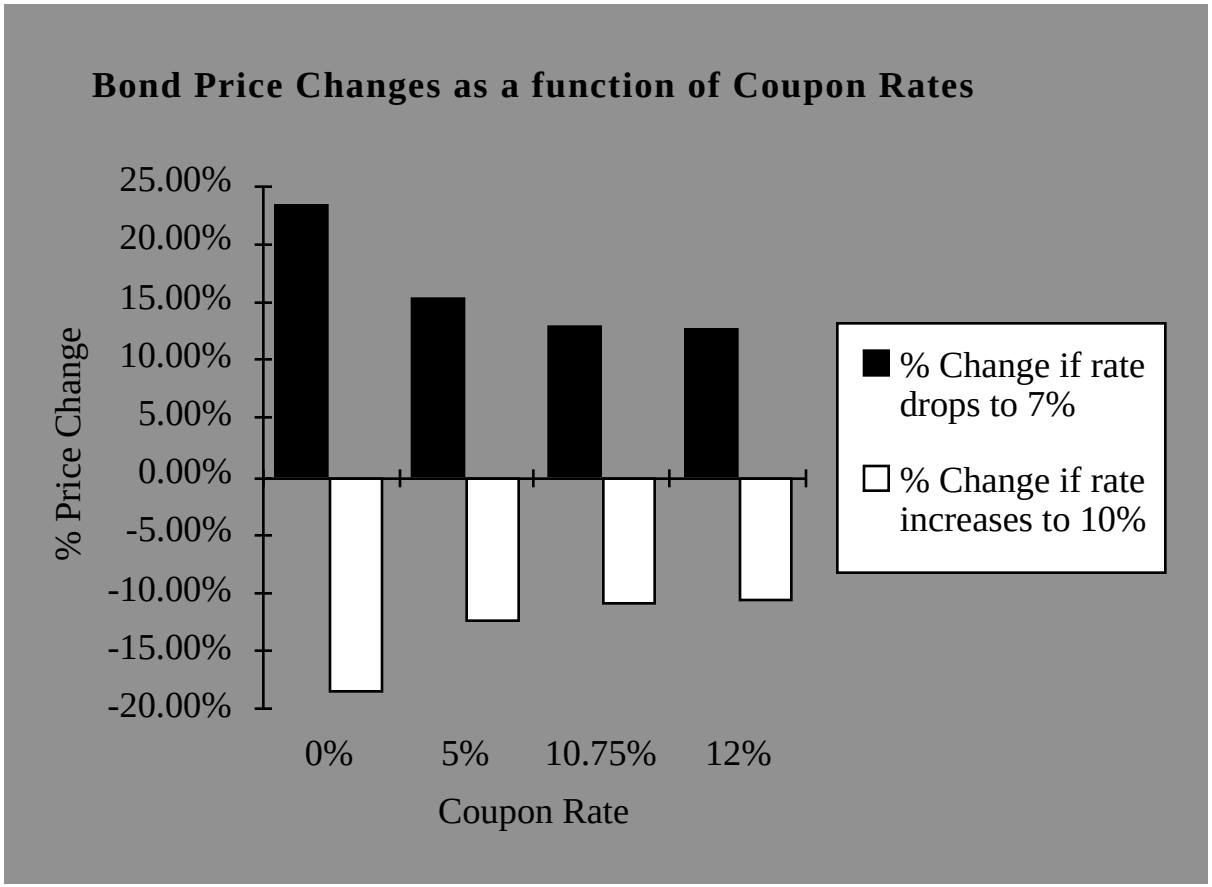
Application 6: Contrasting Short Term and Long Term Bonds



Bond Pricing Proposition 1

- The longer the maturity of a bond, the more sensitive it is to changes in interest rates.

Application 7: Contrasting Low-coupon and High-coupon Bonds



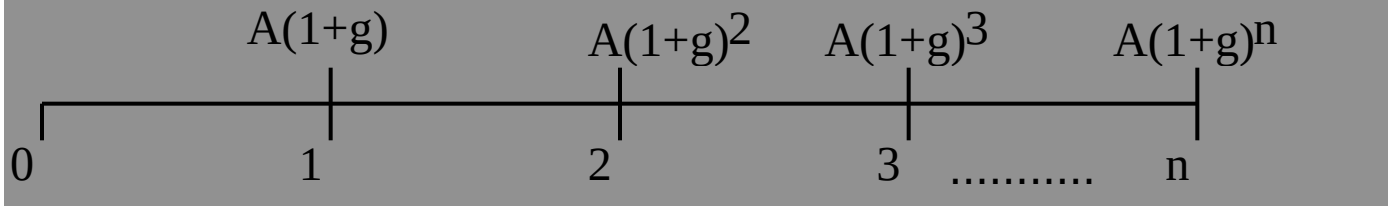
Bond Pricing Proposition 2

- The lower the coupon rate on the bond, the more sensitive it is to changes in interest rates.

III. Growing Annuity

- A growing annuity is a cash flow growing at a constant rate for a specified period of time. If A is the current cash flow, and g is the expected growth rate, the time line for a growing annuity looks as follows –

Figure 3.8: A Growing Annuity



Present Value of a Growing Annuity

- The present value of a growing annuity can be estimated in all cases, but one - where the growth rate is equal to the discount rate, using the following model:

$$PV \text{ of an Annuity} = PV(A, r, n) = A \left[\frac{1 - \frac{1}{(1+r)^n}}{r} \right]$$

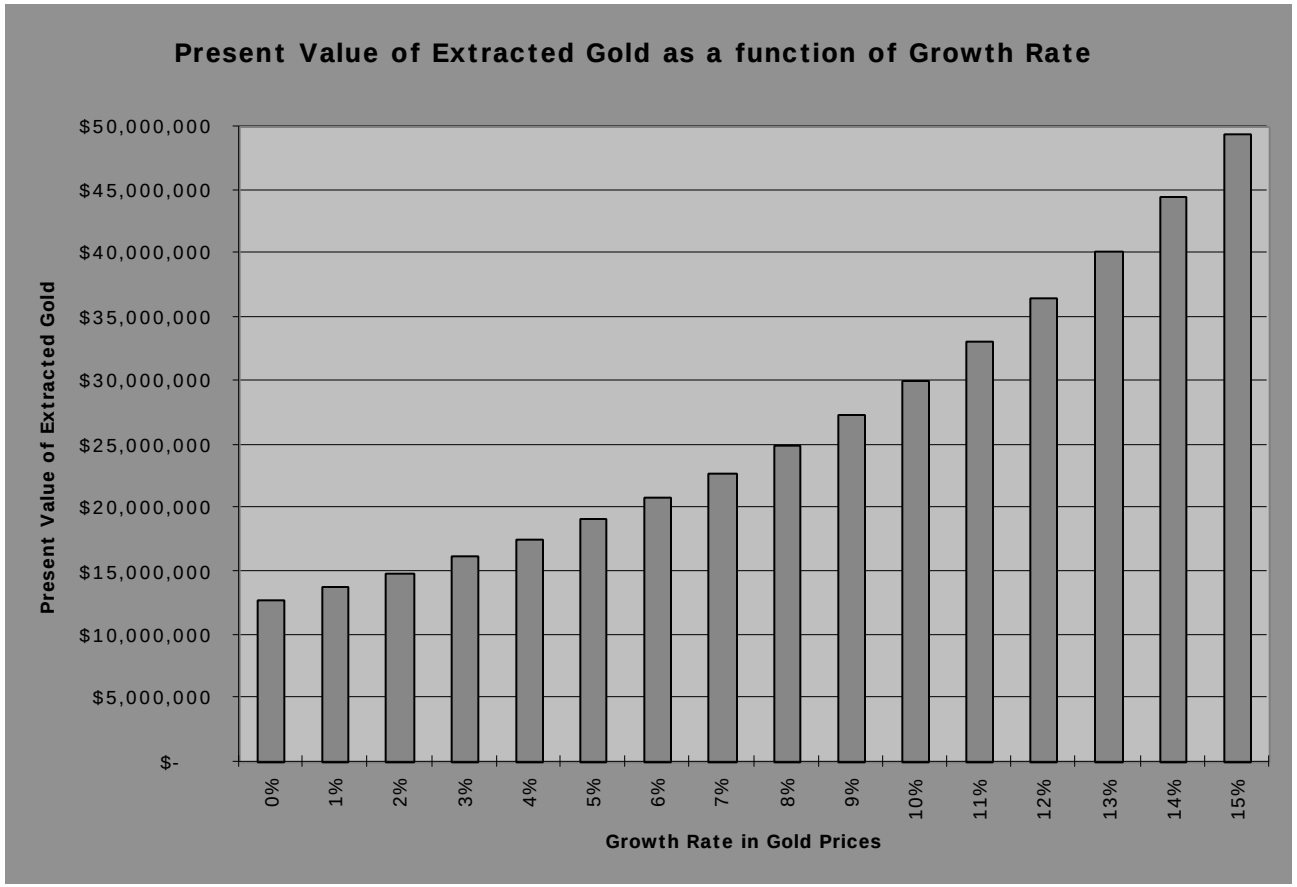
- In that specific case, the present value is equal to the nominal sums of the annuities over the period, without the growth effect.

Appendix 8: The Value of a Gold Mine

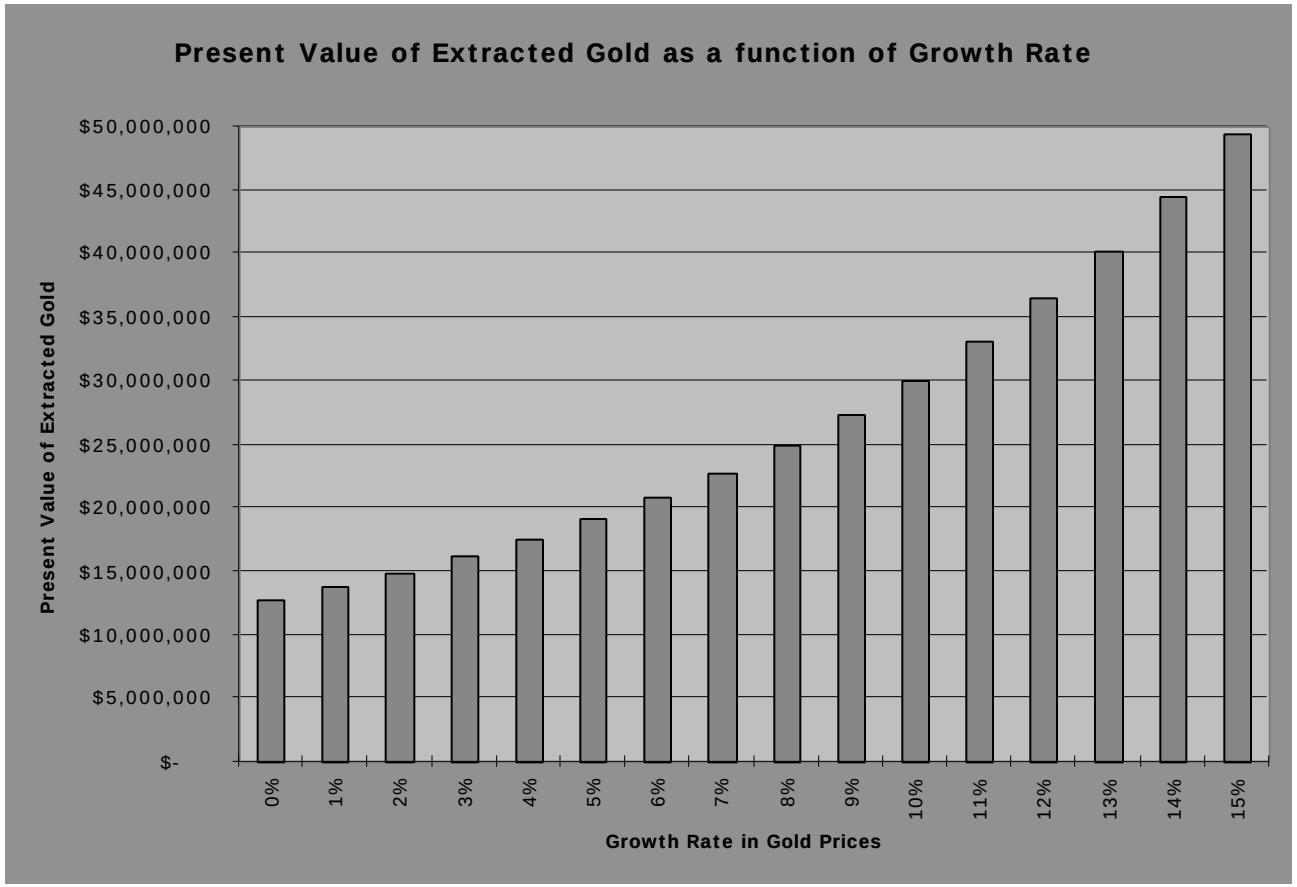
- Consider the example of a gold mine, where you have the rights to the mine for the next 20 years, over which period you plan to extract 5,000 ounces of gold every year. The price per ounce is $300 currently, but it is expected to increase 3% a year. The appropriate discount rate is 10%. The present value of the gold that will be extracted from this mine can be estimated as follows –

$$PV \text{ of extracted gold} = \$300 * 5000 * (1.03) \left[\frac{1 - \frac{(1.03)^{20}}{(1.10)^{20}}}{.10 - .03} \right] = \$16,145,980$$

PV of Extracted Gold as a Function of Expected Growth Rate



PV of Extracted Gold as a Function of Expected Growth Rate



Concept Check

- If both the growth rate and the discount rate go up by 1%, will the present value of the gold to be extracted from this mine increase or decrease?

IV. Perpetuity

- A perpetuity is a constant cash flow at regular intervals forever. The present value of a perpetuity is-

$$PV \text{ of Perpetuity} = \frac{A}{r}$$

Application 9: Valuing a Console Bond

- A console bond is a bond that has no maturity and pays a fixed coupon. Assume that you have a 6% coupon console bond. The value of this bond, if the interest rate is 9%, is as follows -

  Value of Console Bond = $60 / .09 = $667

V. Growing Perpetuities

- A growing perpetuity is a cash flow that is expected to grow at a constant rate forever. The present value of a growing perpetuity is -

$$PV \text{ of Growing Perpetuity} = \frac{CF_1}{(r - g)}$$

where

- CF_1 is the expected cash flow next year,
- g is the constant growth rate and
- r is the discount rate.

Application: Valuing a Stock with Growing Dividends

- Southwestern Bell paid dividends per share of $2.73 in 1992. Its earnings and dividends have grown at 6% a year between 1988 and 1992, and are expected to grow at the same rate in the long term. The rate of return required by investors on stocks of equivalent risk is 12.23%.

  Current Dividends per share = $2.73

  Expected Growth Rate in Earnings and Dividends = 6%

  Discount Rate = 12.23%

  Value of Stock = $2.73 *1.06 / (.1223 -.06) = $46.45

Valuation

Aswath Damodaran

First Principles

- Invest in projects that yield a return greater than the minimum acceptable hurdle rate.
  - The hurdle rate should be higher for riskier projects and reflect the financing mix used - owners' funds (equity) or borrowed money (debt)
  - Returns on projects should be measured based on cash flows generated and the timing of these cash flows; they should also consider both positive and negative side effects of these projects.
- Choose a financing mix that minimizes the hurdle rate and matches the assets being financed.
- If there are not enough investments that earn the hurdle rate, return the cash to stockholders.
  - The form of returns - dividends and stock buybacks - will depend upon the stockholders' characteristics.

Objective: Maximize the Value of the Firm

Discounted Cashflow Valuation: Basis for Approach

$$\text{Value} = \sum_{t=1}^{t=n} \frac{CF_t}{(1+r)^t}$$

- where,
- n = Life of the asset
- CF_t = Cashflow in period t
- r = Discount rate reflecting the riskiness of the estimated cashflows

Equity Valuation

- The value of equity is obtained by discounting expected cashflows to equity, i.e., the residual cashflows after meeting all expenses, tax obligations and interest and principal payments, at the cost of equity, i.e., the rate of return required by equity investors in the firm.

$$\text{Value of Equity} = \sum_{t=1}^{t=n} \frac{\text{CF to Equity}_t}{(1+k_e)^t}$$

where,

CF to Equityt = Expected Cashflow to Equity in period t

ke = Cost of Equity

- The dividend discount model is a specialized case of equity valuation, and the value of a stock is the present value of expected future dividends.

Firm Valuation

- The value of the firm is obtained by discounting expected cashflows to the firm, i.e., the residual cashflows after meeting all operating expenses and taxes, but prior to debt payments, at the weighted average cost of capital, which is the cost of the different components of financing used by the firm, weighted by their market value proportions.

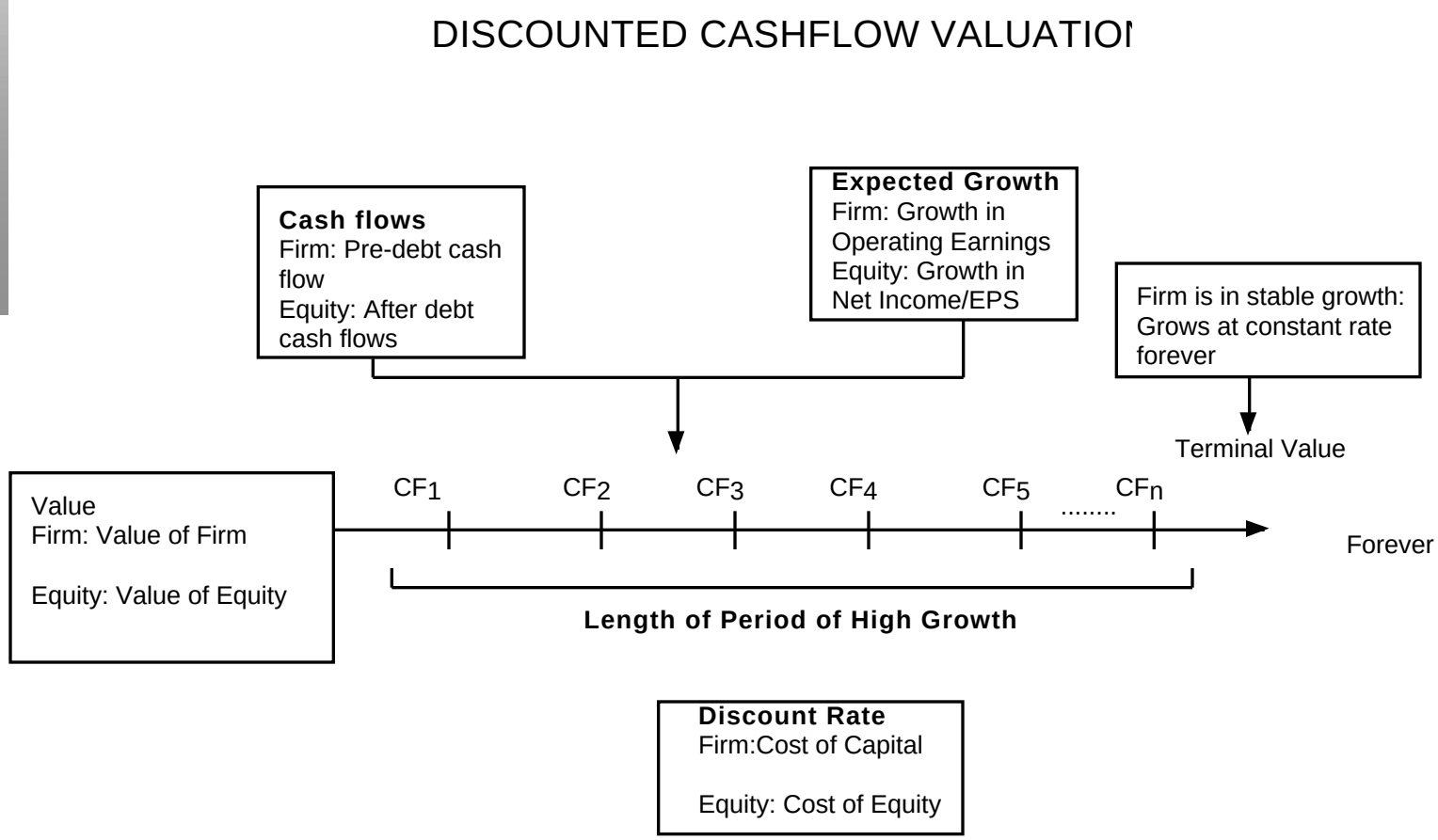
$$\text{Value of Firm} = \sum_{t=1}^{t=n} \frac{\text{CF to Firm}_t}{(1+\text{WACC})^t}$$

where,

CF to Firmt = Expected Cashflow to Firm in period t

WACC = Weighted Average Cost of Capital

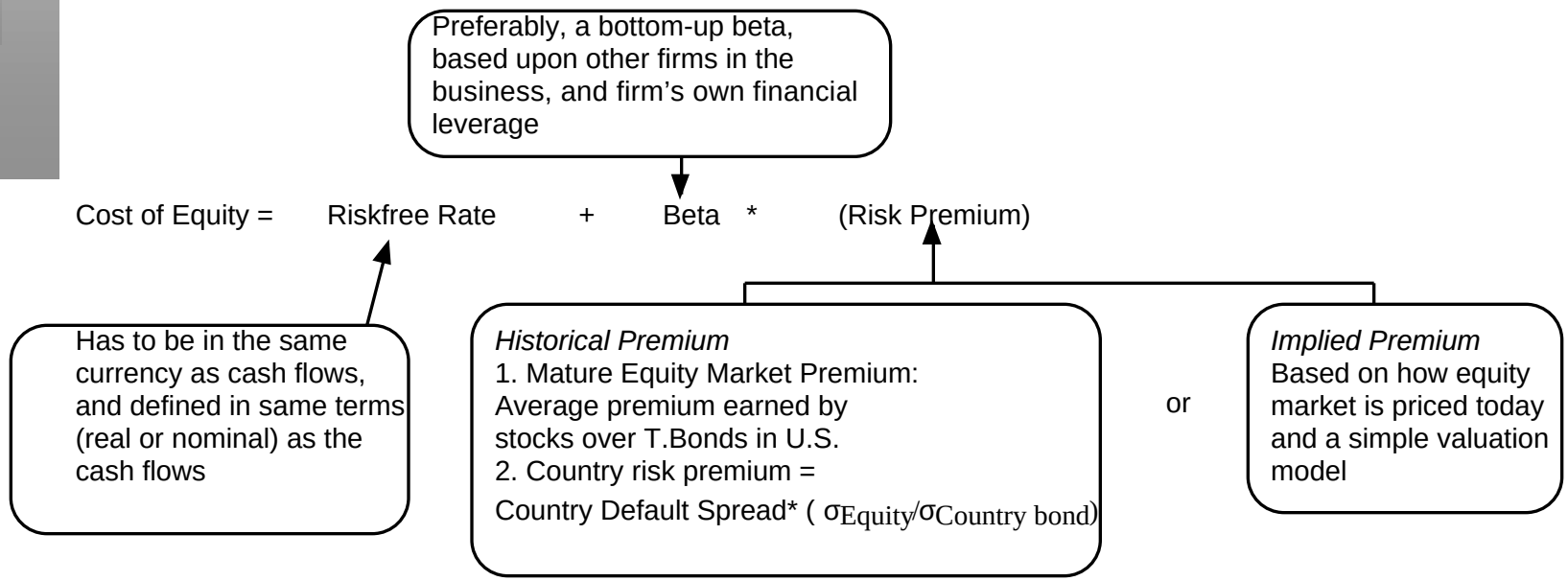
Generic DCF Valuation Model



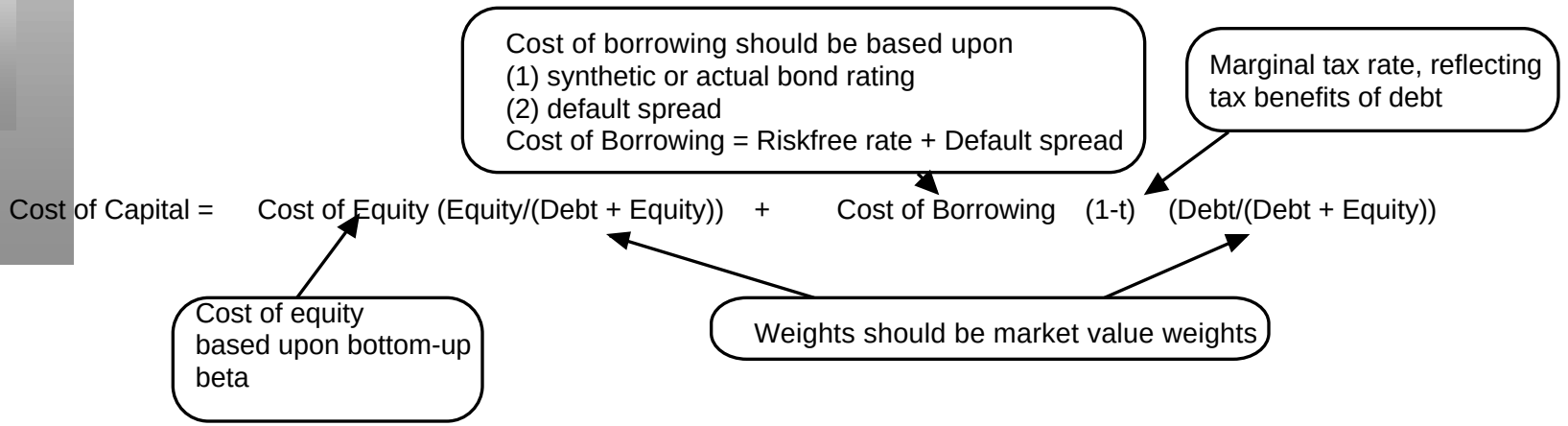
Estimating Inputs: I. Discount Rates

- **Critical ingredient** in discounted cashflow valuation. Errors in estimating the discount rate or mismatching cashflows and discount rates can lead to serious errors in valuation.
- At an intutive level, the discount rate used should be consistent with both the **riskiness** and the **type of cashflow** being discounted.
- The cost of equity is the rate at which we discount cash flows to equity (dividends or free cash flows to equity). The cost of capital is the rate at which we discount free cash flows to the firm.

