



# Finding the Right Financing Mix: The Capital Structure Decision

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# First Principles

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- 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**

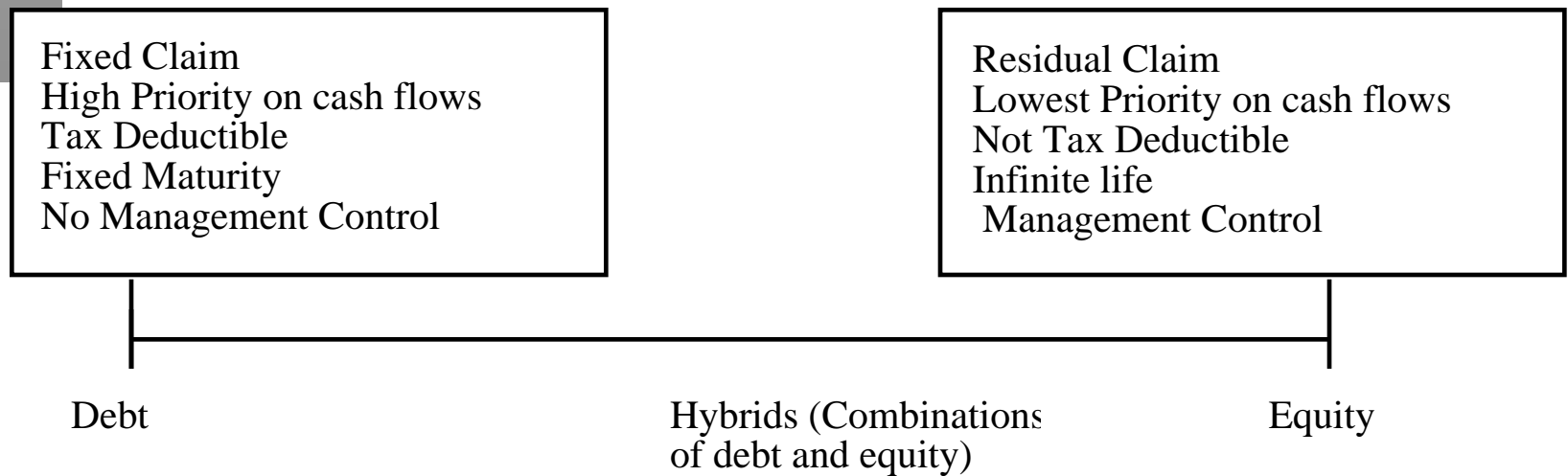
# The Choices in Financing

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- 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*