The Cost of Equity: A Recap



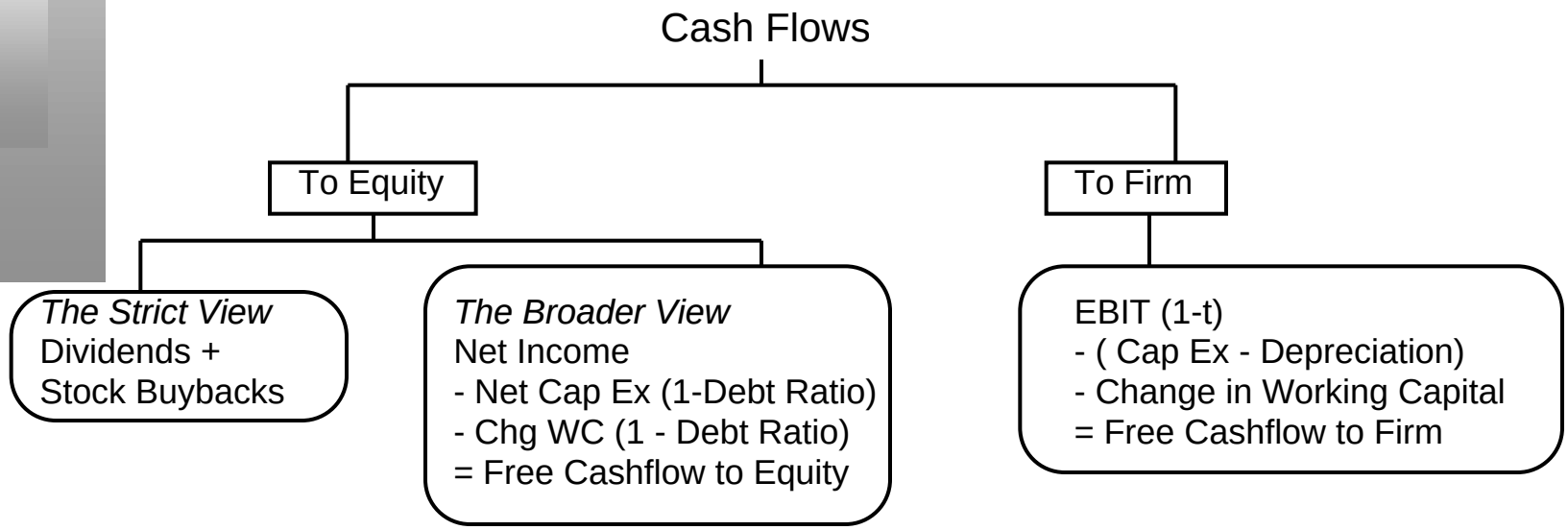
Estimating the Cost of Capital



Costs of Equity, Debt and Capital

	Boeing	*The Home Depot*	*InfoSoft*
Beta (Bottom-up)	1.01	0.87	1.49
Cost of Equity	10.58%	9.78%	13.19%
Equity/(Debt + Equity)	79.91%	95.45%	93.38%
Rating	AA	A+	A
After-tax Cost of Debt	3.58%	3.77%	3.48%
Debt/(Debt + Equity)	20.09%	4.55%	6.62%
Cost of Capital	9.17%	9.51%	12.55%

II. Estimating Cash Flows



Estimating Operating Income

- The first adjustment is for financing expenses that accountants treat as operating expenses. The most significant example is operating leases.
- The second adjustment is the treatment of some capital expenditures as operating expenses. Here, the most dramatic example is the treatment of research and development expenses.
- The third adjustment is to correct for the incidence of one-time or irregular income and expenses. Any expense (or income) that is truly a one-time expense (or income) should be removed from the operating income and should not be used in forecasting future operating income.

Operating Income Estimates

	Boeing	*Home Depot*	*InfoSoft*
Operating Income	$1,720	$2,661	$2,000
+ Special and One-time Charges	$0	$0	$0
+ Research and Development Expenses	$1,895	$0	$4,000
- Amortization of Research Asset	$1,382	$0	$2,367
+ Imputed Interest Expense on Operating Leases	$ 31	$ 154	$ -
= Adjusted Operating Income	$2,264	$2,815	$3,633

Estimating a Tax Rate

- The choice is between the effective and the marginal tax rate. In doing projections, it is far safer to use the marginal tax rate since the effective tax rate is really a reflection of the difference between the accounting and the tax books.
- By using the marginal tax rate, we tend to understate the after-tax operating income in the earlier years, but the after-tax tax operating income is more accurate in later years
- If you choose to use the effective tax rate, adjust the tax rate towards the marginal tax rate over time.

Tax Rate Estimates

	Boeing	*Home Depot*	*InfoSoft*
Taxable Income	1397	2654	1685
Taxes	277	1040	707.7
Effective Tax Rate	19.83%	39.19%	42.00%
Average Effective Tax Rate:94-98	20.44%	38.78%	42%
Marginal tax rate	35%	35%	42%

We will use the 35% tax rate to value Boeing and the Home Depot and 42% for InfoSoft.

Estimating Capital Expenditures

- Research and development expenses, once they have been re-categorized as capital expenses. The adjusted cap ex will be

  Adjusted Net Capital Expenditures = Net Capital Expenditures + Current year's R&D expenses - Amortization of Research Asset

- Acquisitions of other firms, since these are like capital expenditures. The adjusted cap ex will be

  Adjusted Net Cap Ex = Net Capital Expenditures + Acquisitions of other firms - Amortization of such acquisitions

  Two caveats:

  1. Most firms do not do acquisitions every year. Hence, a normalized measure of acquisitions (looking at an average over time) should be used
  2. The best place to find acquisitions is in the statement of cash flows, usually categorized under other investment activities

Net Capital Expenditures: 1998

	Boeing	*The Home Depot*	*InfoSoft*
Capital Expenditures	$1,584	$2,059	$2,000
R&D	$1,895	$0	$4,000
Depreciation	$1,517	$373	$1,000
Amortization of R&D	$1,382	$0	$2,367
Net Cap Ex w/o R&D	$67	$1,686	$1,000
Net Cap Ex with R&D	$580	$1,686	$2,633

Estimating Net Working Capital Needs

- In accounting terms, the working capital is the difference between current assets (inventory, cash and accounts receivable) and current liabilities (accounts payables, short term debt and debt due within the next year)
- A cleaner definition of working capital from a cash flow perspective is the difference between non-cash current assets (inventory and accounts receivable) and non-debt current liabilities (accounts payable)
- Any investment in this measure of working capital ties up cash. Therefore, any increases (decreases) in working capital will reduce (increase) cash flows in that period.
- When forecasting future growth, it is important to forecast the effects of such growth on working capital needs, and building these effects into the cash flows.

Net Working Capital Estimates

	Boeing	*The Home Depot*	*InfoSoft*
Revenues: 1998	$56,154	30219	20000
Non-cash WC: 1998	$1,360	2028	2000
Δ Working capital	$667	$190	$500
Non-cash WC as % of Revenues	2.42%	6.71%	10.00%
Average from 1994-1998	4.12%	7.08%	NA
Industry Average	*18.95%*	*12.30%*	*18.00%*

Application Test: Estimating your firm's FCFF

- Estimate the FCFF for your firm in its most recent financial year:

In general,	If using statement of cash flows
EBIT (1-t)	EBIT (1-t)
+ Depreciation	+ Depreciation
- Capital Expenditures	+ Capital Expenditures
- Change in Non-cash WC	+ Change in Non-cash WC
= FCFF	= FCFF

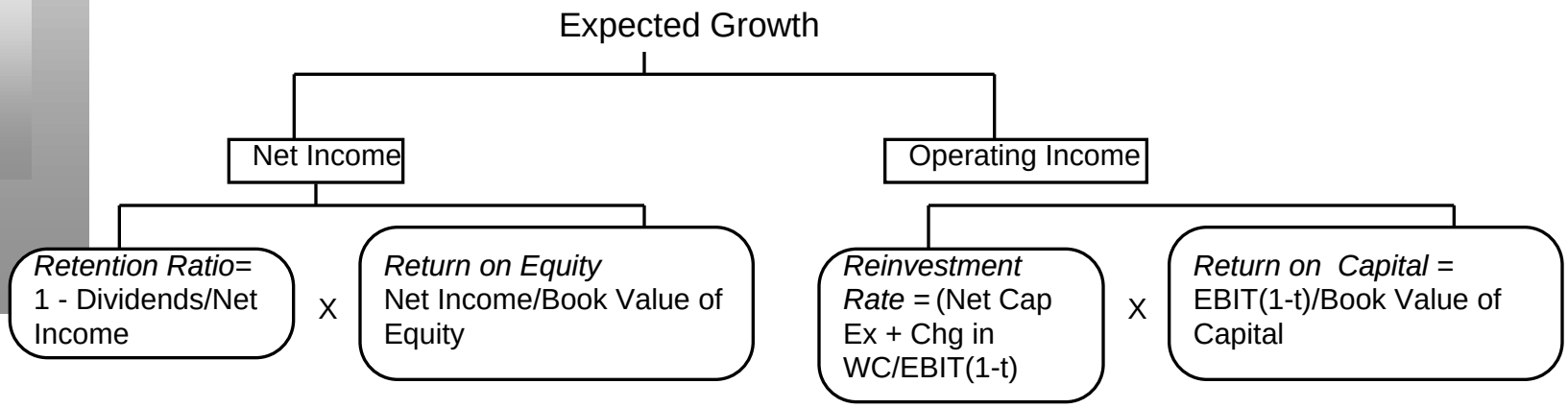
Estimate the dollar reinvestment at your firm:

Reinvestment = EBIT (1-t) - FCFF

Choosing a Cash Flow to Discount

- When you cannot estimate the free cash fllows to equity or the firm, the only cash flow that you can discount is dividends. For financial service firms, it is difficult to estimate free cash flows. For Deutsche Bank, we will be discounting dividends.
- If a firm's debt ratio is not expected to change over time, the free cash flows to equity can be discounted to yield the value of equity. For Aracruz, we will discount free cash flows to equity.
- If a firm's debt ratio might change over time, free cash flows to equity become cumbersome to estimate. Here, we would discount free cash flows to the firm. For Disney, we will discount the free cash flow to the firm.

III. Expected Growth



Expected Growth in EPS

g_{EPS} = Retained Earnings$_{t-1}$ / NI$_{t-1}$ * ROE
= Retention Ratio * ROE
= b * ROE

- Proposition 1: The expected growth rate in earnings for a company cannot exceed its return on equity in the long term.

Expected Growth in EBIT And Fundamentals

- Reinvestment Rate and Return on Capital

  g_{EBIT} = (Net Capital Expenditures + Change in WC)/EBIT(1-t) * ROC
  = Reinvestment Rate * ROC

- Proposition 2: No firm can expect its operating income to grow over time without reinvesting some of the operating income in net capital expenditures and/or working capital.
- Proposition 3: The net capital expenditure needs of a firm, for a given growth rate, should be inversely proportional to the quality of its investments.

Estimating Reinvestment Rate

	Boeing	*The Home Depot*	*InfoSoft*
Net Cap Ex	$ 580	$ 1,686	$ 2,633
Change in Non-Cash WC	$ 667	$ 190	$ 500
Total Reinvestment	$ 1,247	$ 1,876	$ 3,133
EBIT (1-t)	$ 1,651	$ 1,830	$ 2,793
Reinvestment Rate	75.52%	102.53%	112.17%
Average : 1994-98	65.98%	131.85%	NA
Industry Average	55.48%	88.62%	73.12%

Estimating Return on Capital

	Boeing	*The Home Depot*	*InfoSoft*
Adjusted EBIT (1-t)	$ 1,651	$ 1,830	$ 2,793
Adjusted BV of capital	$ 28,957	$ 11,173	$ 11800
ROC	5.70%	16.38%	23.67%
Average ROC: 1994-1998	6.59%	15.12%	NA
Industry average ROC	15.07%	14.10%	17.20%

Expected Growth Estimates

	Boeing	*The Home Depot*	*InfoSoft*
Return on Capital	6.59%	16.38%	23.67%
Reinvestment Rate	65.98%	88.62%	112.17%
Expected Growth Rate	4.35%	14.51%	26.55%

Boeing: Used average return on capital and reinvestment rate over last 5 years

The Home Depot: Used current return on capital and Industry average reinvestment rate

InfoSoft: Used current return on capital and reinvestment rate

Application Test: Estimating Expected Growth

- Estimate the following:
  - The reinvestment rate for your firm
  - The after-tax return on capital
  - The expected growth in operating income, based upon these inputs

IV. Getting Closure in Valuation

- A publicly traded firm potentially has an infinite life. The value is therefore the present value of cash flows forever.

$$\text{Value} = \sum_{t=1}^{t=\infty} \frac{CF_t}{(1+r)^t}$$

- Since we cannot estimate cash flows forever, we estimate cash flows for a "growth period" and then estimate a terminal value, to capture the value at the end of the period:

$$\text{Value} = \sum_{t=1}^{t=N} \frac{CF_t}{(1+r)^t} + \frac{\text{Terminal Value}}{(1+r)^N}$$

Stable Growth and Terminal Value

- When a firm's cash flows grow at a "constant" rate forever, the present value of those cash flows can be written as:

  Value = Expected Cash Flow Next Period / (r - g)

  where,

  r = Discount rate (Cost of Equity or Cost of Capital)

  g = Expected growth rate

- This "constant" growth rate is called a stable growth rate and cannot be higher than the growth rate of the economy in which the firm operates.
- While companies can maintain high growth rates for extended periods, they will all approach "stable growth" at some point in time.
- When they do approach stable growth, the valuation formula above can be used to estimate the "terminal value" of all cash flows beyond.

Growth Patterns

- A key assumption in all discounted cash flow models is the period of high growth, and the pattern of growth during that period. In general, we can make one of three assumptions:
  - there is no high growth, in which case the firm is already in stable growth
  - there will be high growth for a period, at the end of which the growth rate will drop to the stable growth rate (2-stage)
  - there will be high growth for a period, at the end of which the growth rate will decline gradually to a stable growth rate(3-stage)

Determinants of Length of High Growth Period

- Size of the firm
  - Success usually makes a firm larger. As firms become larger, it becomes much more difficult for them to maintain high growth rates
- Current growth rate
  - While past growth is not always a reliable indicator of future growth, there is a correlation between current growth and future growth. Thus, a firm growing at 30% currently probably has higher growth and a longer expected growth period than one growing 10% a year now.
- Barriers to entry and differential advantages
  - Ultimately, high growth comes from high project returns, which, in turn, comes from barriers to entry and differential advantages.
  - The question of how long growth will last and how high it will be can therefore be framed as a question about what the barriers to entry are, how long they will stay up and how strong they will remain.

Analyzing the Growth Period

	Boeing	*The Home Depot*	*InfoSoft*
Firm Size/Market Size	Firm has the dominant market share of a slow-growing market	Firm has dominant market share of domestic market, but is entering new businesses and new markets (overseas)	Firm is a small firm in a market that is experiencing significant growth.
Current Excess Returns	Firm is earning less than its cost of capital, and has done so for last 5 years	Firm is earning substantially more than its cost of capital.	Firm is earning significant excess returns.
Competitive Advantages	Huge capital requirements and technological barriers to new entrants. Management record over the last few years has been poor.	Significant economies of scale are used to establish cost advantages over rivals. Has a management team that is focused on growth and efficiency.	Has both a good product and good software engineers. Competitive advantage is likely to be limited, since employees can be hired away, and competitors are extremely aggressive.
Length of High Growth period	10 years, entirely because of competitive advantages and barriers to entry.	10 years; it will be difficult for competitors to overcome the economies of scale.	5 years. In spite of the firm's small size, the competitive nature of this market and the lack of barriers to competition make us conservative on our estimate.

Firm Characteristics as Growth Changes

Variable	High Growth Firms tend to	Stable Growth Firms tend to
Risk	be above-average risk	be average risk
Dividend Payout	pay little or no dividends	pay high dividends
Net Cap Ex	have high net cap ex	have low net cap ex
Return on Capital	earn high ROC (excess return)	earn ROC closer to WACC
Leverage	have little or no debt	higher leverage

Estimating Stable Growth Inputs

- Start with the fundamentals:
  - Profitability measures such as return on equity and capital, in stable growth, can be estimated by looking at
    - industry averages for these measure, in which case we assume that this firm in stable growth will look like the average firm in the industry
    - cost of equity and capital, in which case we assume that the firm will stop earning excess returns on its projects as a result of competition.
  - Leverage is a tougher call. While industry averages can be used here as well, it depends upon how entrenched current management is and whether they are stubborn about their policy on leverage (If they are, use current leverage; if they are not; use industry averages)
- Use the relationship between growth and fundamentals to estimate payout and net capital expenditures.

Estimating Stable Period Cost of Capital

	Boeing		The Home Depot		InfoSoft	
	High Growth	Stable Growth	High Growth	Stable Growth	High Growth	Stable Growth
Beta	1.014	1	0.869	0.869	1.489	1.2
Cost of Equity	10.58%	10.50%	9.78%	9.78%	13.19%	11.60%
After-tax Cost of Debt	3.58%	3.58%	3.77%	3.58%	3.48%	3.48%
Debt Ratio	20.09%	30.00%	4.55%	30.00%	6.62%	6.62%
Cost of Capital	9.17%	8.42%	9.51%	7.92%	12.55%	11.06%

Estimating Stable Period Net Cap Ex

g_{EBIT} = (Net Capital Expenditures + Change in WC)/EBIT(1-t) * ROC
= Reinvestment Rate * ROC

- Moving terms around,

Reinvestment Rate = g_{EBIT} / Return on Capital

- For instance, assume that Boeing in stable growth will
  - grow 5% and that
  - its return on capital in stable growth will be 8.42% (its cost of capital).

Reinvestment Rate for Boeing in Stable Growth = 5/8.42 = 59.36%

- In other words,
  - the net capital expenditures and working capital investment each year during the stable growth period will be 59.36% of after-tax operating income.

Stable Period Return on Capital and Reinvestment Rates

	Boeing		The Home Depot		InfoSoft	
	High Growth	Stable Growth	High Growth	Stable Growth	High Growth	Stable Growth
Return on Capital	6.59%	8.42%	16.38%	14.10%	23.67%	17.20%
Reinvestment Rate	65.98%	59.35%	88.62%	35.46%	112.17%	29.07%
Expected Growth Rate	4.35%	5.00%	14.51%	5.00%	26.55%	5.00%

Dealing with Cash and Marketable Securities

- The simplest and most direct way of dealing with cash and marketable securities is to keep it out of the valuation - the cash flows should be before interest income from cash and securities, and the discount rate should not be contaminated by the inclusion of cash. (Use betas of the operating assets alone to estimate the cost of equity).
- Once the firm has been valued, add back the value of cash and marketable securities.
  - If you have a particularly incompetent management, with a history of overpaying on acquisitions, markets may discount the value of this cash.

Cash and Marketable Securities: Estimates

	Boeing	*The Home Depot*	*InfoSoft*
Cash	$2,183	$62	$100
Marketable Securities	$279	$0	$400
Non-Operating Assets	$0	$0	$0
Excess of Pension Assets	$1,861	$0	$0
Cash and Non-Operating Assets	$4,323	$62	$500

Boeing has an overfunded pension plan. We considered only 50% of the overfunding, since the firm will have to pay a tax of 50% if it decides to withdraw the funds.

The Value of Cash

- Implicitly, we are assuming here that the market will value cash at face value. Assume now that you are buying a firm whose only asset is marketable securities worth $ 100 million. Can you ever consider a scenario where you would not be willing to pay $ 100 million for this firm?
  - Yes
  - No
- What is or are the scenario(s)?

Dealing with Holdings in Other firms

- Holdings in other firms can be categorized into
  - Minority passive holdings, in which case only the dividend from the holdings is shown in the balance sheet
  - Minority active holdings, in which case the share of equity income is shown in the income statements
  - Majority active holdings, in which case the financial statements are consolidated.

How to value holdings in other firms

Fin Statement	*Valuing*	*What to do…*
Not consolidated	Equity	Value equity in subsidiary and take share of holding.
Not consolidated	Firm	Value subsidiary as a firm and add portion of firm value. Add portion of debt in subsidiary to the debt in estimating equity value.
Consolidated	Firm	Strip operating income of subsidiary and value subsidiary separately. Add portion of this value to value of parent firm.

How some deal with subsidiaries...

- When financial statements are consolidated, some analysts value the firm with the consolidated operating income and then subtract minority interests from the firm value to arrive at the value of the equity in the firm. What is wrong with this approach?

Equity Value and Per Share Value: A Test

- Assume that you have done an equity valuation of Microsoft. The total value for equity is estimated to be $ 400 billion and there are 5 billion shares outstanding. What is the value per share?

An added fact

- In 1999, Microsoft had 500 million options outstanding, granted to employees over time. These options had an average exercise price of $ 20 (the current stock price is $ 80). Estimate the value per share.

Equity Value and Per Share Value

- The conventional way of getting from equity value to per share value is to divide the equity value by the number of shares outstanding. This approach assumes, however, that common stock is the only equity claim on the firm.
- In many firms, there are other equity claims as well including:
  - warrants, that are publicly traded
  - management and employee options, that have been granted, but do not trade
  - conversion options in convertible bonds
  - contingent value rights, that are also publicly traded.
- The value of these non-stock equity claims has to be subtracted from the value of equity before dividing by the number of shares outstanding.

Warrants

- A warrant is a security issued by a company that provides the holder with the right to buy a share of stock in the company at a fixed price during the life of the warrant.
- A warrant is therefore a long term call option on the equity of the firm and can be valued using option pricing models.
- Warrants and other equity options issued by the firm are claims on the equity of the firm and have to be treated as equity, which has relevance for:
  - estimating debt and equity for the leverage calculation
  - estimating per share value from total equity value

Convertible Bonds

- A convertible bond is a bond that can be converted into a pre-determined number of shares, at the option of the bond holder.
- While it generally does not pay to convert at the time of the bond issue, conversion becomes a more attractive option as stock prices increase.
- A convertible bond can be considered to be made up of two securities - a straight bond and a conversion option.
- Firms generally add conversions options to bonds to lower the interest rate paid on the bonds.

Factors in Using Option Pricing Models to Value Convertibles and Warrants

- Option pricing models can be used to value the conversion option with three caveats –
  - conversion options are long term, making the assumptions about constant variance and constant dividend yields much shakier,
  - conversion options result in stock dilution, and
  - conversion options are often exercised before expiration, making it dangerous to use European option pricing models.
- These problems can be partially alleviated by using a binomial option pricing model, allowing for shifts in variance and early exercise, and factoring in the dilution effect

Options Outstanding: Boeing

Exercise Price	*Number (in '000s)*	*Life*	*Black-Scholes Value/option*	*Total Value (in '000s)*
$ 16.35	4315	4.5	$ 17.71	$ 76,418.65
$ 23.32	8480	5	$ 14.23	$ 120,670.40
$ 38.44	1779	7.1	$ 10.75	$ 19,124.25
$ 41.25	4598	7.4	$ 10.34	$ 47,543.32
$ 53.37	9481	8.7	$ 9.12	$ 86,466.72
Total Value of Options Outstanding at Boeing =				$ 350,223.34

Options Outstanding: The Home Depot

- Average Exercise Price of Options Outstanding = $20.17
- Stock Price at time of analysis= $ 37.00
- Average Maturity of Options Outstanding = 7.6 years
- Number of Options Outstanding = 47.728 million
- Standard Deviation of The Home Depot stock = 30%
- Value of Options Outstanding = $2,021 million

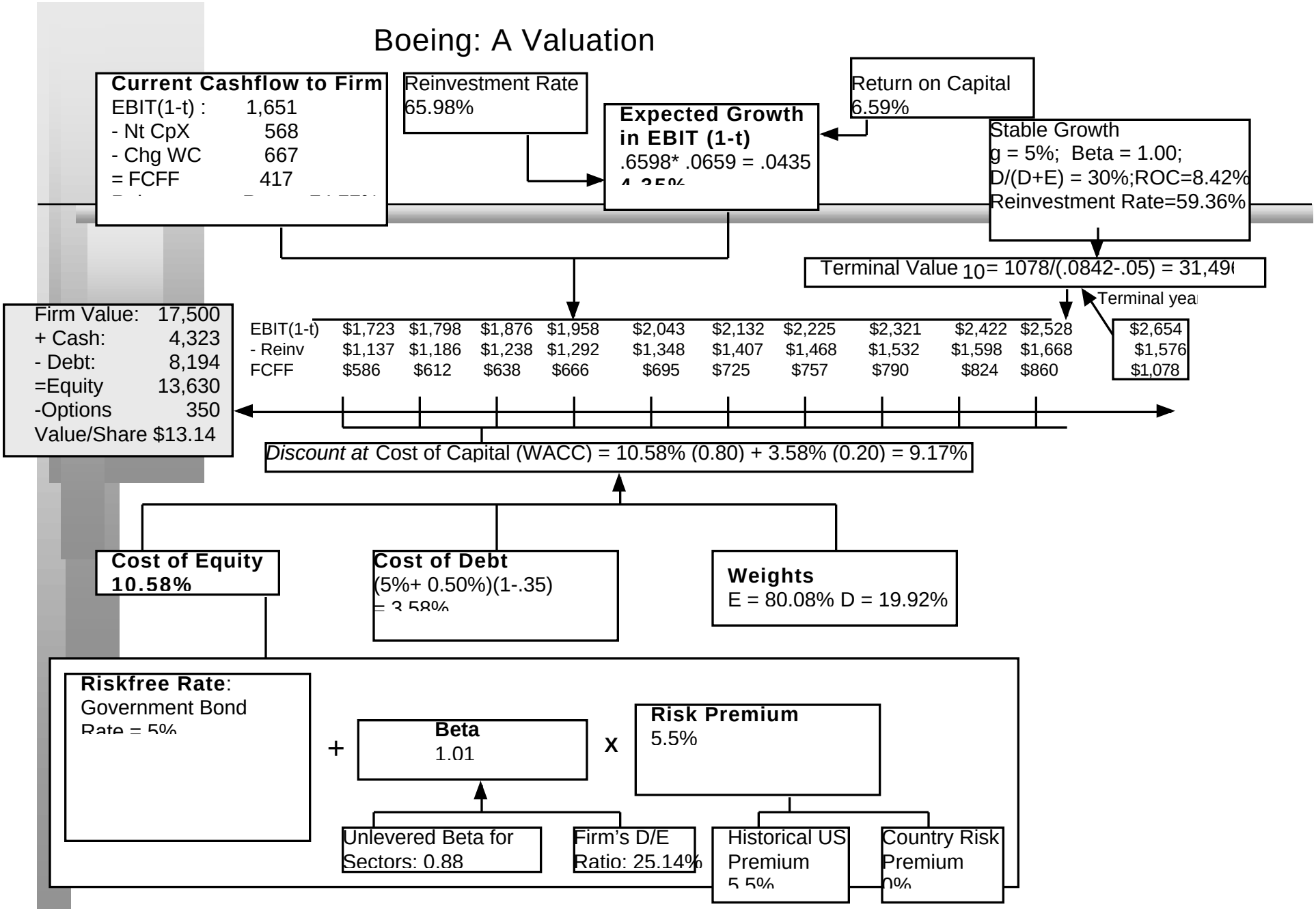
Steps in Getting to Value Per Share

- Step 1: Value the firm, using discounted cash flow or other valuation models.
- Step 2:Subtract out the value of the outstanding debt to arrive at the value of equity. Alternatively, skip step 1 and estimate the of equity directly.
- Step 3:Subtract out the market value (or estimated market value) of other equity claims:
  - Value of Warrants = Market Price per Warrant * Number of Warrants : Alternatively estimate the value using OPM
  - Value of Conversion Option = Market Value of Convertible Bonds - Value of Straight Debt Portion of Convertible Bonds
- Step 4:Divide the remaining value of equity by the number of shares outstanding to get value per share.

Boeing: Valuation - Summary of Inputs

	High Growth Phase	Stable Growth Phase
Length	10 years	Forever after year 10
Growth Inputs		
- Reinvestment Rate	65.98%	59.36%
- Return on Capital	6.59%%	8.42%
- Expected Growth rate	4.35%	5.00%
Cost of Capital Inputs		
- Beta	1.01	1.00
- Cost of Debt	5.50%	5.50%
- Debt Ratio	19.92%	30.00%
- Cost of Capital	9.17%	8.42%
General Information		
- Tax Rate	35%	35%

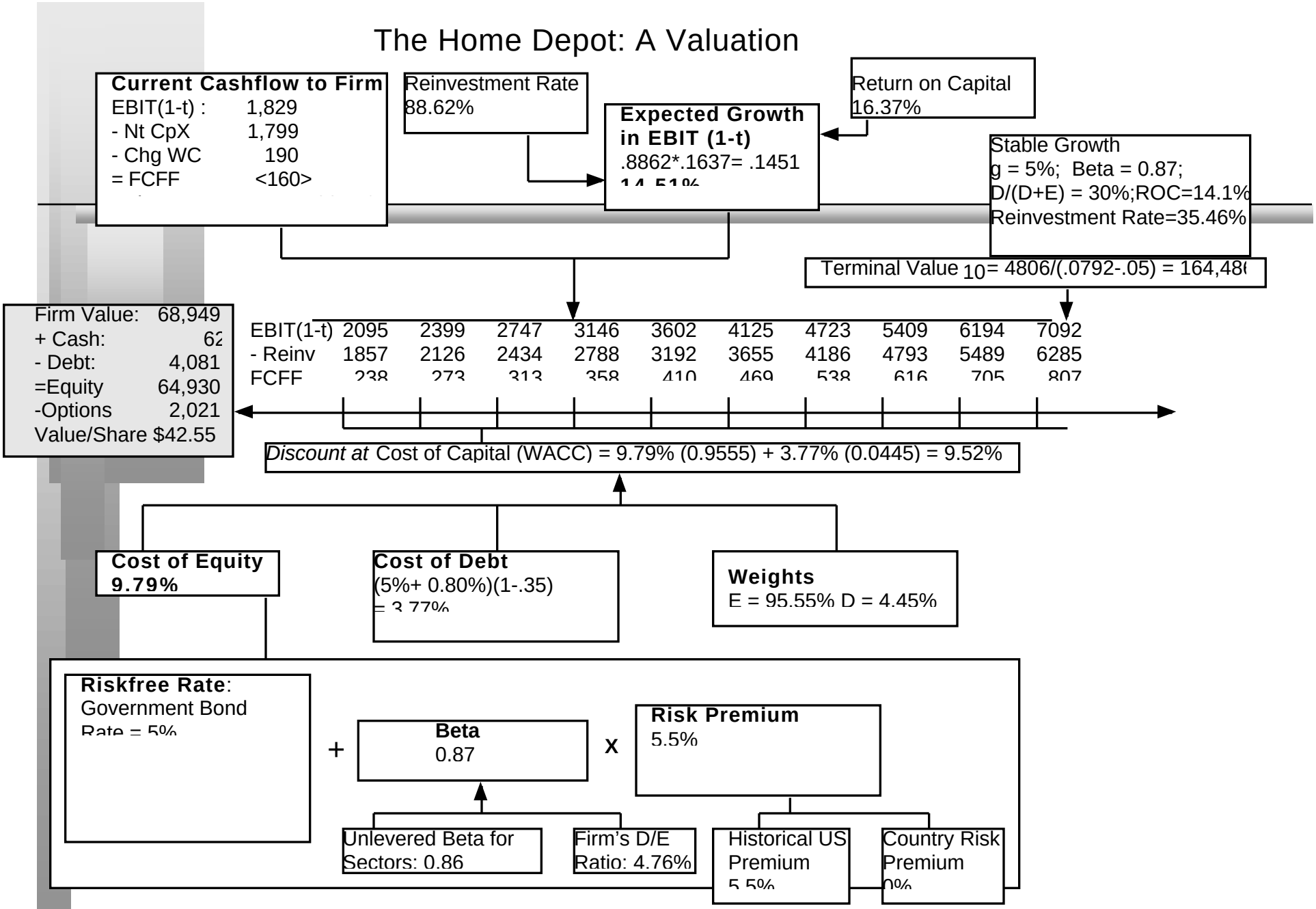
Boeing: A Valuation



The Home Depot: Valuation Inputs

	High Growth Phase	Stable Growth Phase
Length	10 years	Forever after year 10
Growth Inputs		
- Reinvestment Rate	88.62%	35.46%
- Return on Capital	16.37%	14.10%
- Expected Growth rate	14.51%	5.00%
Cost of Capital Inputs		
- Beta	0.87	0.87
- Cost of Debt	5.80%	5.50%
- Debt Ratio	4.55%	30.00%
- Cost of Capital	9.52%	7.92%
General Information		
- Tax Rate	35%	35%

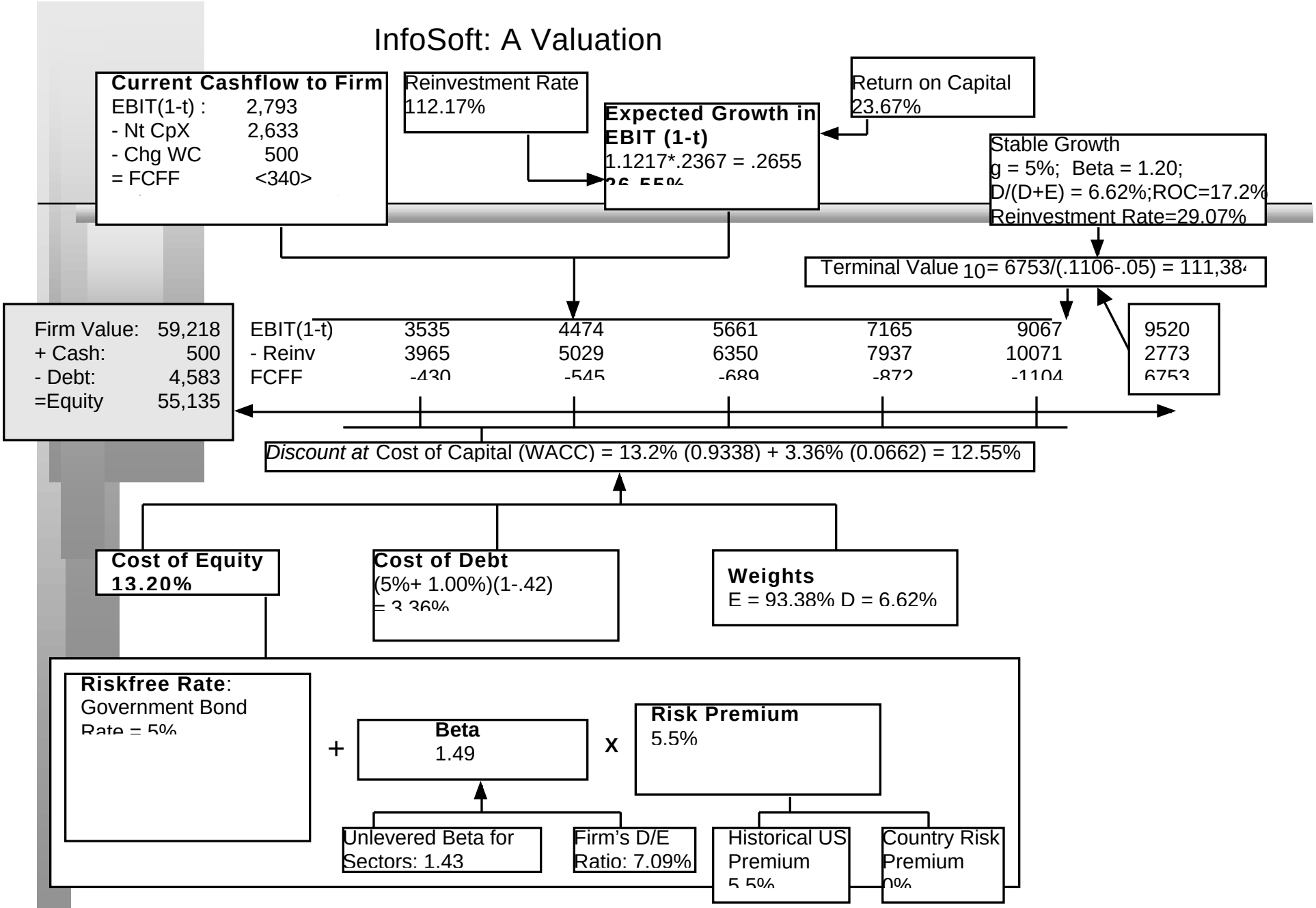
The Home Depot: A Valuation



InfoSoft: Valuation Estimates

	High Growth Phase	Stable Growth Phase
Length	5 years	Forever after year 5
Growth Inputs		
- Reinvestment Rate	112.17%	29.07%
- Return on Capital	23.67%	17.2%
- Expected Growth rate	26.55%	5.00%
Cost of Capital Inputs		
- Beta	1.49	1.20
- Cost of Debt	6.00%	6.00%
- Debt Ratio	6.62%	6.62%
- Cost of Capital	12.54%	11.05%
General Information		
- Tax Rate	42%	42%

InfoSoft: A Valuation



Relative Valuation

- In relative valuation, the value of an asset is derived from the pricing of 'comparable' assets, standardized using a common variable such as earnings, cashflows, book value or revenues. Examples include --
  - Price/Earnings (P/E) ratios
    - and variants (EBIT multiples, EBITDA multiples, Cash Flow multiples)
  - Price/Book (P/BV) ratios
    - and variants (Tobin's Q)
  - Price/Sales ratios

Equity Multiples: Determinants

- Gordon Growth Model: $P_0 = \frac{DPS_1}{r - g_n}$
- Dividing both sides by the earnings,

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

- Dividing both sides by the book value of equity,

$$\frac{P_0}{BV_0} = PBV = \frac{ROE * \text{Payout Ratio} * (1 + g_n)}{r - g_n}$$

- If the return on equity is written in terms of the retention ratio and the expected growth rate $\frac{P_0}{BV_0} = PBV = \frac{ROE - g_n}{r - g_n}$
- Dividing by the Sales per share,

$$\frac{P_0}{Sales_0} = PS = \frac{\text{Profit Margin} * \text{Payout Ratio} * (1 + g_n)}{r - g_n}$$

Firm Value Multiples

- The value of a firm in stable growth can be written as:

  Value of Firm =

- Dividing both sides by the expected free cash flow to the firm yields the Value/FCFF multiple for a stable growth firm:

- The value/EBITDA multiple, for instance, can be written as follows:

Determinants of Multiples

Multiple	*Determining Variables*
Price/Earnings Ratio	*Growth*, Payout, Risk
Price/Book Value Ratio	Growth, Payout, Risk, *ROE*
Price/Sales Ratio	Growth, Payout, Risk, *Net Margin*
Value/EBITDA	Growth, *Net Capital Expenditure needs*, Leverage, Risk
Value/Sales	Growth, Net Capital Expenditure needs, Leverage, Risk, *Operating Margin*
Value/Book Capital	Growth, Leverage, Risk and *ROC*

Companion variable is in italics.

Using Multiples based upon Comparables

- Simple Averages: The average multiple of comparable firms is used to value any firm. This works only if the firm is similar to the average firm in the sector.
- Adjusted Averages: Here, the average multiple is adjusted using one variable. For instance, the PE ratio may be divided by growth to arrive at a PEG ratio.
- Regression Estimates: Here, the multiple is regressed against one or more variables, and the regression is used to estimate the value any firm.

PE Ratios and Growth Rates: Software Firms

Company Name	*PE*	*Expected Growth*	*PEG*
Spanlink Communications	51.00	50%	1.02
Expert Software	11.18	15%	0.75
Applied Microsystems	10.74	20%	0.54
Tripos	9.73	25%	0.39
MathSoft	14.14	30%	0.47
Comshare	6.06	10%	0.61
Eagle Point Software	46.57	5%	9.31
TSR	12.56	20%	0.63
Computer Outsourcing Services	16.04	40%	0.40
Data Research Associates	12.14	15%	0.81
Mecon	46.55	30%	1.55
Forsoft	16.86	25%	0.67
HIE	39.53	38%	1.04
CFI ProServices	13.54	22%	0.62
Adept Technology	23.96	19%	1.26
TechForce	23.15	15%	1.54
InVision Technologies	9.83	23%	0.43
American Software A	8.33	30%	0.28
Viasoft	9.05	17%	0.53
Micrografx	122.17	35%	3.49
Orcad	18.14	16%	1.13
MySoftware	153.00	30%	5.10
Integrated Measurement Systems	15.71	11%	1.43
Jetform	10.87	20%	0.54
Aladdin Knowledge Systems	9.53	18%	0.53
Average	***28.41***	***23%***	***1.40***

Valuing InfoSoft

- Using Simple Average

  Value of Equity

  = InfoSoft Net Earnings in 1998* Average PE ratio for sector

  = $977,300 * 28.41 = $27.765 million

- Using Average Adjusted for Growth
  - PEG Ratio = 1.40
  - Expected Growth Rate for InfoSoft= 27.03%
  - Value of Equity = $977,300 million * 1.40 * 27.03 = $ 37.056 million

Boeing: Price to Book Ratios for Aerospace/Defense Firms

Company	*PBV*	*ROE*	*Standarad Deviation in Stock Prices*
AAR Corp.	1.83	11.85%	61.19%
Orbital Sci Corp	2.32	3.28%	32.46%
CAE Inc.	3.66	25.41%	36.63%
Alliant Techsystems	3.93	25.57%	26.07%
Precision Castparts	1.77	14.46%	47.02%
Howmet Intl	6.00	27.10%	27.62%
Cordant Techn.	3.33	13.95%	27.15%
Litton Inds.	2.49	15.38%	35.62%
Sundstrand Corp.	7.17	33.03%	18.15%
Northrop Grumman	1.59	11.02%	37.59%
Raytheon Co. 'A'	0.65	10.51%	36.12%
Gen'l Dynamics	4.22	16.40%	19.48%
Bombardier Inc. 'B'	4.46	16.23%	22.16%
Lockheed Martin	2.83	19.29%	39.07%
Boeing	3.50	9.09%	34.32%
Average	3.32	16.84%	33.38%

PBV Regression

- Regressing price to book ratios against returns on equity and risk (standard deviation), we get

PBV = 3.54 + 12.69 ROE –6.97 Standard Deviation R^2 = 76.15%

(2.97) (3.35) (2.41)

- Using this regression, we get a predicted price to book value ratio for Boeing, based upon its return on equity of 9.09% and a standard deviation of 34.32%:

Predicted PBV_{Boeing} = 3.54 + 12.69 (.0909) –6.97 (.3432) = 2.27

- Boeing, which is trading at 3.50 times book value, looks over valued.

Is Boeing fairly valued?

- Based upon the PBV ratio, is Boeing under, over or correctly valued?
  - Under Valued
  - Over Valued
  - Correctly Valued
- Will this valuation give you a higher or lower valuation than the discounted cashflow valuation?
  - Higher
  - Lower

Relative Valuation Assumptions

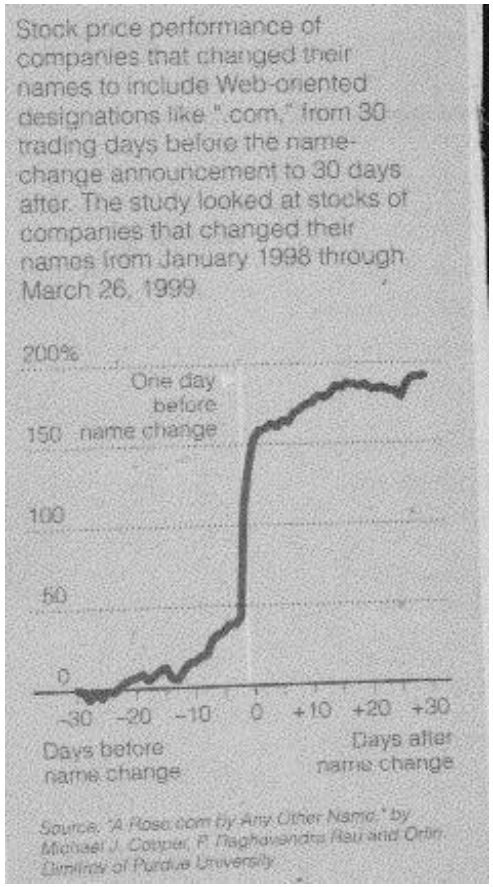
- Assume that you are reading an equity research report where a buy recommendation for a company is being based upon the fact that its PE ratio is lower than the average for the industry. Implicitly, what is the underlying assumption or assumptions being made by this analyst?
  - The sector itself is, on average, fairly priced
  - The earnings of the firms in the group are being measured consistently
  - The firms in the group are all of equivalent risk
  - The firms in the group are all at the same stage in the growth cycle
  - The firms in the group are of equivalent risk and have similar cash flow patterns
  - All of the above

Value Enhancement: Back to Basics

Aswath Damodaran

http://www.stern.nyu.edu/~adamodar

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

A Basic Proposition

- For an action to affect the value of the firm, it has to
  - Affect current cash flows (or)
  - Affect future growth (or)
  - Affect the length of the high growth period (or)
  - Affect the discount rate (cost of capital)
- **Proposition 1: Actions that do not affect current cash flows, future growth, the length of the high growth period or the discount rate cannot affect value.**

Value-Neutral Actions

- Stock splits and stock dividends change the number of units of equity in a firm, but cannot affect firm value since they do not affect cash flows, growth or risk.
- Accounting decisions that affect reported earnings but not cash flows should have no effect on value.
  - Changing inventory valuation methods from FIFO to LIFO or vice versa in financial reports but not for tax purposes
  - Changing the depreciation method used in financial reports (but not the tax books) from accelerated to straight line depreciation
  - Major non-cash restructuring charges that reduce reported earnings but are not tax deductible
  - Using pooling instead of purchase in acquisitions cannot change the value of a target firm.
- Decisions that create new securities on the existing assets of the firm (without altering the financial mix) such as tracking stock cannot create value, though they might affect perceptions and hence the price.

Value Creation 1: Increase Cash Flows from Assets in Place

- The assets in place for a firm reflect investments that have been made historically by the firm. To the extent that these investments were poorly made and/or poorly managed, it is possible that value can be increased by increasing the after-tax cash flows generated by these assets.
- The cash flows discounted in valuation are after taxes and reinvestment needs have been met:

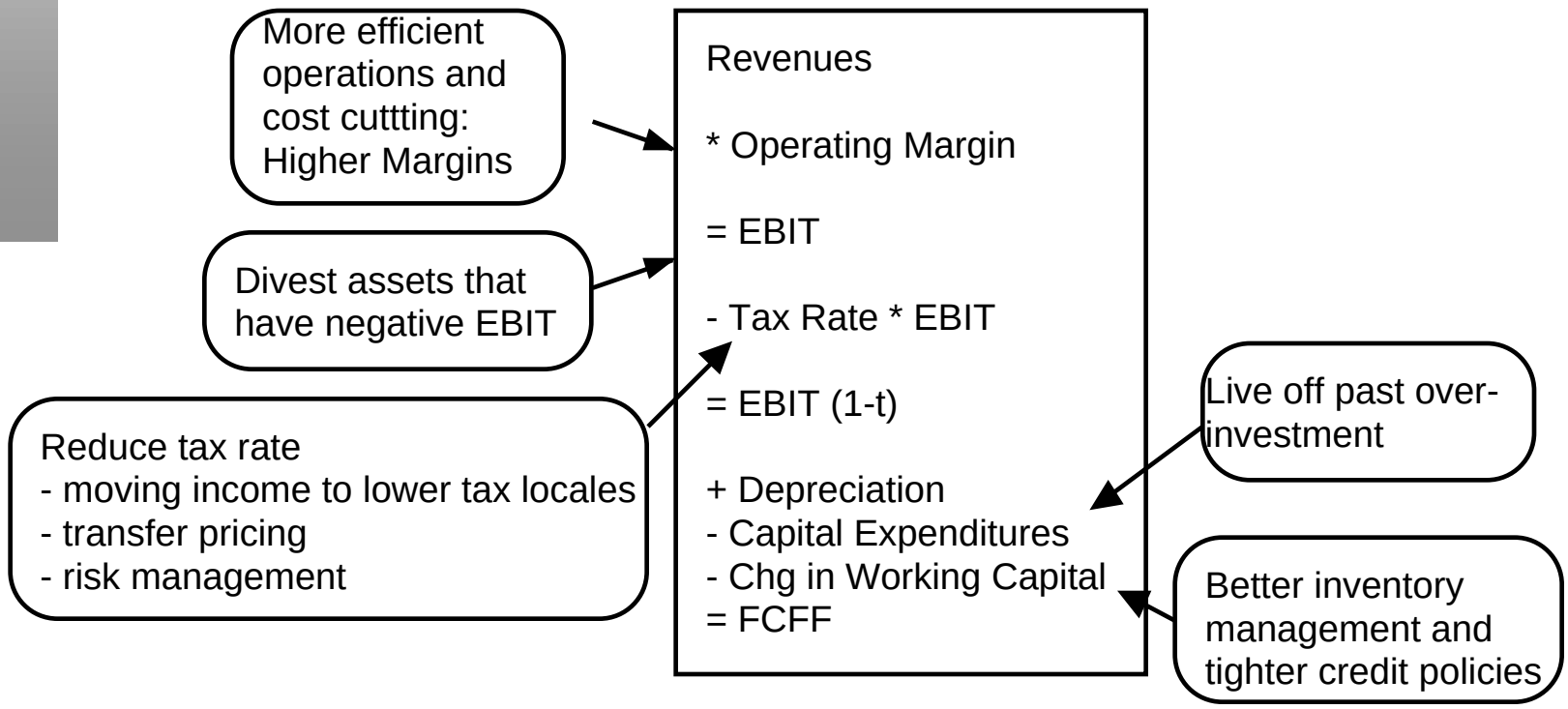
  EBIT (1-t)

  - (Capital Expenditures - Depreciation)

  - Change in Non-cash Working Capital

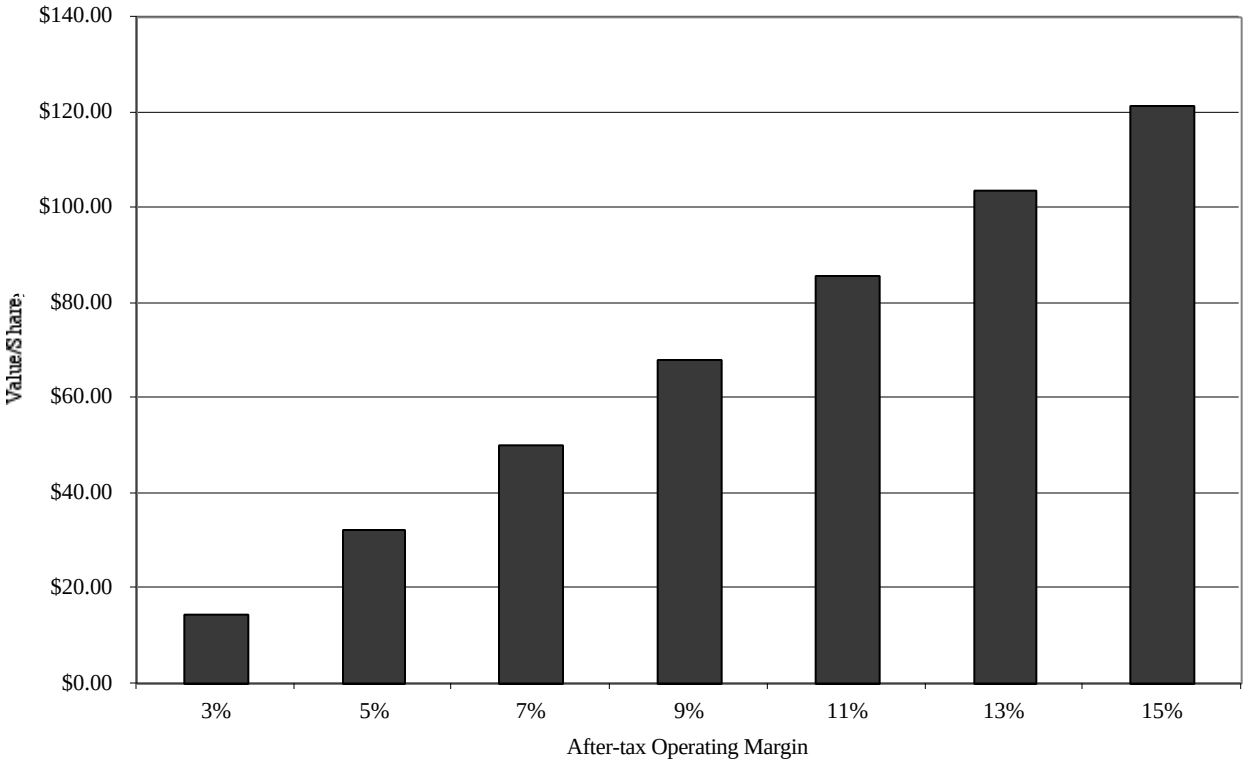
  = Free Cash Flow to Firm
- Proposition 2: A firm that can increase its current cash flows, without significantly impacting future growth or risk, will increase its value.

Ways of Increasing Cash Flows from Assets in Place



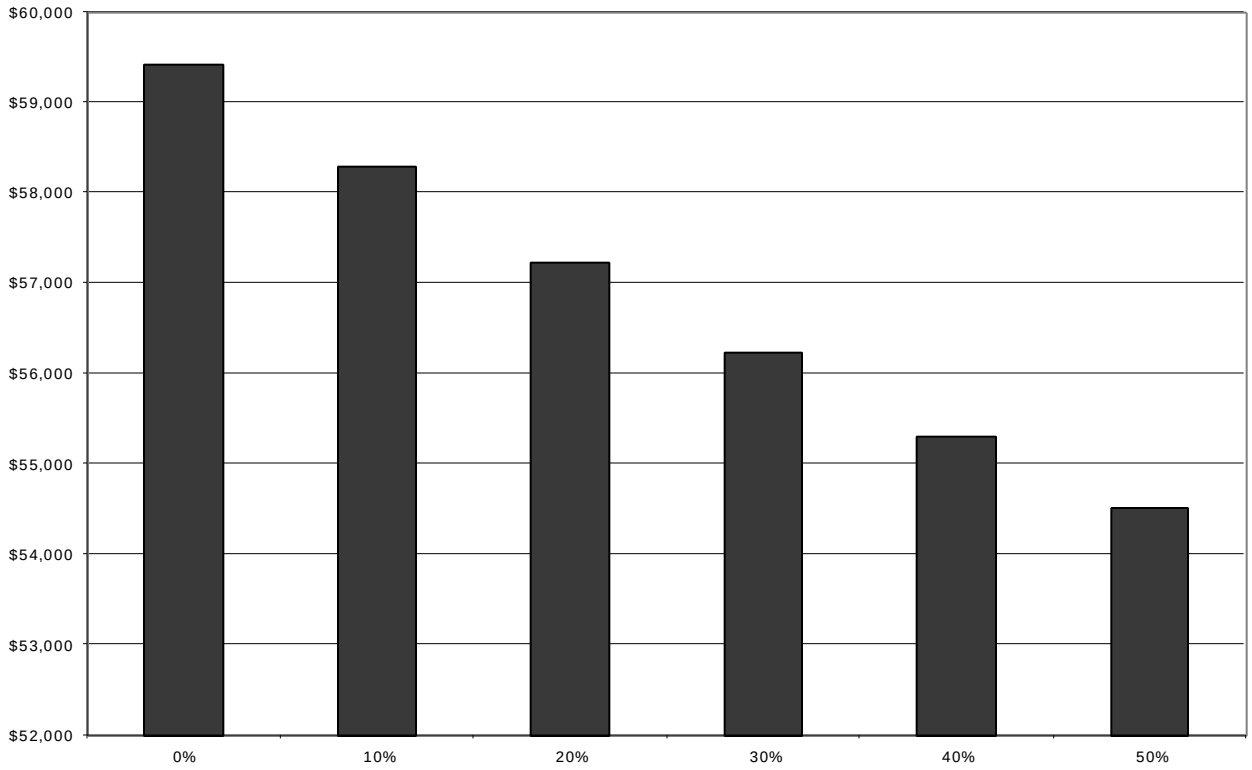
Operating Margin and Value Per Share: Boeing

Figure 25.2: Boeing: Operating Margin Effect on Value



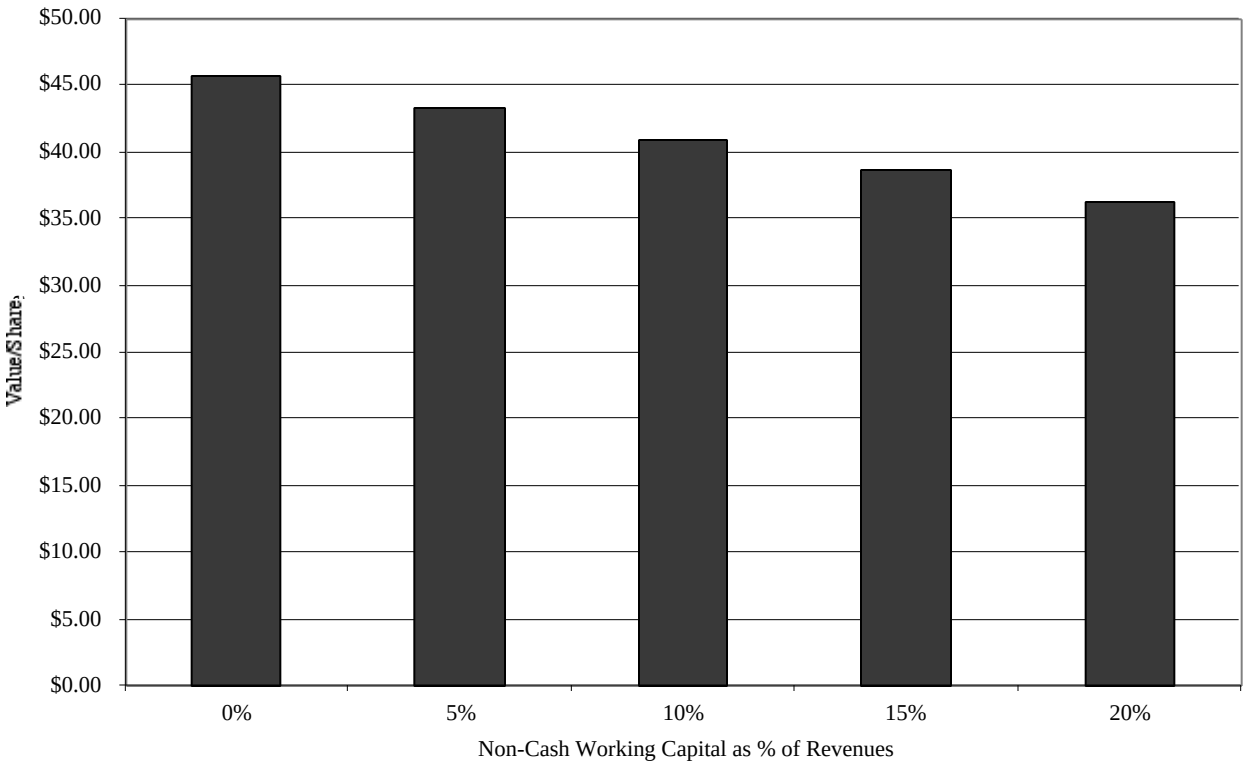
Tax Rate and Value: InfoSoft

Figure 25.3: Tax Rate and InfoSoft Value



Working Capital and Value: The Home Depot

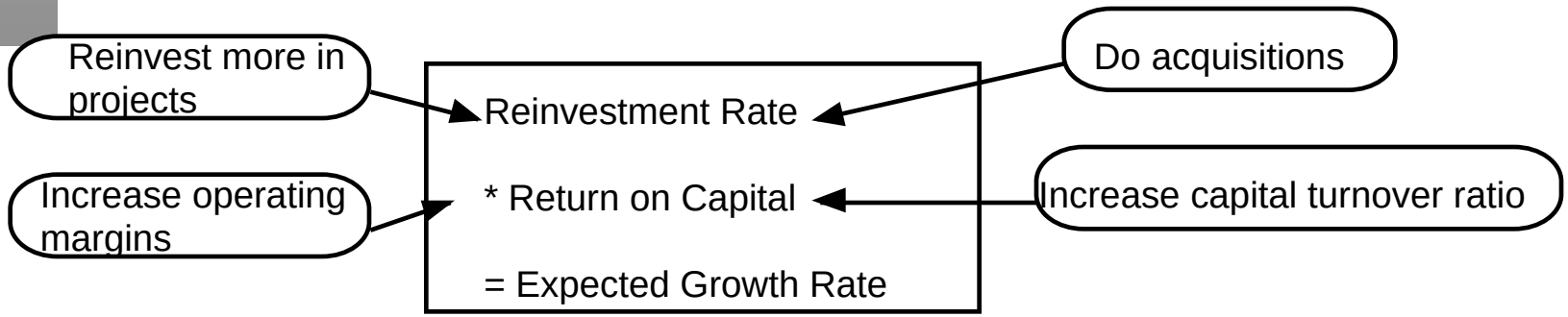
Figure 25.5: The Home Depot: Working Capital and Value/Share



Value Creation 2: Increase Expected Growth

- Keeping all else constant, increasing the expected growth in earnings will increase the value of a firm.
- The expected growth in earnings of any firm is a function of two variables:
  - The amount that the firm reinvests in assets and projects
  - The quality of these investments

Value Enhancement through Growth

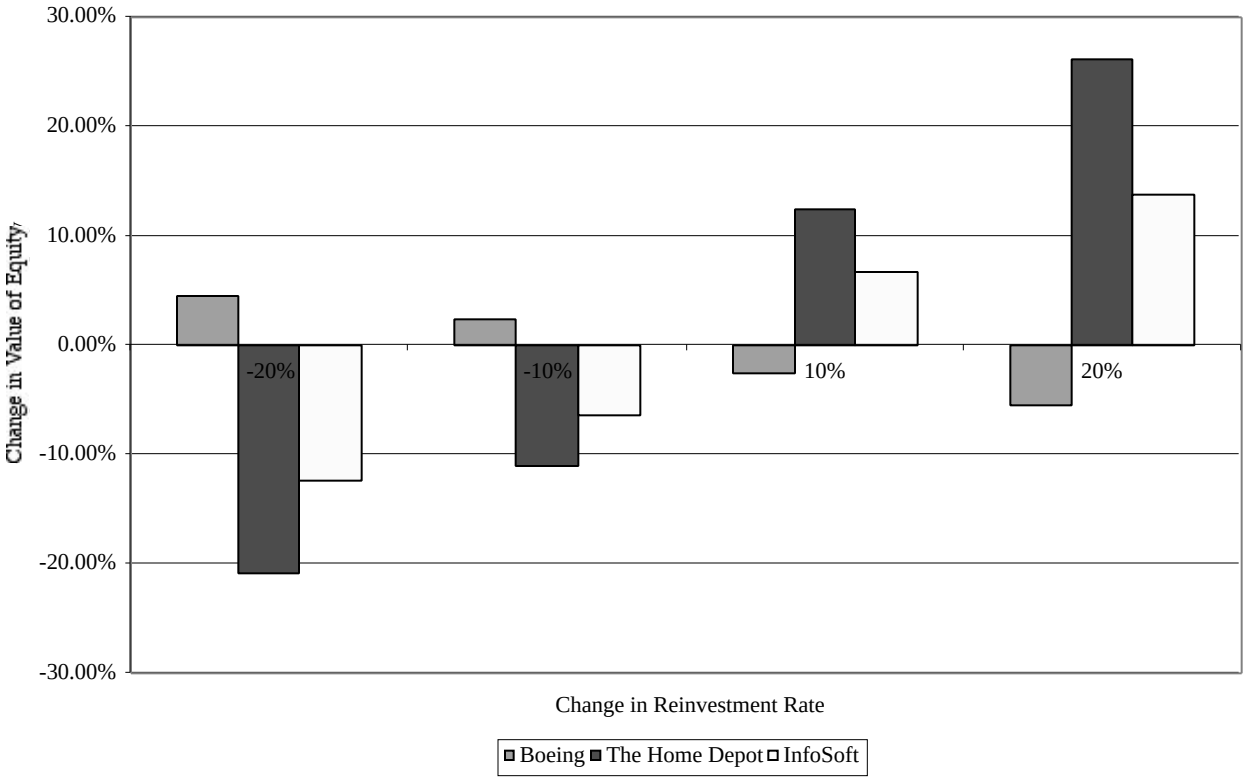


Reviewing the Valuation Inputs

	Boeing	*The Home Depot*	*InfoSoft*
Cost of Capital	9.17%	9.51%	12.55%
Return on Capital	6.59%	16.38%	23.67%
Reinvestment Rate	65.98%	88.62%	112.17%
Expected Growth Rate	5.72%	14.51%	27.03%
Value Per Share	$13.14	$42.55	$55.15

Changing the Reinvestment Rate

Figure 25.6: Effect of Changes in the Reinvestment Rate on the Value of Ec



Reinvestment Rate and Value

- Increasing the reinvestment rate increases value per share at The Home Depot and InfoSoft, but reduces it at Boeing. Why?

Value Creation 3: Increase Length of High Growth Period

- Every firm, at some point in the future, will become a stable growth firm, growing at a rate equal to or less than the economy in which it operates.
- The high growth period refers to the period over which a firm is able to sustain a growth rate greater than this "stable" growth rate.
- If a firm is able to increase the length of its high growth period, other things remaining equal, it will increase value.
- The length of the high growth period is a direct function of the competitive advantages that a firm brings into the process. Creating new competitive advantage or augmenting existing ones can create value.

3.1: The Brand Name Advantage

- Some firms are able to sustain above-normal returns and growth because they have well-recognized brand names that allow them to charge higher prices than their competitors and/or sell more than their competitors.
- Firms that are able to improve their brand name value over time can increase both their growth rate and the period over which they can expect to grow at rates above the stable growth rate, thus increasing value.

Illustration: Valuing a brand name: Coca Cola

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

3.2: Patents and Legal Protection

- The most complete protection that a firm can have from competitive pressure is to own a patent, copyright or some other kind of legal protection allowing it to be the sole producer for an extended period.
- Note that patents only provide partial protection, since they cannot protect a firm against a competitive product that meets the same need but is not covered by the patent protection.
- Licenses and government-sanctioned monopolies also provide protection against competition. They may, however, come with restrictions on excess returns; utilities in the United States, for instance, are monopolies but are regulated when it comes to price increases and returns.

3.3: Switching Costs

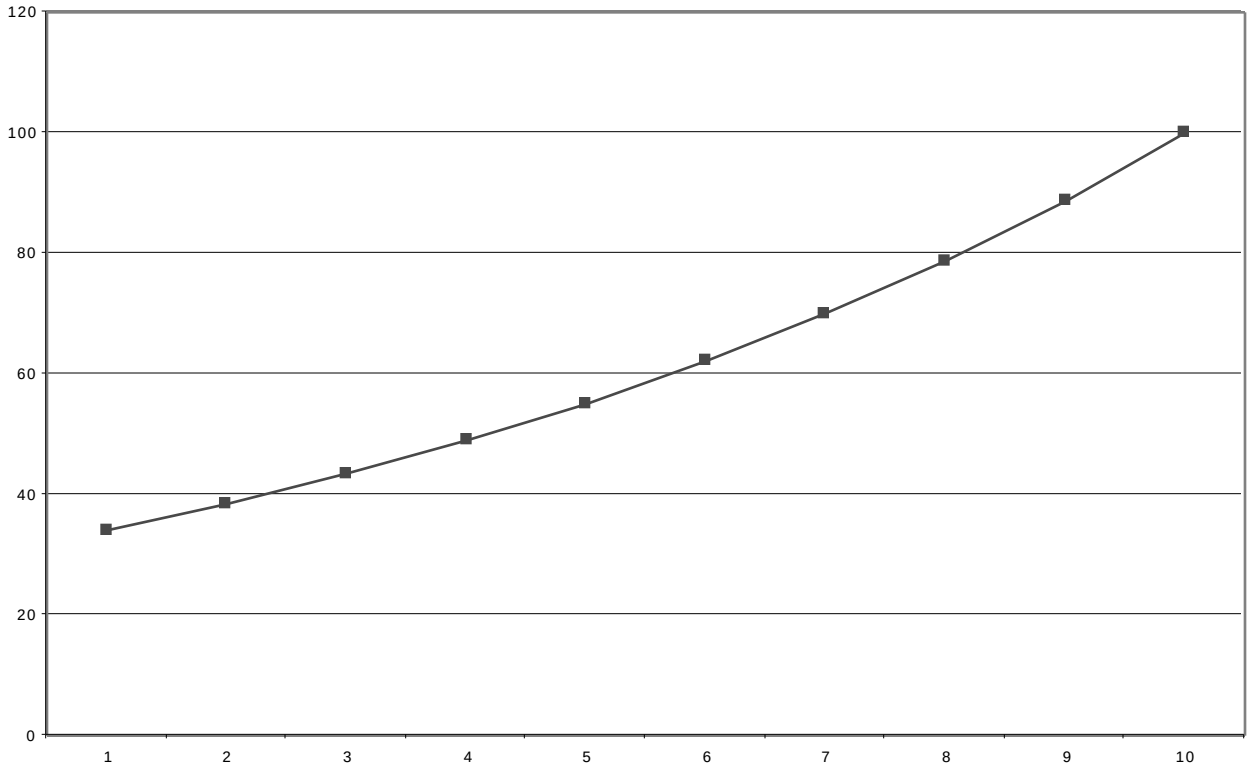
- Another potential barrier to entry is the cost associated with switching from one firm's products to another.
- The greater the switching costs, the more difficult it is for competitors to come in and compete away excess returns.
- Firms that devise ways to increase the cost of switching from their products to competitors' products, while reducing the costs of switching from competitor products to their own will be able to increase their expected length of growth.

3.4: Cost Advantages

- There are a number of ways in which firms can establish a cost advantage over their competitors, and use this cost advantage as a barrier to entry:
  - In businesses, where scale can be used to reduce costs, economies of scale can give bigger firms advantages over smaller firms
  - Owning or having exclusive rights to a distribution system can provide firms with a cost advantage over its competitors.
  - Owning or having the rights to extract a natural resource which is in restricted supply (The undeveloped reserves of an oil or mining company, for instance)
- These cost advantages will show up in valuation in one of two ways:
  - The firm may charge the same price as its competitors, but have a much higher operating margin.
  - The firm may charge lower prices than its competitors and have a much higher capital turnover ratio.

Growth Period and Value: InfoSoft

Figure 25.7: Value of InfoSoft and Expected Growth Period



Gauging Barriers to Entry

- Which of the following barriers to entry are most likely to work for the firm that you are analyzing?
  - Brand Name
  - Patents and Legal Protection
  - Switching Costs
  - Cost Advantages

Value Creation 4: Reduce Cost of Capital

- The cost of capital for a firm can be written as:

$$\text{Cost of Capital} = k_e \left(E/(D+E)\right) + k_d \left(D/(D+E)\right)$$

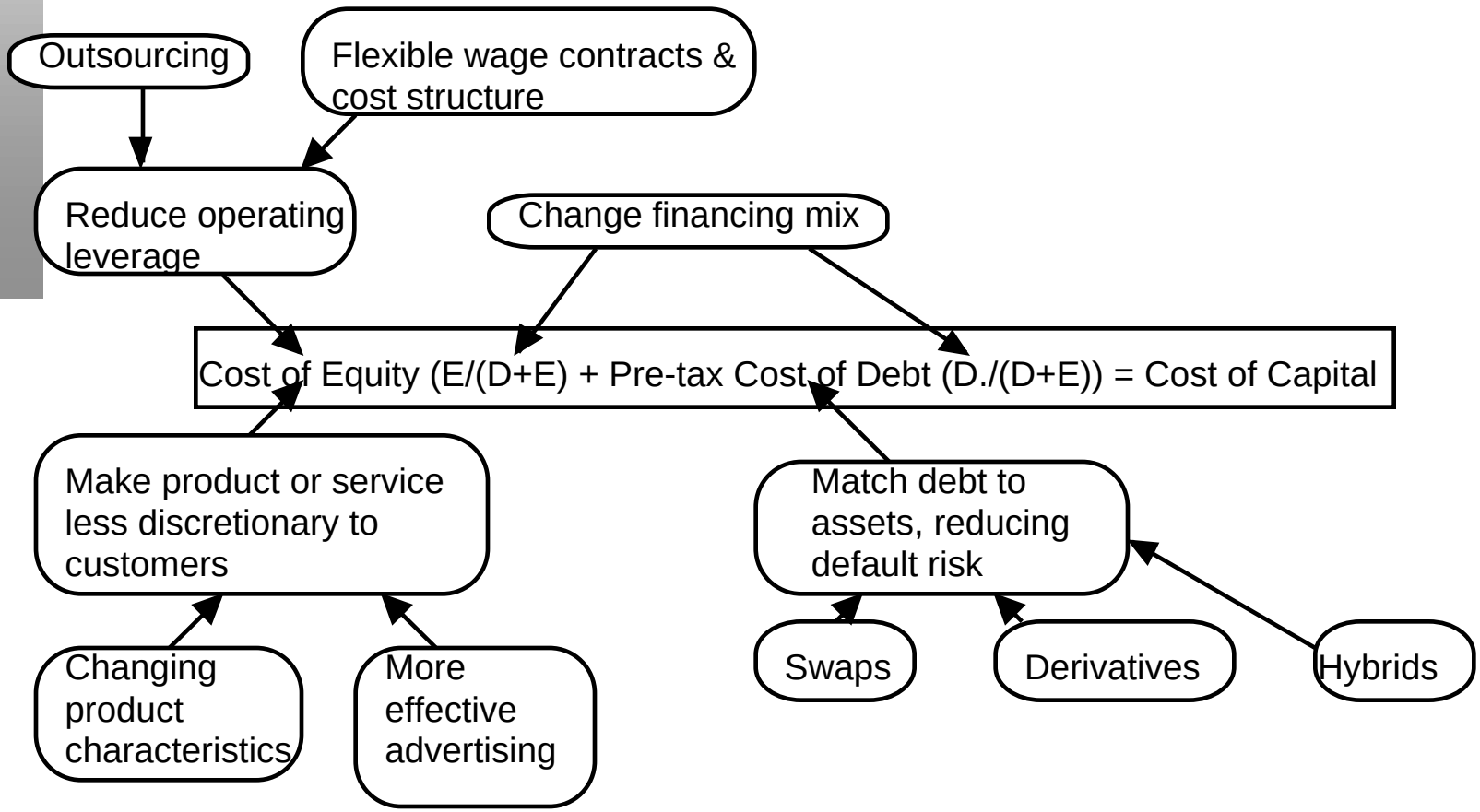
Where,

k_e = Cost of Equity for the firm

k_d = Borrowing rate (1 - tax rate)

- The cost of equity reflects the rate of return that equity investors in the firm would demand to compensate for risk, while the borrowing rate reflects the current long-term rate at which the firm can borrow, given current interest rates and its own default risk.
- The cash flows generated over time are discounted back to the present at the cost of capital. Holding the cash flows constant, reducing the cost of capital will increase the value of the firm.

Reducing Cost of Capital



Actual versus Optimal Debt Ratios

	Current		*Optimal*	
	Debt Ratio	*Cost of Capital*	*Debt Ratio*	*Cost of Capital*
Boeing	20.09%	9.17%	30%	9.16%
The Home Depot	4.55%	9.51%	20%	9.23%
InfoSoft	6.55%	12.55%	20%	12.28%

Changing Financing Type

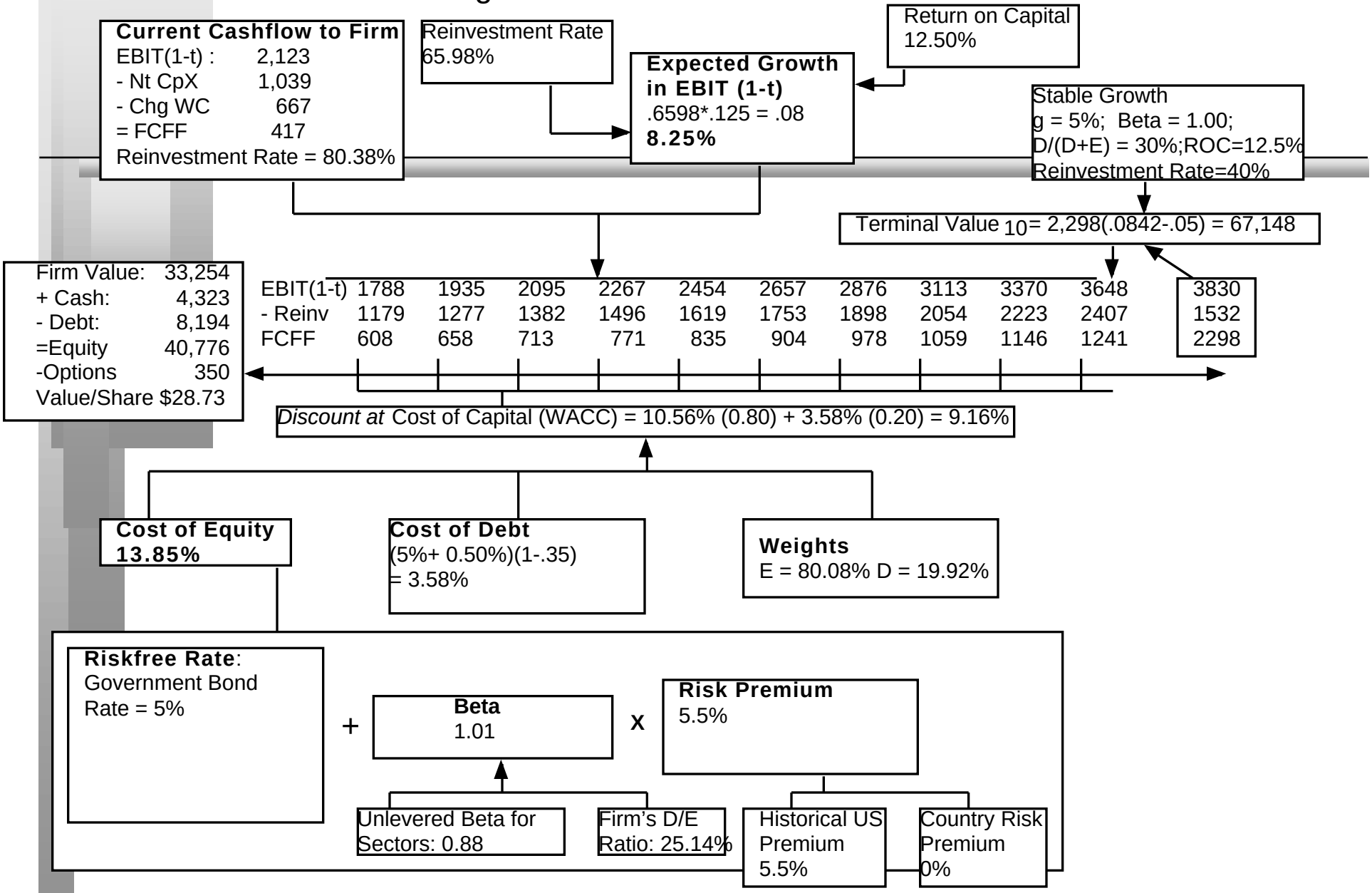
- The fundamental principle in designing the financing of a firm is to ensure that the cash flows on the debt should match as closely as possible the cash flows on the asset.
- By matching cash flows on debt to cash flows on the asset, a firm reduces its risk of default and increases its capacity to carry debt, which, in turn, reduces its cost of capital, and increases value.
- Firms which mismatch cash flows on debt and cash flows on assets by using
  - Short term debt to finance long term assets
  - Dollar debt to finance non-dollar assets
  - Floating rate debt to finance assets whose cash flows are negatively or not affected by inflation

  will end up with higher default risk, higher costs of capital and lower firm value.

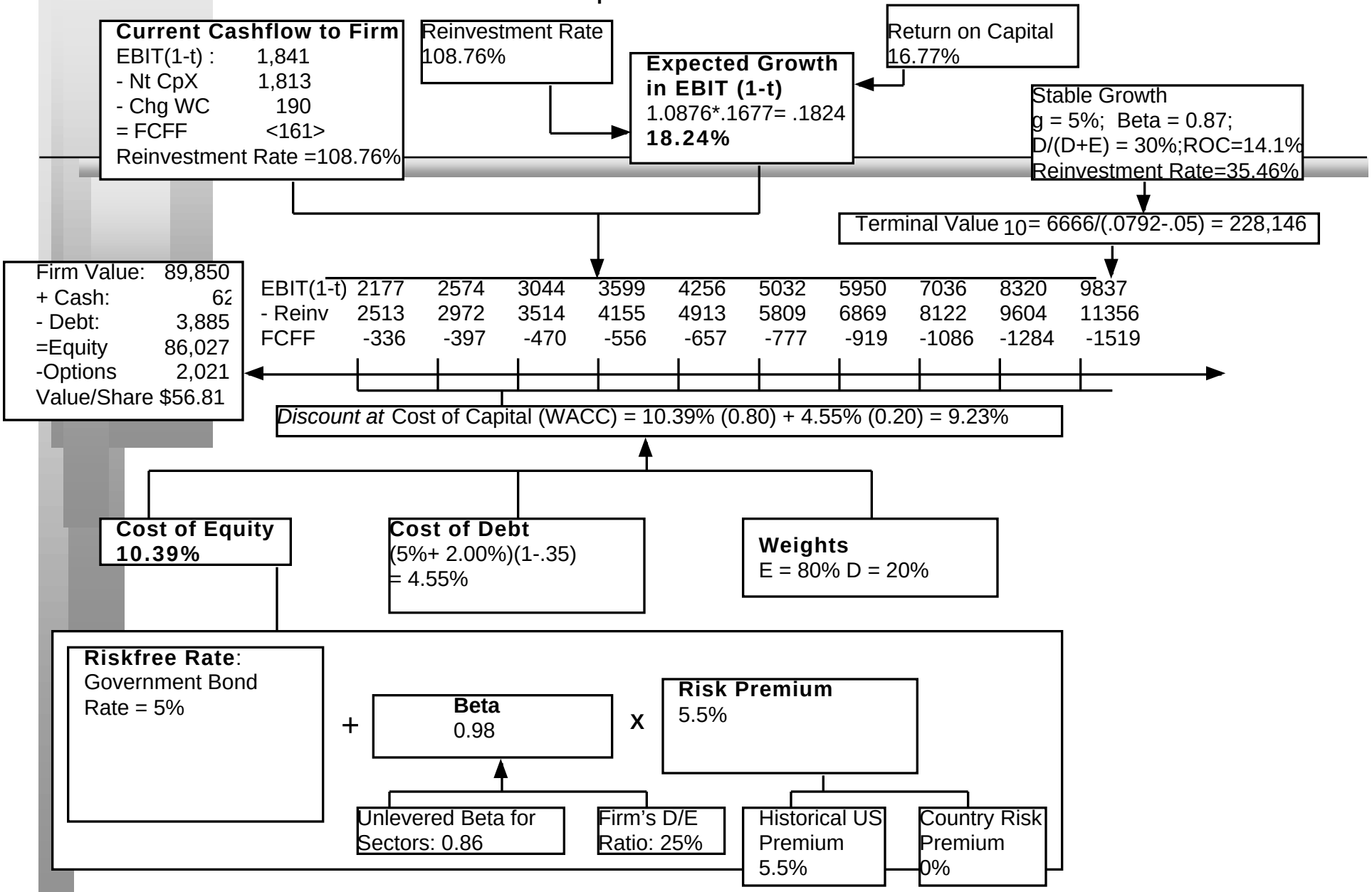
The Value Enhancement Chain

	Gimme'	*Odds on.*	*Could work if..*
Assets in Place	1. Divest assets/projects with Divestiture Value > Continuing Value 2. Terminate projects with Liquidation Value > Continuing Value 3. Eliminate operating expenses that generate no current revenues and no growth.	1. Reduce net working capital requirements, by reducing inventory and accounts receivable, or by increasing accounts payable. 2. Reduce capital maintenance expenditures on assets in place.	1. Change pricing strategy to maximize the product of profit margins and turnover ratio.
Expected Growth	Eliminate new capital expenditures that are expected to earn less than the cost of capital	Increase reinvestment rate or marginal return on capital or both in firm's existing businesses.	Increase reinvestment rate or marginal return on capital or both in new businesses.
Length of High Growth Period	If any of the firm's products or services can be patented and protected, do so	Use economies of scale or cost advantages to create higher return on capital.	1. Build up brand name 2. Increase the cost of switching from product and reduce cost of switching to it.
Cost of Financing	1. Use swaps and derivatives to match debt more closely to firm's assets 2. Recapitalize to move the firm towards its optimal debt ratio.	1. Change financing type and use innovative securities to reflect the types of assets being financed 2. Use the optimal financing mix to finance new investments. 3. Make cost structure more flexible to reduce operating leverage.	Reduce the operating risk of the firm, by making products less discretionary to customers.

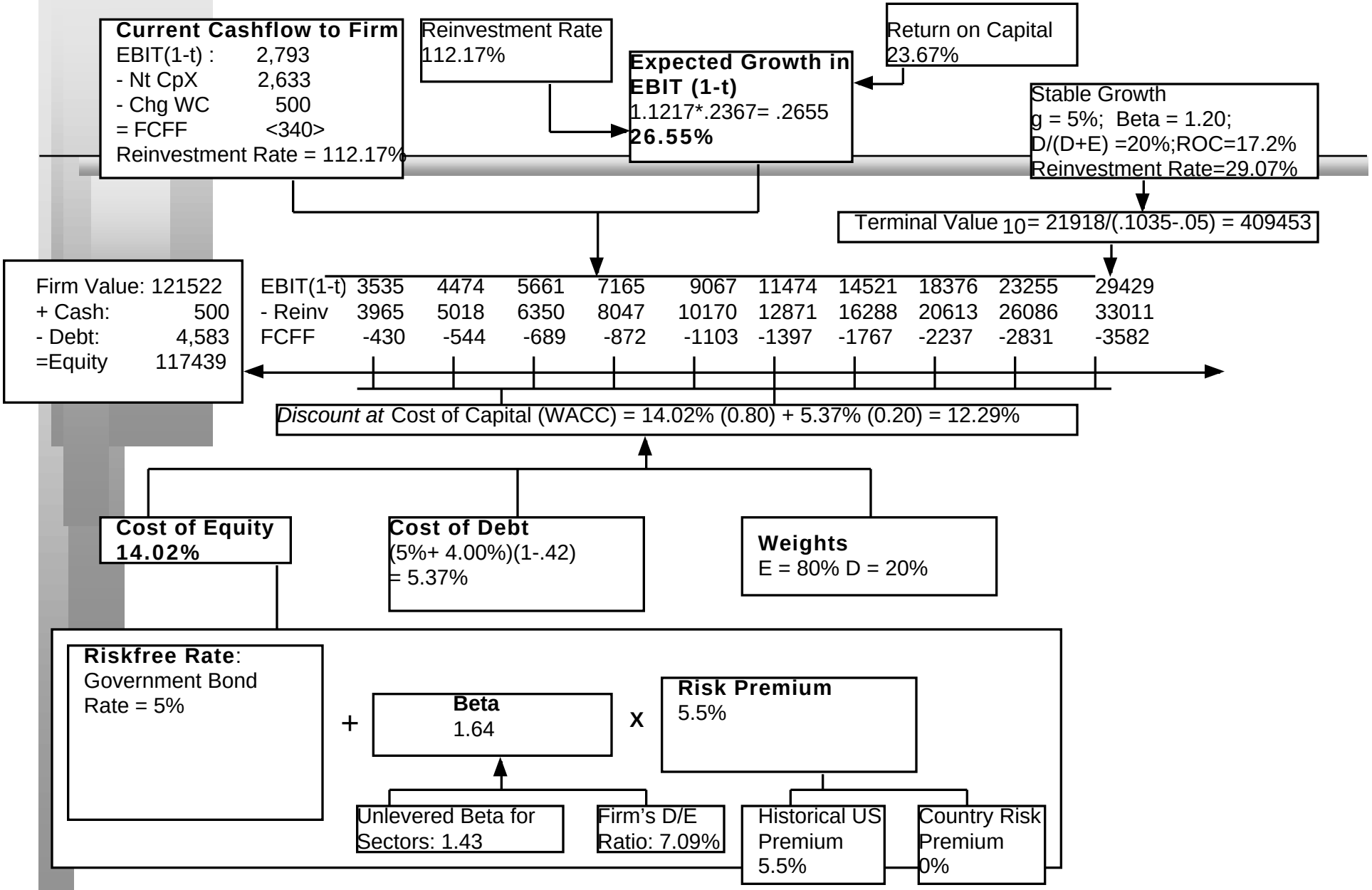
Boeing: A Restructured Valuation



The Home Depot: A Restructured Valuation



InfoSoft: A Restructured Valuation



First Principles

- Invest in projects that yield a return greater than the minimum acceptable hurdle rate.
  - The hurdle rate should be higher for riskier projects and reflect the financing mix used - owners' funds (equity) or borrowed money (debt)
  - Returns on projects should be measured based on cash flows generated and the timing of these cash flows; they should also consider both positive and negative side effects of these projects.
- Choose a financing mix that minimizes the hurdle rate and matches the assets being financed.
- If there are not enough investments that earn the hurdle rate, return the cash to stockholders.
  - The form of returns - dividends and stock buybacks - will depend upon the stockholders' characteristics.

Objective: Maximize the Value of the Firm

Picking the Right Investments: Investment Analysis

Aswath Damodaran

First Principles

- Invest in projects that yield a return greater than the **minimum acceptable hurdle rate**.
  - **The hurdle rate should be higher for riskier projects and reflect the financing mix used - owners' funds (equity) or borrowed money (debt)**
  - Returns on projects should be measured based on cash flows generated and the timing of these cash flows; they should also consider both positive and negative side effects of these projects.
- Choose a financing mix that minimizes the hurdle rate and matches the assets being financed.
- If there are not enough investments that earn the hurdle rate, return the cash to stockholders.
  - The form of returns - dividends and stock buybacks - will depend upon the stockholders' characteristics.

What is a investment or a project?

- Any decision that requires the use of resources (financial or otherwise) is a project.
- Broad strategic decisions
  - Entering new areas of business
  - Entering new markets
  - Acquiring other companies
- Tactical decisions
- Management decisions
  - The product mix to carry
  - The level of inventory and credit terms
- Decisions on delivering a needed service
  - Lease or buy a distribution system
  - Creating and delivering a management information system

The notion of a benchmark

- Since financial resources are finite, there is a hurdle that projects have to cross before being deemed acceptable.
- This hurdle will be higher for riskier projects than for safer projects.
- A simple representation of the hurdle rate is as follows:

  Hurdle rate = Riskless Rate + Risk Premium

- The two basic questions that every risk and return model in finance tries to answer are:
  - How do you measure risk?
  - How do you translate this risk measure into a risk premium?

What is Risk?

- Risk, in traditional terms, is viewed as a ‘negative’. Webster’s dictionary, for instance, defines risk as “exposing to danger or hazard”. The Chinese symbols for risk, reproduced below, give a much better description of risk

- The first symbol is the symbol for “danger”, while the second is the symbol for “opportunity”, making risk a mix of danger and opportunity.

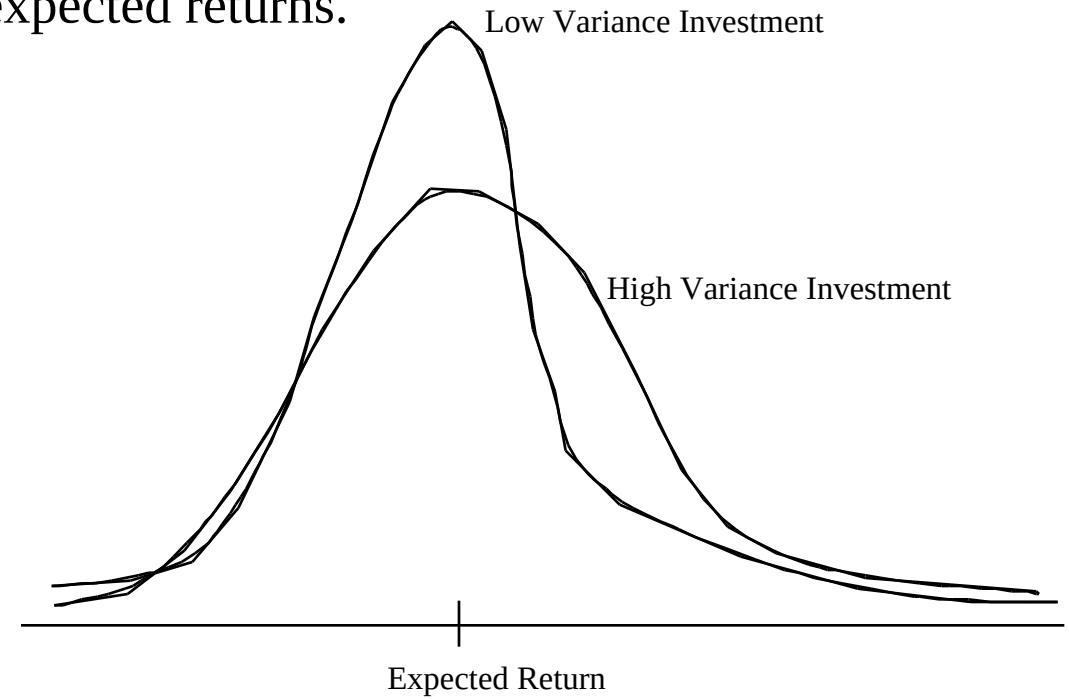
The Capital Asset Pricing Model

- Uses variance as a measure of risk
- Specifies that a portion of variance can be diversified away, and that is only the non-diversifiable portion that is rewarded.
- Measures the non-diversifiable risk with beta, which is standardized around one.
- Translates beta into expected return -

  Expected Return = Riskfree rate + Beta * Risk Premium
- Works as well as the next best alternative in most cases.

The Mean-Variance Framework

- The variance on any investment measures the disparity between actual and expected returns.



The Importance of Diversification: Risk Types

- The risk (variance) on any individual investment can be broken down into two sources. Some of the risk is specific to the firm, and is called firm-specific, whereas the rest of the risk is market wide and affects all investments.
- The risk faced by a firm can be fall into the following categories –
  - (1) Project-specific; an individual project may have higher or lower cash flows than expected.
  - (2) Competitive Risk, which is that the earnings and cash flows on a project can be affected by the actions of competitors.
  - (3) Industry-specific Risk, which covers factors that primarily impact the earnings and cash flows of a specific industry.
  - (4) International Risk, arising from having some cash flows in currencies other than the one in which the earnings are measured and stock is priced
  - (5) Market risk, which reflects the effect on earnings and cash flows of macro economic factors that essentially affect all companies

The Effects of Diversification

- Firm-specific risk can be reduced, if not eliminated, by increasing the number of investments in your portfolio (i.e., by being diversified). Market-wide risk cannot. This can be justified on either economic or statistical grounds.
- On economic grounds, diversifying and holding a larger portfolio eliminates firm-specific risk for two reasons-
  - (a) Each investment is a much smaller percentage of the portfolio, muting the effect (positive or negative) on the overall portfolio.
  - (b) Firm-specific actions can be either positive or negative. In a large portfolio, it is argued, these effects will average out to zero. (For every firm, where something bad happens, there will be some other firm, where something good happens.)

The Role of the Marginal Investor

- The marginal investor in a firm is the investor who is most likely to be the buyer or seller on the next trade.
- Since trading is required, the largest investor may not be the marginal investor, especially if he or she is a founder/manager of the firm (Michael Dell at Dell Computers or Bill Gates at Microsoft)
- In all risk and return models in finance, we assume that the marginal investor is well diversified.

The Market Portfolio

- Assuming diversification costs nothing (in terms of transactions costs), and that all assets can be traded, the limit of diversification is to hold a portfolio of every single asset in the economy (in proportion to market value). This portfolio is called the market portfolio.
- Individual investors will adjust for risk, by adjusting their allocations to this market portfolio and a riskless asset (such as a T-Bill)

Preferred risk level	*Allocation decision*
No risk	100% in T-Bills
Some risk	50% in T-Bills; 50% in Market Portfolio;
A little more risk	25% in T-Bills; 75% in Market Portfolio
Even more risk	100% in Market Portfolio
A risk hog..	Borrow money; Invest in market portfolio;

- Every investor holds some combination of the risk free asset and the market portfolio.

The Risk of an Individual Asset

- The risk of any asset is the risk that it adds to the market portfolio
- Statistically, this risk can be measured by how much an asset moves with the market (called the covariance)
- Beta is a standardized measure of this covariance
- Beta is a measure of the non-diversifiable risk for any asset can be measured by the covariance of its returns with returns on a market index, which is defined to be the asset's beta.
- The cost of equity will be the required return,

$$\text{Cost of Equity} = R_f + \text{Equity Beta} * (E(R_m) - R_f)$$

where,

R_f = Riskfree rate

$E(R_m)$ = Expected Return on the Market Index

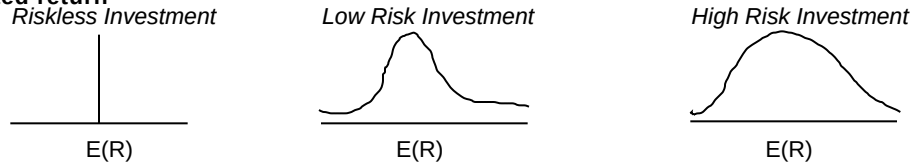
Limitations of the CAPM

- 1. The model makes unrealistic assumptions
- 2. The parameters of the model cannot be estimated precisely
  - - Definition of a market index
  - - Firm may have changed during the 'estimation' period'
- 3. The model does not work well
  - - If the model is right, there should be
    - a linear relationship between returns and betas
    - the only variable that should explain returns is betas
  - - The reality is that
    - the relationship between betas and returns is weak
    - Other variables (size, price/book value) seem to explain differences in returns better.

Alternatives to the CAPM

Step 1: Defining Risk

The risk in an investment can be measured by the variance in actual returns around an expected return



Step 2: Differentiating between Rewarded and Unrewarded Risk

Risk that is specific to investment (Firm Specific)
Can be diversified away in a diversified portfolio
1. each investment is a small proportion of portfolio
2. risk averages out across investments in portfolio

Risk that affects all investments (Market Risk)
Cannot be diversified away since most assets are affected by it.

The marginal investor is assumed to hold a "diversified" portfolio. Thus, only market risk will be rewarded and priced.

Step 3: Measuring Market Risk

The CAPM	**The APM**	**Multi-Factor Models**	**Proxy Models**
If there is 1. no private information 2. no transactions cost the optimal diversified portfolio includes every traded asset. Everyone will hold this market portfolio **Market Risk = Risk added by any investment to the market portfolio:**	If there are no arbitrage opportunities then the market risk of any asset must be captured by betas relative to factors that affect all investments. **Market Risk = Risk exposures of any asset to market factors**	Since market risk affects most or all investments, it must come from macro economic factors. **Market Risk = Risk exposures of any asset to macro economic factors.**	In an efficient market, differences in returns across long periods mus be due to market risk differences. Looking for variables correlated with returns should then give us proxies for this risk. **Market Risk = Captured by the Proxy Variable(s)**
Beta of asset relative to Market portfolio (from a regression)	Betas of asset relative to unspecified market factors (from a factor analysis)	Betas of assets relative to specified macro economic factors (from a regression)	Equation relating returns to proxy variables (from a regression)

⌛Application Test: Who is the marginal investor in your firm?

- Looking at the top 15 stockholders in your firm again, consider whether the marginal investor is
  - An institutional investor
  - An individual investor
  - The manager(s) of the firm

Inputs required to use the CAPM -

(a) the current risk-free rate

(b) the expected market risk premium (the premium expected for investing in risky assets over the riskless asset)

(c) the beta of the asset being analyzed.

The Riskfree Rate and Time Horizon

- On a riskfree asset, the actual return is equal to the expected return.
- Therefore, there is no variance around the expected return.
- For an investment to be riskfree, i.e., to have an actual return be equal to the expected return, two conditions have to be met –
  - There has to be no default risk, which generally implies that the security has to be issued by the government. Note, however, that not all governments can be viewed as default free.
  - There can be no uncertainty about reinvestment rates, which implies that it is a zero coupon security with the same maturity as the cash flow being analyzed.

Riskfree Rate in Practice

- The riskfree rate is the rate on a zero coupon government bond matching the time horizon of the cash flow being analyzed.
- Theoretically, this translates into using different riskfree rates for each cash flow - the 1 year zero coupon rate for the cash flow in year 2, the 2-year zero coupon rate for the cash flow in year 2 ...
- Practically speaking, if there is substantial uncertainty about expected cash flows, the present value effect of using time varying riskfree rates is small enough that it may not be worth it.

The Bottom Line on Riskfree Rates

- Using a long term government rate (even on a coupon bond) as the riskfree rate on all of the cash flows in a long term analysis will yield a close approximation of the true value.
- For short term analysis, it is entirely appropriate to use a short term government security rate as the riskfree rate.
- If the analysis is being done in real terms (rather than nominal terms) use a real riskfree rate, which can be obtained in one of two ways –
  - from an inflation-indexed government bond, if one exists
  - set equal, approximately, to the long term real growth rate of the economy in which the valuation is being done.

Measurement of the risk premium

- The risk premium is the premium that investors demand for investing in an average risk investment, relative to the riskfree rate.
- As a general proposition, this premium should be
  - greater than zero
  - increase with the risk aversion of the investors in that market
  - increase with the riskiness of the “average” risk investment

What is your risk premium?

- Assume that stocks are the only risky assets and that you are offered two investment options:
  - a riskless investment (say a Government Security), on which you can make 6.7%
  - a mutual fund of all stocks, on which the returns are uncertain

How much of an expected return would you demand to shift your money from the riskless asset to the mutual fund?

- Less than 6.7%
- Between 6.7 - 7.8%
- Between 8.7 - 10.7%
- Between 10.7 - 12.7%
- Between 12.7 - 14.7%
- More than 14.7%

Risk Aversion and Risk Premiums

- If this were the capital market line, the risk premium would be a weighted average of the risk premiums demanded by each and every investor.
- The weights will be determined by the magnitude of wealth that each investor has. Thus, Warren Bufffet's risk aversion counts more towards determining the "equilibrium" premium than yours' and mine.
- As investors become more risk averse, you would expect the "equilibrium" premium to increase.

Risk Premiums do change..

Go back to the previous example. Assume now that you are making the same choice but that you are making it in the aftermath of a stock market crash (it has dropped 25% in the last month). Would you change your answer?

- I would demand a larger premium
- I would demand a smaller premium
- I would demand the same premium

Estimating Risk Premiums in Practice

- Survey investors on their desired risk premiums and use the average premium from these surveys.
- Assume that the actual premium delivered over long time periods is equal to the expected premium - i.e., use historical data
- Estimate the implied premium in today's asset prices.

The Survey Approach

- Surveying all investors in a market place is impractical.
- However, you can survey a few investors (especially the larger investors) and use these results. In practice, this translates into surveys of money managers' expectations of expected returns on stocks over the next year.
- The limitations of this approach are:
  - there are no constraints on reasonability (the survey could produce negative risk premiums or risk premiums of 50%)
  - they are extremely volatile
  - they tend to be short term; even the longest surveys do not go beyond one year

The Historical Premium Approach

- This is the default approach used by most to arrive at the premium to use in the model
- In most cases, this approach does the following
  - it defines a time period for the estimation (1926-Present, 1962-Present....)
  - it calculates average returns on a stock index during the period
    - it calculates average returns on a riskless security over the period
      - it calculates the difference between the two
      - and uses it as a premium looking forward
- The limitations of this approach are:
  - it assumes that the risk aversion of investors has not changed in a systematic way across time. (The risk aversion may change from year to year, but it reverts back to historical averages)
  - it assumes that the riskiness of the "risky" portfolio (stock index) has not changed in a systematic way across time.

Historical Average Premiums for the United States

Historical period	Stocks - T.Bills		Stocks - T.Bonds	
	Arith	Geom	Arith	Geom
1926-1999	9.41%	8.14%	7.64%	6.60%
1962-1999	7.07%	6.46%	5.96%	5.74%
1981-1999	13.24%	11.62%	16.08%	14.17%

What is the right historical premium?

- Go back as far as you can. Otherwise, the standard error in the estimate will be large. The standard error in the risk premium estimate is roughly equal to
  - Standard Error in Risk premium = Annual Standard deviation in Stock prices / Square root of the number of years of historical data
  - With an annual standard deviation in stock prices of 24% and 25 years of data, for instance, the standard error would be

    Standard Error of Estimate = 24%/ √25 = 4.8%
- Be consistent in your use of a riskfree rate. If you use the T.Bill(T.Bond) rate, use the spread over the T.Bill (T.Bond) rate.
- Use arithmetic premiums for one-year estimates of costs of equity and geometric premiums for estimates of long term costs of equity.

What about historical premiums for other markets?

- Historical data for markets outside the United States tends to be sketch and unreliable.
- Ibbotson, for instance, estimates the following premiums for major markets from 1970-1996

Country	*Annual Return on*	*Annual Return on*	*Equity Risk Premium*
Australia	8.47%	6.99%	1.48%
France	11.51%	9.17%	2.34%
Germany	11.30%	12.10%	-0.80%
Italy	5.49%	7.84%	-2.35%
Japan	15.73%	12.69%	3.04%
Mexico	11.88%	10.71%	1.17%
Singapore	15.48%	6.45%	9.03%
Spain	8.22%	7.91%	0.31%
Switzerland	13.49%	10.11%	3.38%
UK	12.42%	7.81%	4.61%

Assessing Country Risk Using Currency Ratings: Latin America - June 1999

Country	*Rating*	*Default Spread over US T.Bond*
Argentina	Ba3	525
Bolivia	B1	600
Brazil	B2	750
Chile	Baa1	150
Colombia	Baa3	200
Ecuador	B3	850
Paraguay	B2	750
Peru	Ba3	525
Uruguay	Baa3	200
Venezuela	B2	750

Using Country Ratings to Estimate Equity Spreads

- The simplest way of estimating a country risk premium for another country is to add the default spread for that country to the US risk premium (treating the US premium as the premium for a mature equity market). Thus, the risk premium for Argentina would be:

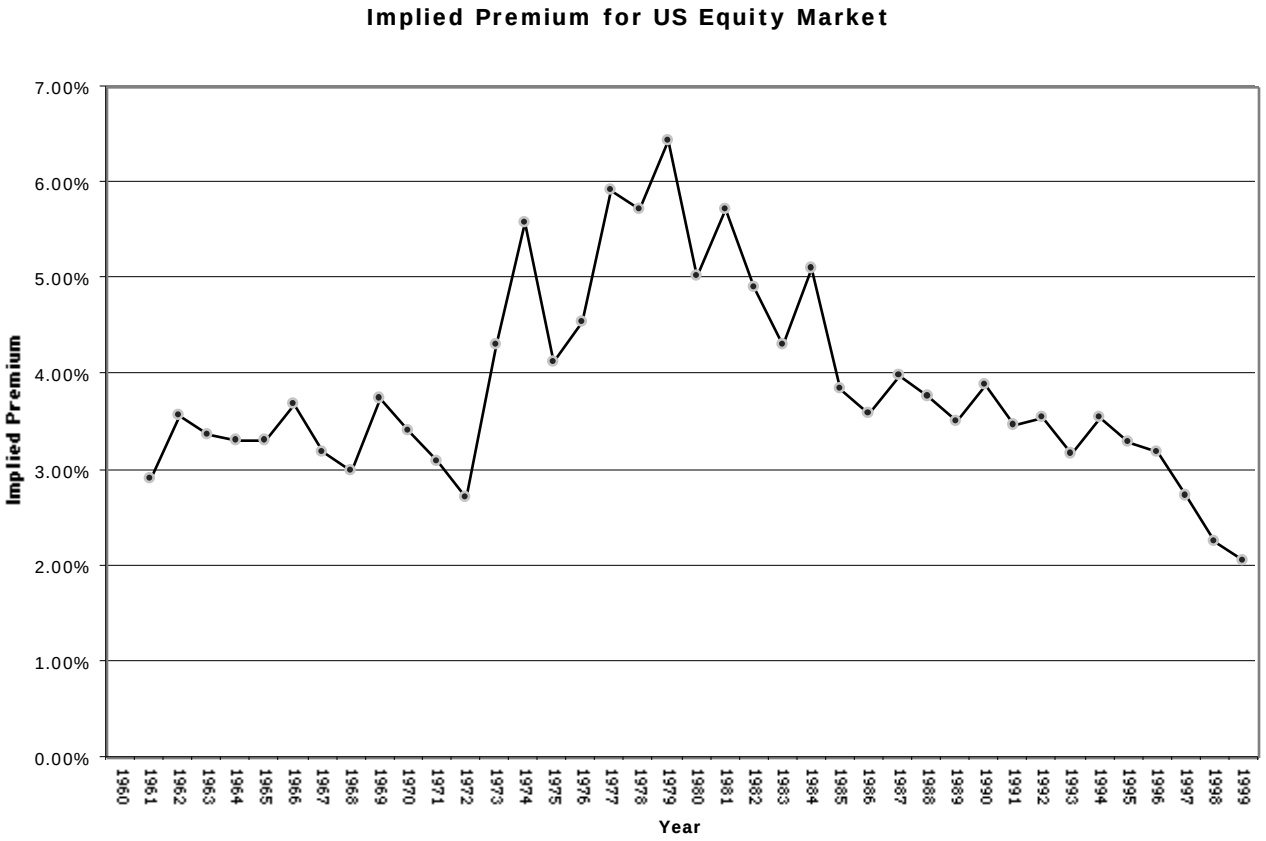
  Risk Premium = U.S. premium + 5.25%

- Country ratings measure default risk. While default risk premiums and equity risk premiums are highly correlated, one would expect equity spreads to be higher than debt spreads.
  - One way to estimate it is to multiply the bond spread by the relative volatility of stock and bond prices in that market. For example,
    - Standard Deviation in Merval (Equity) = 42.87%
    - Standard Deviation in Argentine Long Bond = 21.37%
    - Adjusted Equity Spread = 5.25% (42.87/21.37) = 10.53%

Implied Equity Premiums

- If we use a basic discounted cash flow model, we can estimate the implied risk premium from the current level of stock prices.
- For instance, if stock prices are determined by the simple Gordon Growth Model:
  - Value = Expected Dividends next year/ (Required Returns on Stocks - Expected Growth Rate)
  - Plugging in the current level of the index, the dividends on the index and expected growth rate will yield a “implied” expected return on stocks. Subtracting out the riskfree rate will yield the implied premium.
- The problems with this approach are:
  - the discounted cash flow model used to value the stock index has to be the right one.
  - the inputs on dividends and expected growth have to be correct
  - it implicitly assumes that the market is currently correctly valued

Implied Premiums in the US



Application Test: A Market Risk Premium

- Based upon our discussion of historical risk premiums so far, the risk premium looking forward should be:
- About 10%, which is what the arithmetic average premium has been since 1981, for stocks over T.Bills
- About 6%, which is the geometric average premum since 1926, for stocks over T.Bonds
- About 2%, which is the implied premium in the stock market today

In Summary...

- The historical risk premium is 6.6%, if we use a geometric risk premium, and much higher, if we use arithmetic averages.
- The implied risk premium is much lower. Even if we use liberal estimates of cashflows (dividends +stock buybacks) and high expected growth rates, the implied premium is about 4% and probably lower.
- We will use a risk premium of 5.5%, because
  - The historical risk premium is much too high to use in a market, where equities are priced with with premiums of 4% or lower.
  - The implied premium might be too low, especially if we believe that markets can become overvalued.

Estimating Beta

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

$$R_j = a + b\ R_m$$

  - where a is the intercept and b is the slope of the regression.
- The slope of the regression corresponds to the beta of the stock, and measures the riskiness of the stock.

Estimating Performance

- The intercept of the regression provides a simple measure of performance during the period of the regression, relative to the capital asset pricing model.

$R_j = R_f + b (R_m - R_f)$

$= R_f (1-b) + b R_m$ ..... Capital Asset Pricing Model

$R_j = a + b R_m$ ..... Regression Equation

- If

$a > R_f (1-b)$ .... Stock did better than expected during regression period

$a = R_f (1-b)$ .... Stock did as well as expected during regression period

$a < R_f (1-b)$ .... Stock did worse than expected during regression period

- This is Jensen's alpha.

Firm Specific and Market Risk

- The R squared (R^2) of the regression provides an estimate of the proportion of the risk (variance) of a firm that can be attributed to market risk;
- The balance ($1 - R^2$) can be attributed to firm specific risk.

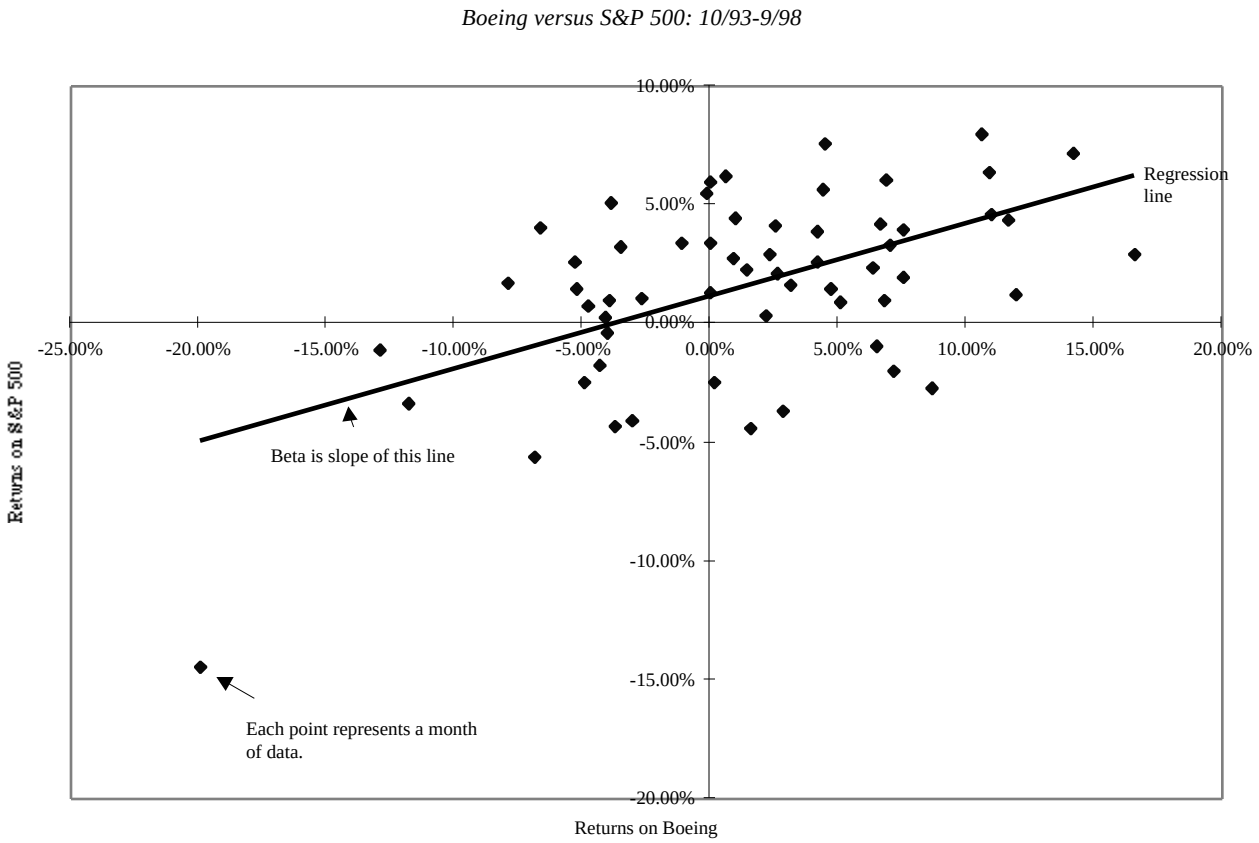
Setting up for the Estimation

- Decide on an estimation period
  - Services use periods ranging from 2 to 5 years for the regression
  - Longer estimation period provides more data, but firms change.
  - Shorter periods can be affected more easily by significant firm-specific event that occurred during the period (Example: ITT for 1995-1997)
- Decide on a return interval - daily, weekly, monthly
  - Shorter intervals yield more observations, but suffer from more noise.
  - Noise is created by stocks not trading and biases all betas towards one.
- Estimate returns (including dividends) on stock
  - Return = $(\text{Price}_{\text{End}} - \text{Price}_{\text{Beginning}} + \text{Dividends}_{\text{Period}})/ \text{Price}_{\text{Beginning}}$
  - Included dividends only in ex-dividend month
- Choose a market index, and estimate returns (inclusive of dividends) on the index for each interval for the period.

Choosing the Parameters: Boeing

- Period used: 5 years
- Return Interval = Monthly
- Market Index: S&P 500 Index.
- For instance, to calculate returns on Boeing in May 1995,
  - Price for Boeing at end of April= $ 27.50
  - Price for Boeing at end of May = $ 29.44
  - Dividends during month = $0.125 (It was an ex-dividend month)
  - Return =($29.44 - $ 27.50 + $ 0.125)/$ 27.50= 7.50%
- To estimate returns on the index in the same month
  - Index level (including dividends) at end of April = 514.7
  - Index level (including dividends) at end of May = 533.4
  - Dividends on the Index in May = 1.84
  - Return =(533.4-514.7+1.84)/ 514.7 = 3.99%

Boeing's Historical Beta



The Regression Output

- $\text{Returns}_{\text{Boeing}} = -0.09\% + 0.96\ \text{Returns}_{\text{S \& P 500}}$ (R squared=29.57%)
  (0.20)
- Intercept = -0.09%
- Slope = 0.96

Analyzing Boeing's Performance

- Intercept = -0.09%
- This is an intercept based on monthly returns. Thus, it has to be compared to a monthly riskfree rate.
- Between 1993 and 1998,
  - Monthly Riskfree Rate = 0.4% (Annual T.Bill rate divided by 12)
  - Riskfree Rate (1-Beta) = 0.4% (1-0.96) = .01%
- The Comparison is then between

Intercept	versus	Riskfree Rate (1 - Beta)
-0.09%	versus	0.4%(1-0.96)= 0.01%

- Jensen's Alpha = -0.09% -(0.01%) = -0.10%
- Boeing did 0.1% worse than expected, per month, between 1993 and 1998.
- Annualized, Boeing's annual excess return = (1-.0001)^12-1= -1.22%

More on Jensen's Alpha

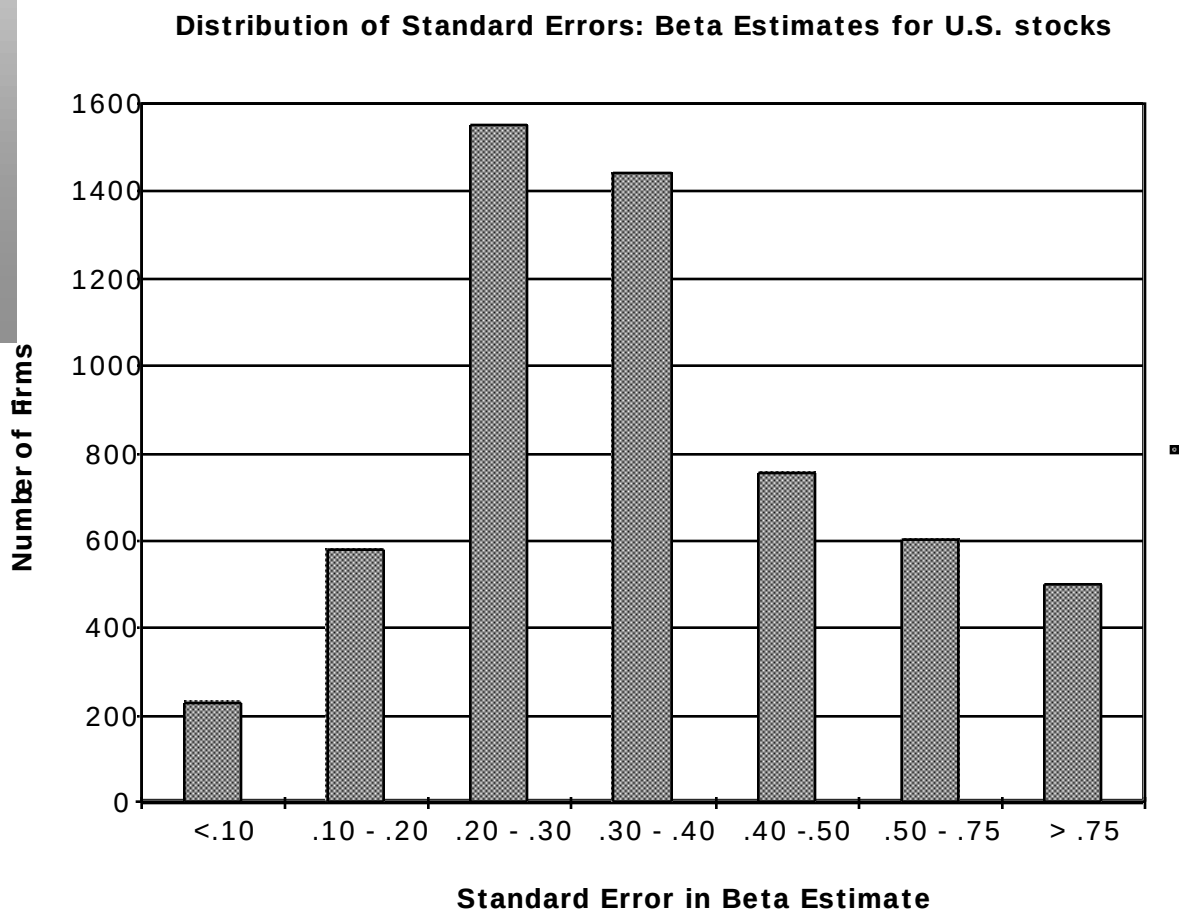
If you did this analysis on every stock listed on an exchange, what would the average Jensen's alpha be across all stocks?

- Depend upon whether the market went up or down during the period
- Should be zero
- Should be greater than zero, because stocks tend to go up more often than down

Estimating Boeing's Beta

- Slope of the Regression of 0.96 is the beta
- Regression parameters are always estimated with noise. The noise is captured in the standard error of the beta estimate, which in the case of Boeing is 0.20.
- Assume that I asked you what Boeing's true beta is, after this regression.
  - What is your best point estimate?
  - What range would you give me, with 67% confidence?
  - What range would you give me, with 95% confidence?

The Dirty Secret of "Standard Error"



Breaking down Boeing's Risk

- R Squared = 29.57%
- This implies that
  - 29.57% of the risk at Boeing comes from market sources
  - 70.43%, therefore, comes from firm-specific sources
- The firm-specific risk is diversifiable and will not be rewarded

The Relevance of R Squared

You are a diversified investor trying to decide whether you should invest in Boeing or Amgen. They both have betas of 0.96, but Boeing has an R Squared of 30% while Amgen's R squared of only 15%. Which one would you invest in?

- Amgen, because it has the lower R squared
- Boeing, because it has the higher R squared
- You would be indifferent

Would your answer be different if you were an undiversified investor?

Beta Estimation in Practice: Bloomberg

HISTORICAL BETA

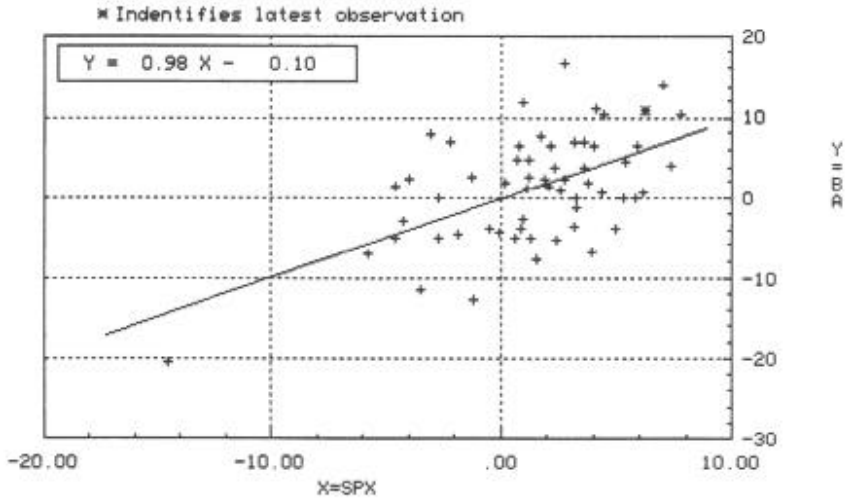
Number of points may be insufficient for an accurate beta.

BA **US** BOEING CO

Relative Index SPX S&P 500 INDEX

Period M
Range 10/29/93 To 9/30/98
Market U Trade

ADJ BETA	.98
RAW BETA	.98
Alpha (Intercept)	-.10
R2 (Correlation)	.31
Std Dev of Error	5.75
Std Error of Beta	.19
Number of Points	59



Adj beta = (0.67) * Raw Beta
+ (0.33) * 1.0

Estimating Expected Returns: December 31, 1998

- Boeing's Beta = 0.96
- Riskfree Rate = 5.00% (Long term Government Bond rate)
- Risk Premium = 5.50% (Approximate historical premium)
- Expected Return = 5.00% + 0.96 (5.50%) = 10.31%

Use to a Potential Investor in Boeing

As a potential investor in Boeing, what does this expected return of 10.31% tell you?

- This is the return that I can expect to make in the long term on Boeing, if the stock is correctly priced and the CAPM is the right model for risk,
- This is the return that I need to make on Boeing in the long term to break even on my investment in the stock
- Both

Assume now that you are an active investor and that your research suggests that an investment in Boeing will yield 25% a year for the next 5 years. Based upon the expected return of 10.31%, you would

- Buy the stock
- Sell the stock

How managers use this expected return

- Managers at Boeing
  - need to make at least 10.31% as a return for their equity investors to break even.
  - this is the hurdle rate for projects, when the investment is analyzed from an equity standpoint
- In other words, Boeing's cost of equity is 10.31%.
- What is the cost of not delivering this cost of equity?

Application Test: Analyzing the Risk Regression

- Using your Bloomberg risk and return print out, answer the following questions:
  - How well or badly did your stock do, relative to the market, during the period of the regression? (You can assume an annualized riskfree rate of 4.8% during the regression period)
  - What proportion of the risk in your stock is attributable to the market? What proportion is firm-specific?
  - What is the historical estimate of beta for your stock? What is the range on this estimate with 67% probability? With 95% probability?
  - Based upon this beta, what is your estimate of the required return on this stock?

A Quick Test

You are advising a very risky software firm on the right cost of equity to use in project analysis. You estimate a beta of 2.0 for the firm and come up with a cost of equity of 18%. The CFO of the firm is concerned about the high cost of equity and wants to know whether there is anything he can do to lower his beta.

How do you bring your beta down?

Should you focus your attention on bringing your beta down?

- Yes
- No

Beta Estimation and Index Choice

HISTORICAL BETA

Number of points may be insufficient for an accurate beta.

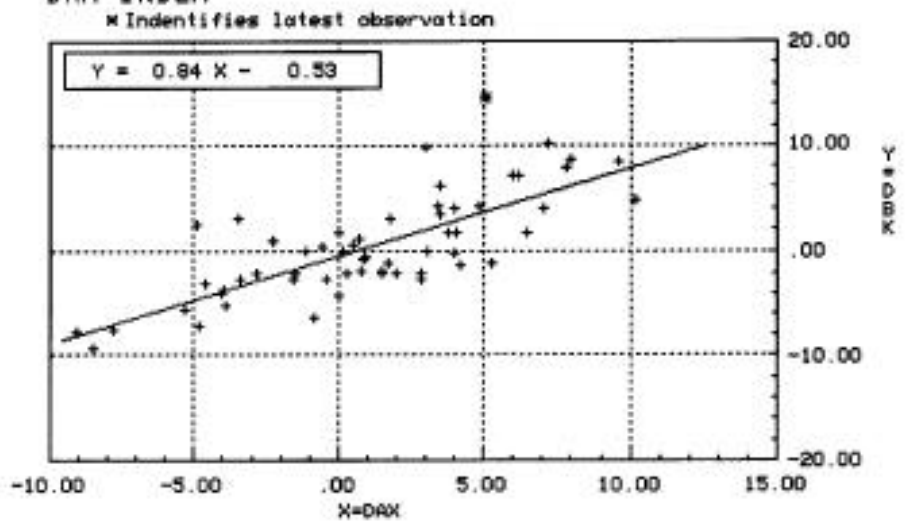
DBK **GR** DEUTSCHE BANK AG

Market DAX

DAX INDEX

Period M (D-W-M-Q-Y)
Range 1/31/92 To 1/31/97
1 (T=Trade,F=Fixing)

ADJ BETA	.90
RAW BETA	.84
Alpha (Intercept)	-.53
R2 (Correlation)	.57
Std Dev of Error	3.22
Std Error of Beta	.10
Number of Points	60



Adj beta = (0.67) * Raw Beta
+ (0.33) * 1.0

A Few Questions

- The R squared for Deutsche Bank is very high (57%), at least relative to U.S. firms. Why is that?
- The beta for Deutsche Bank is 0.84.
  - Is this an appropriate measure of risk?
  - If not, why not?
- If you were an investor in primarily U.S. stocks, would this be an appropriate measure of risk?

Deutsche Bank: To a U.S. Investor?

HISTORICAL BETA

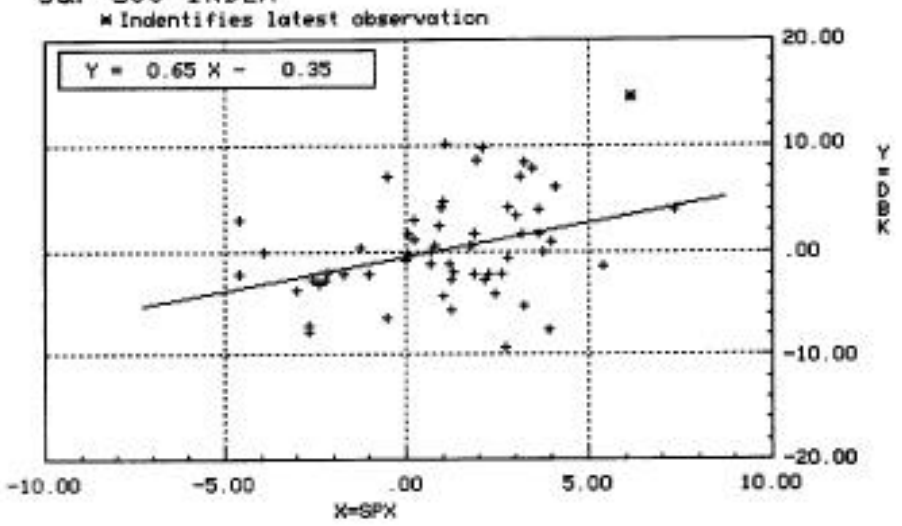
Number of points may be insufficient for an accurate beta.

DBK **GR** DEUTSCHE BANK AG

Market SPX S&P 500 INDEX

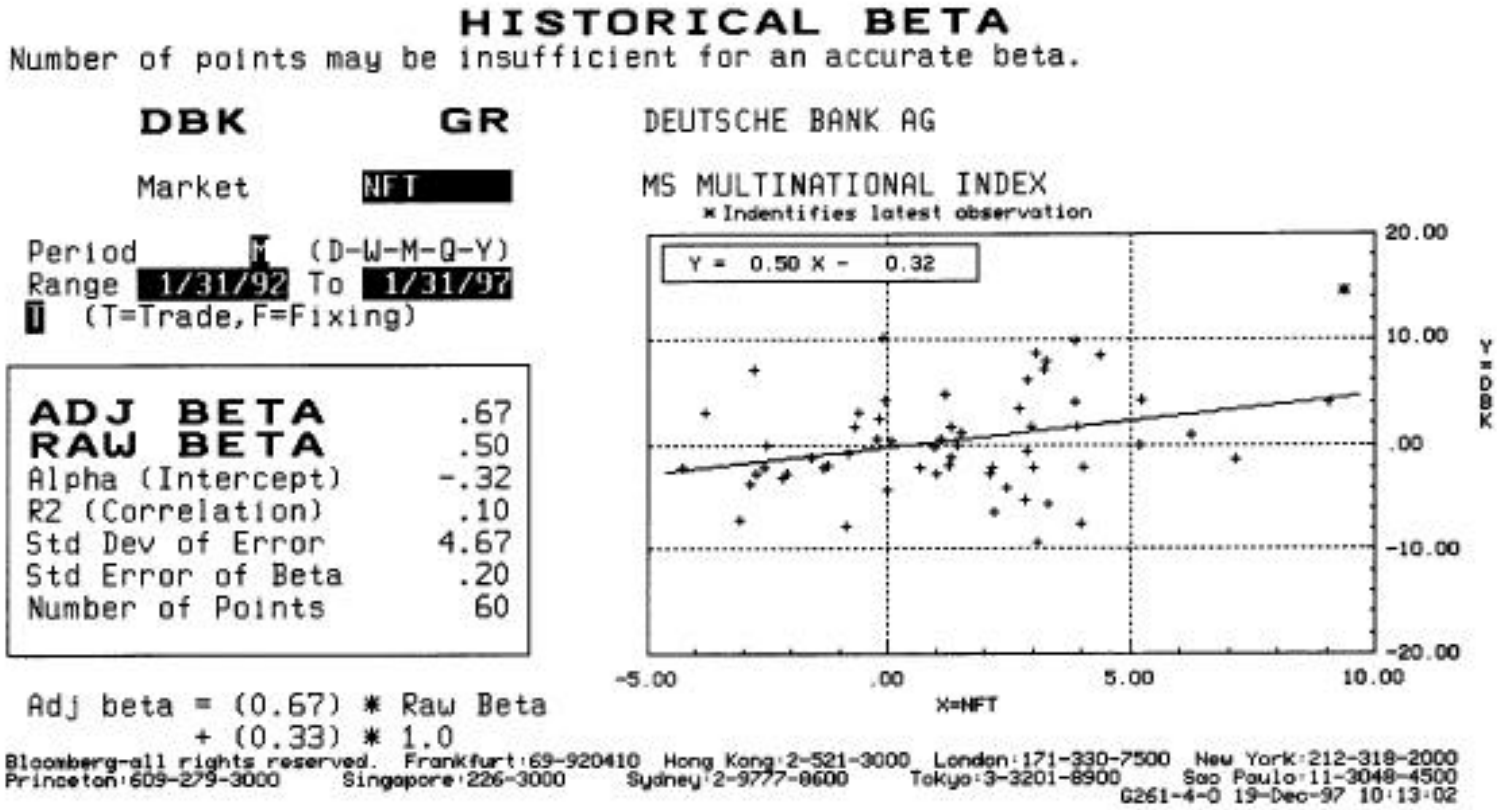
Period M (D-W-M-Q-Y)
Range 1/31/92 To 1/31/97
T (T=Trade, F=Fixing)

ADJ BETA	.77
RAW BETA	.65
Alpha (Intercept)	-.35
R2 (Correlation)	.12
Std Dev of Error	4.62
Std Error of Beta	.23
Number of Points	60



Adj beta = (0.67) * Raw Beta
+ (0.33) * 1.0

Deutsche Bank: To a Global Investor



Beta Estimation With an Index Problem

- **The Local Solution**: Estimate the beta relative to a local index, that is equally weighted or more diverse than the one in use.
- **The U.S. Solution**: If the stock has an ADR listed on the U.S. exchanges, estimate the beta relative to the S&P 500.
- **The Global Solution**: Use a global index to estimate the beta
- An Alternative Solution: Do not use a regression to estimate the firm's beta.

Fundamental Determinants of Betas

- **Type of Business**: Firms in more cyclical businesses or that sell products that are more discretionary to their customers will have higher betas than firms that are in non-cyclical businesses or sell products that are necessities or staples.
- **Operating Leverage**: Firms with greater fixed costs (as a proportion of total costs) will have higher betas than firms will lower fixed costs (as a proportion of total costs)
- **Financial Leverage**: Firms that borrow more (higher debt, relative to equity) will have higher equity betas than firms that borrow less.

Determinant 1: Product Type

- **Industry Effects**: The beta value for a firm depends upon the sensitivity of the demand for its products and services and of its costs to macroeconomic factors that affect the overall market.
  - Cyclical companies have higher betas than non-cyclical firms
  - Firms which sell more discretionary products will have higher betas than firms that sell less discretionary products

A Simple Test

Consider an investment in Tiffany's. What kind of beta do you think this investment will have?

- Much higher than one
- Close to one
- Much lower than one

Determinant 2: Operating Leverage Effects

- Operating leverage refers to the proportion of the total costs of the firm that are fixed.
- Other things remaining equal, higher operating leverage results in greater earnings variability which in turn results in higher betas.

Measures of Operating Leverage

Fixed Costs Measure = Fixed Costs / Variable Costs

- This measures the relationship between fixed and variable costs. The higher the proportion, the higher the operating leverage.

EBIT Variability Measure = % Change in EBIT / % Change in Revenues

- This measures how quickly the earnings before interest and taxes changes as revenue changes. The higher this number, the greater the operating leverage.

A Look at The Home Depot's Operating Leverage

Year	Net Sales	% Change in Sales	EBIT	% Change in EBIT
1988	$ 1,454		$ 98	
1989	$ 2,000	37.55%	$ 127	29.59%
1990	$ 2,759	37.95%	$ 185	45.67%
1991	$ 3,815	38.27%	$ 265	43.24%
1992	$ 5,137	34.65%	$ 382	44.15%
1993	$ 7,148	39.15%	$ 549	43.72%
1994	$ 9,239	29.25%	$ 744	35.52%
1995	$ 12,477	35.05%	$ 1,039	39.65%
1996	$ 15,470	23.99%	$ 1,232	18.58%
1997	$ 19,536	26.28%	$ 1,534	24.51%
1998	$ 24,156	23.65%	$ 1,914	24.77%
Average (87-96)		32.58%		34.94%

Reading The Home Depot's Operating Leverage

- Operating Leverage = % Change in EBIT/ % Change in Sales
  = 34.94%/ 32.58% = 1.07
- This is similar to the operating leverage for other retail firms, which we computed to be 1.05. This would suggest that The Home Depot has a similar cost structure to its competitors.

A Test

Assume that you are comparing a European automobile manufacturing firm with a U.S. automobile firm. European firms are generally much more constrained in terms of laying off employees, if they get into financial trouble. What implications does this have for betas, if they are estimated relative to a common index?

- ❒ European firms will have much higher betas than U.S. firms
- ❒ European firms will have similar betas to U.S. firms
- ❒ European firms will have much lower betas than U.S. firms

Determinant 3: Financial Leverage

- As firms borrow, they create fixed costs (interest payments) that make their earnings to equity investors more volatile.
- This increased earnings volatility which increases the equity beta

Equity Betas and Leverage

- The beta of equity alone can be written as a function of the **unlevered beta** and the debt-equity ratio

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

where

β_L = Levered or Equity Beta

β_u = Unlevered Beta

t = Corporate marginal tax rate

D = Market Value of Debt

E = Market Value of Equity

- The unlevered beta measures the riskiness of the business that a firm is in and is often called an **asset beta**.

Effects of leverage on betas: Boeing

- The regression beta for Boeing is 0.96. This beta is a levered beta (because it is based on stock prices, which reflect leverage) and the leverage implicit in the beta estimate is the average market debt equity ratio during the period of the regression (1993 to 1998)
- The average debt equity ratio during this period was 17.88%.
- The unlevered beta for Boeing can then be estimated:(using a marginal tax rate of 35%)

  = Current Beta / (1 + (1 - tax rate) (Average Debt/Equity))

  = 0.96 / (1 + (1 - 0.35) (0.1788)) = 0.86

Boeing : Beta and Leverage

Debt to Capital	Debt/Equity Ratio	Beta	Effect of Leverage
0.00%	0.00%	0.86	0.00
10.00%	11.11%	0.92	0.06
20.00%	25.00%	1.00	0.14
30.00%	42.86%	1.10	0.24
40.00%	66.67%	1.23	0.37
50.00%	100.00%	1.42	0.56
60.00%	150.00%	1.70	0.84
70.00%	233.33%	2.16	1.30
80.00%	400.00%	3.10	2.24
90.00%	900.00%	5.89	5.03

Betas are weighted Averages

- The beta of a portfolio is always the market-value weighted average of the betas of the individual investments in that portfolio.
- Thus,
  - the beta of a mutual fund is the weighted average of the betas of the stocks and other investment in that portfolio
  - the beta of a firm after a merger is the market-value weighted average of the betas of the companies involved in the merger.

The Boeing/McDonnell Douglas Merger

Company	*Beta*	*Debt*	*Equity*	*Firm Value*
Boeing	0.95	$ 3,980	$ 32,438	$ 36,418
McDonnell Douglas	0.90	$ 2,143	$ 12,555	$ 14,698

Beta Estimation: Step 1

- Calculate the unlevered betas for both firms

  Boeing = 0.95/(1+0.65*(3980/32438)) = 0.88

  McDonnell Douglas = 0.90/(1+0.65*(2143/12555)) = 0.81

- Calculate the unlevered beta for the combined firm

  Unlevered Beta for combined firm

  = 0.88 (36,418/51,116) + 0.81 (14,698/51,116)

  = 0.86

Beta Estimation: Step 2

- Boeing's acquisition of McDonnell Douglas was accomplished by issuing new stock in Boeing to cover the value of McDonnell Douglas's equity of $12,555 million.

Debt = McDonnell Douglas Old Debt + Boeing's Old Debt

= $3,980 + $2,143 = $6,123 million

Equity = Boeing's Old Equity + New Equity used for Acquisition

= $ 32,438 + $ 12,555 = $44,993 million

D/E Ratio = $ 6,123/44,993 = 13.61%

New Beta = 0.86 (1 + 0.65 (.1361)) = 0.94

Firm Betas versus divisional Betas

- Firm Betas as weighted averages: The beta of a firm is the weighted average of the betas of its individual projects.
- At a broader level of aggregation, the beta of a firm is the weighted average of the betas of its individual division.

Bottom-up versus Top-down Beta

- The top-down beta for a firm comes from a regression
- The bottom up beta can be estimated by doing the following:
  - Find out the businesses that a firm operates in
  - Find the unlevered betas of other firms in these businesses
  - Take a weighted (by sales or operating income) average of these unlevered betas
  - Lever up using the firm's debt/equity ratio
- The bottom up beta will give you a better estimate of the true beta when
  - the standard error of the beta from the regression is high (and) the beta for a firm is very different from the average for the business
  - the firm has reorganized or restructured itself substantially during the period of the regression
  - when a firm is not traded

The Home Depot's Comparable Firms

Company Name	*Beta*	*Market Cap $ (Mil)*	*Debt Due 1-Yr Out*	*Long-Term Debt*
Building Materials	1.05	$136	$1	$113
Catalina Lighting	1	$16	$7	$19
Cont'l Materials Corp	0.55	$32	$2	$7
Eagle Hardware	0.95	$612	$6	$146
Emco Limited	0.65	$187	$39	$119
Fastenal Co.	1.25	$1,157	$16	$ -
HomeBase Inc.	1.1	$227		$116
Hughes Supply	1	$610	$1	$335
Lowe's Cos.	1.2	$12,554	$111	$1,046
Waxman Industries	1.25	$18	$6	$121
Westburne Inc.	0.65	$607	$9	$34
Wolohan Lumber	0.55	$76	$2	$20
Sum		$16,232	$200	$2,076
Average	0.93			

Estimating The Home Depot's Bottom-up Beta

- Average Beta of comparable firms = 0.93
- D/E ratio of comparable firms = (200+2076)/16,232 = 14.01%
- Unlevered Beta for comparable firms = 0.93/(1+(1-.35)(.1401))
  = 0.86

Decomposing Boeing's Beta

Segment	*Revenues*	*Estimated Value*	$\beta_{unlevered}$	*Weight*	*Weighted* β
Commercial Aircraft	$ 26,929	$ 30,160	0.91	70.39%	0.6405
ISDS	$ 18,125	$ 12,688	0.80	29.61%	0.2369
Firm		$ 42,848		100.00%	0.88

- The values were estimated based upon the revenues in each business and the typical multiple of revenues that other firms in that business trade for.
- The unlevered betas for each business were estimated by looking at other publicly traded firms in each business, averaging across the betas estimated for these firms, and then unlevering the beta using the average debt to equity ratio for firms in that business.

  Unlevered Beta = Average Beta / (1 + (1-tax rate) (Average D/E))
- Using Boeing's current market debt to equity ratio of 25%

  Boeing's Beta = = 0.88 (1+(1-.35)(.25)) = 1.014

Discussion Issue

- If you were the chief financial officer of Boeing, what cost of equity would you use in capital budgeting in the different divisions?
  - The cost of equity for Boeing as a company
  - The cost of equity for each of Boeing's divisions?

Estimating Betas for Non-Traded Assets

- The conventional approaches of estimating betas from regressions do not work for assets that are not traded.
- There are two ways in which betas can be estimated for non-traded assets
  - using comparable firms
  - using accounting earnings

Beta for InfoSoft, a Private Software Firm

The following table summarizes the unlevered betas for publicly traded software firms.

Grouping	*Number of Firms*	*Beta*	*D/E Ratio*	*Unlevered Beta*
All Software	264	1.45	3.70%	1.42
Small-cap Software	125	1.54	10.12%	1.45
Entertainment Software	31	1.50	7.09%	1.43

- We will use the beta of entertainment software firms as the unlevered beta for InfoSoft.
- We will also assume that InfoSoft's D/E ratio will be similar to that of these publicly traded firms (D/E = 7.09%)
- Beta for InfoSoft = 1.43 (1 + (1-.42) (.0709)) = 1.49

(We used a tax rate of 42% for the private firm)

Using Accounting Earnings to Estimate Beta for InfoSoft

Period	InfoSoft	S&P 500	Period	InfoSoft	S&P 500
1992: Q1	7.50%	-1.30%	1995: Q2	24.10%	8.50%
1992: Q2	8.30%	2.20%	1995: Q3	17.50%	6.00%
1992: Q3	8.80%	2.50%	1995: Q4	16.00%	5.00%
1992: Q4	7.90%	3.00%	1996: Q1	27.00%	8.10%
1993: Q1	14.30%	3.60%	1996: Q2	21.30%	7.00%
1993: Q2	16.50%	5.10%	1996: Q3	22.50%	7.20%
1993: Q3	17.10%	5.50%	1996: Q4	20.00%	6.00%
1993: Q4	13.50%	6.20%	1997: Q1	17.10%	5.80%
1994: Q1	11.50%	4.30%	1997: Q2	22.20%	8.00%
1994: Q2	12.30%	4.70%	1997: Q3	17.80%	6.10%
1994: Q3	13.00%	4.50%	1997: Q4	14.50%	4.50%
1994: Q4	11.10%	4.20%	1998: Q1	8.50%	1.30%
1995: Q1	18.60%	7.10%	1998: Q2	3.50%	-0.50%

The Accounting Beta for InfoSoft

- Regressing the changes in profits at InfoSoft against changes in profits for the S&P 500 yields the following:

  InfoSoft Earnings Change = 0.05 + 2.15 (S & P 500 Earnings Change)
- Based upon this regression, the beta for InfoSoft's equity is 2.15.
- Using operating earnings for both the firm and the S&P 500 should yield the equivalent of an unlevered beta.

Is Beta an Adequate Measure of Risk for a Private Firm?

- The owners of most private firms are not diversified. Beta measures the risk added on to a diversified portfolio. Therefore, using beta to arrive at a cost of equity for a private firm will
  - Under estimate the cost of equity for the private firm
  - Over estimate the cost of equity for the private firm
  - Could under or over estimate the cost of equity for the private firm

Total Risk versus Market Risk

- Adjust the beta to reflect total risk rather than market risk. This adjustment is a relatively simple one, since the R squared of the regression measures the proportion of the risk that is market risk.

  Total Beta = Market Beta / √R squared

- In the InfoSoft example, where the market beta is 1.10 and the average R-squared of the comparable publicly traded firms is 16%,
  - Total Beta = 1.49/√0.16 = 3.725
  - Total Cost of Equity = 5% + 3.725 (5.5%)= 25.49%
- This cost of equity is much higher than the cost of equity based upon the market beta because the owners of the firm are not diversified.

Application Test: Estimating a Bottom-up Beta

- Based upon the business or businesses that your firm is in right now, and its current financial leverage, estimate the bottom-up unlevered beta for your firm.

From Cost of Equity to Cost of Capital

- The cost of capital is a composite cost to the firm of raising financing to fund its projects.
- In addition to equity, firms can raise capital from debt

What is debt?

- General Rule: Debt generally has the following characteristics:
  - Commitment to make fixed payments in the future
  - The fixed payments are tax deductible
  - Failure to make the payments can lead to either default or loss of control of the firm to the party to whom payments are due.
- As a consequence, debt should include
  - Any interest-bearing liability, whether short term or long term.
  - Any lease obligation, whether operating or capital.

Estimating the Cost of Debt

- If the firm has bonds outstanding, and the bonds are traded, the yield to maturity on a long-term, straight (no special features) bond can be used as the interest rate.
- If the firm is rated, use the rating and a typical default spread on bonds with that rating to estimate the cost of debt.
- If the firm is not rated,
  - and it has recently borrowed long term from a bank, use the interest rate on the borrowing or
  - estimate a synthetic rating for the company, and use the synthetic rating to arrive at a default spread and a cost of debt
- The cost of debt has to be estimated in the same currency as the cost of equity and the cash flows in the valuation.

Estimating Synthetic Ratings

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

  Interest Coverage Ratio = EBIT / Interest Expenses

- Consider InfoSoft, a firm with EBIT of $2000 million and interest expenses of $ 315 million

  Interest Coverage Ratio = 2,000/315= 6.15

  - Based upon the relationship between interest coverage ratios and ratings, we would estimate a rating of A for the firm.

Interest Coverage Ratios, Ratings and Default Spreads

Interest Coverage Ratio	*Rating*	*Default Spread*
> 12.5	AAA	0.20%
9.50 - 12.50	AA	0.50%
7.50 – 9.50	A+	0.80%
6.00 – 7.50	A	1.00%
4.50 – 6.00	A-	1.25%
3.50 – 4.50	BBB	1.50%
3.00 – 3.50	BB	2.00%
2.50 – 3.00	B+	2.50%
2.00 - 2.50	B	3.25%
1.50 – 2.00	B-	4.25%
1.25 – 1.50	CCC	5.00%
0.80 – 1.25	CC	6.00%
0.50 – 0.80	C	7.50%
< 0.65	D	10.00%

Costs of Debt for Boeing, the Home Depot and InfoSoft

	Boeing	*Home Depot*	*InfoSoft*
Bond Rating	AA	A+	A
Rating is	Actual	Actual	Synthetic
Default Spread over treasury	0.50%	0.80%	1.00%
Market Interest Rate	5.50%	5.80%	6.00%
Marginal tax rate	35%	35%	42%
Cost of Debt	3.58%	3.77%	3.48%

The treasury bond rate is 5%.

Application Test: Estimating a Cost of Debt

- Based upon your firm's current earnings before interest and taxes, its interest expenses, estimate
  - An interest coverage ratio for your firm
  - A synthetic rating for your firm (use the table from previous page)
  - A pre-tax cost of debt for your firm
  - An after-tax cost of debt for your firm

Estimating Market Value Weights

- Market Value of Equity should include the following
  - Market Value of Shares outstanding
  - Market Value of Warrants outstanding
  - Market Value of Conversion Option in Convertible Bonds
- Market Value of Debt is more difficult to estimate because few firms have only publicly traded debt. There are two solutions:
  - Assume book value of debt is equal to market value
  - Estimate the market value of debt from the book value
  - For Boeing, the book value of debt is $6,972 million, the interest expense on the debt is $ 453 million, the average maturity of the debt is 13.76 years and the pre-tax cost of debt is 5.50%.

$$\text{Estimated MV of Boeing Debt} = 453\left[\frac{\left(1-\frac{1}{(1.055)^{13.76}}\right)}{.055}\right] + \frac{6,972}{(1.055)^{13.76}} = \$7,631$$

Converting Operating Leases to Debt

- The “debt value” of operating leases is the present value of the lease payments, at a rate that reflects their risk.
- In general, this rate will be close to or equal to the rate at which the company can borrow.

Operating Leases at Boeing

- The pre-tax cost of debt at Boeing is 5.80%

Year	*Commitment*	*Present Value at 5.5%*
1	$ 205.00	$ 194.31
2	$ 167.00	$ 150.04
3	$ 120.00	$ 102.19
4	$ 86.00	$ 69.42
5	$ 61.00	$ 46.67
PV of Operating Leases =		$ 562.64

- Debt outstanding at Boeing = $ 7,631 + $ 563 = $ 8,194 mil

Application Test: Estimating Market Value

- Estimate the
  - Market value of equity at your firm and Book Value of equity
  - Market value of debt and book value of debt (If you cannot find the average maturity of your debt, use 3 years): Remember to capitalize the value of operating leases and add them on to both the book value and the market value of debt.
- Estimate the
  - Weights for equity and debt based upon market value
  - Weights for equity and debt based upon book value

Estimating Cost of Capital: Boeing

- Equity
  - Cost of Equity = 5% + 1.01 (5.5%) = 10.58%
  - Market Value of Equity = $32.60 Billion
  - Equity/(Debt+Equity) = 82%
- Debt
  - After-tax Cost of debt = 5.50% (1-.35) = 3.58%
  - Market Value of Debt = $ 8.2 Billion
  - Debt/(Debt +Equity) = 18%
- Cost of Capital = 10.58%(.80)+3.58%(.20) = 9.17%

Boeing's Divisional Costs of Capital

	Boeing	Aerospace	Defense
Cost of Equity	10.58%	10.77%	10.07%
Equity/(Debt + Equity)	79.91%	79.91%	79.91%
Cost of Debt	3.58%	3.58%	3.58%
Debt/(Debt + Equity)	20.09%	20.09%	20.09%
Cost of Capital	9.17%	9.32%	8.76%

Cost of Capital: InfoSoft and The Home Depot

	The Home Depot	*InfoSoft*
Cost of Equity	9.78%	13.19%
Equity/(Debt + Equity)	95.45%	93.38%
Cost of Debt	3.77%	3.48%
Debt/(Debt + Equity)	4.55%	6.62%
Cost of Capital	9.51%	12.55%

Application Test: Estimating Cost of Capital

- Using the bottom-up unlevered beta that you computed for your firm, and the values of debt and equity you have estimated for your firm, estimate a bottom-up levered beta and cost of equity for your firm.

- Based upon the costs of equity and debt that you have estimated, and the weights for each, estimate the cost of capital for your firm.

- How different would your cost of capital have been, if you used book value weights?

Current Practices: Costs of Capital

Cost of capital item	*Current Practices*
Cost of Equity	· 81% of firms used the capital asset pricing model to estimate the cost of equity, 4% used a modified capital asset pricing model and 15% were uncertain about how they estimated the cost of equtiy. · 70% of firms used 10-year treasuries or longer as the riskless rate, 7% used 3 to 5-year treasuries and 4% used the treasury bill rate. · 52% used a published source for a beta estimate, while 30% estimated it themselves. · There was wide variation in the market risk premium used, with 37% using a premium between 5 and 6%.
Cost of Debt	· 52% of firms used a marginal borrowing rate and a marginal tax rate, while 37% used the current average borrowing rate and the effective tax rate.
Weights for Debt and Equity	· 59% used market value weights for debt and equity in the cost of capital, 15% used book value weights and 19% were uncertain about what weights they used.

Choosing a Hurdle Rate

- Either the cost of equity or the cost of capital can be used as a hurdle rate, depending upon whether the returns measured are to equity investors or to all claimholders on the firm (capital)
- If returns are measured to equity investors, the appropriate hurdle rate is the cost of equity.
- If returns are measured to capital (or the firm), the appropriate hurdle rate is the cost of capital.

Back to First Principles

- Invest in projects that yield a return greater than the **minimum acceptable hurdle rate.**
  - **The hurdle rate should be higher for riskier projects and reflect the financing mix used - owners' funds (equity) or borrowed money (debt)**
  - Returns on projects should be measured based on cash flows generated and the timing of these cash flows; they should also consider both positive and negative side effects of these projects.
- Choose a financing mix that minimizes the hurdle rate and matches the assets being financed.
- If there are not enough investments that earn the hurdle rate, return the cash to stockholders.
  - The form of returns - dividends and stock buybacks - will depend upon the stockholders' characteristics.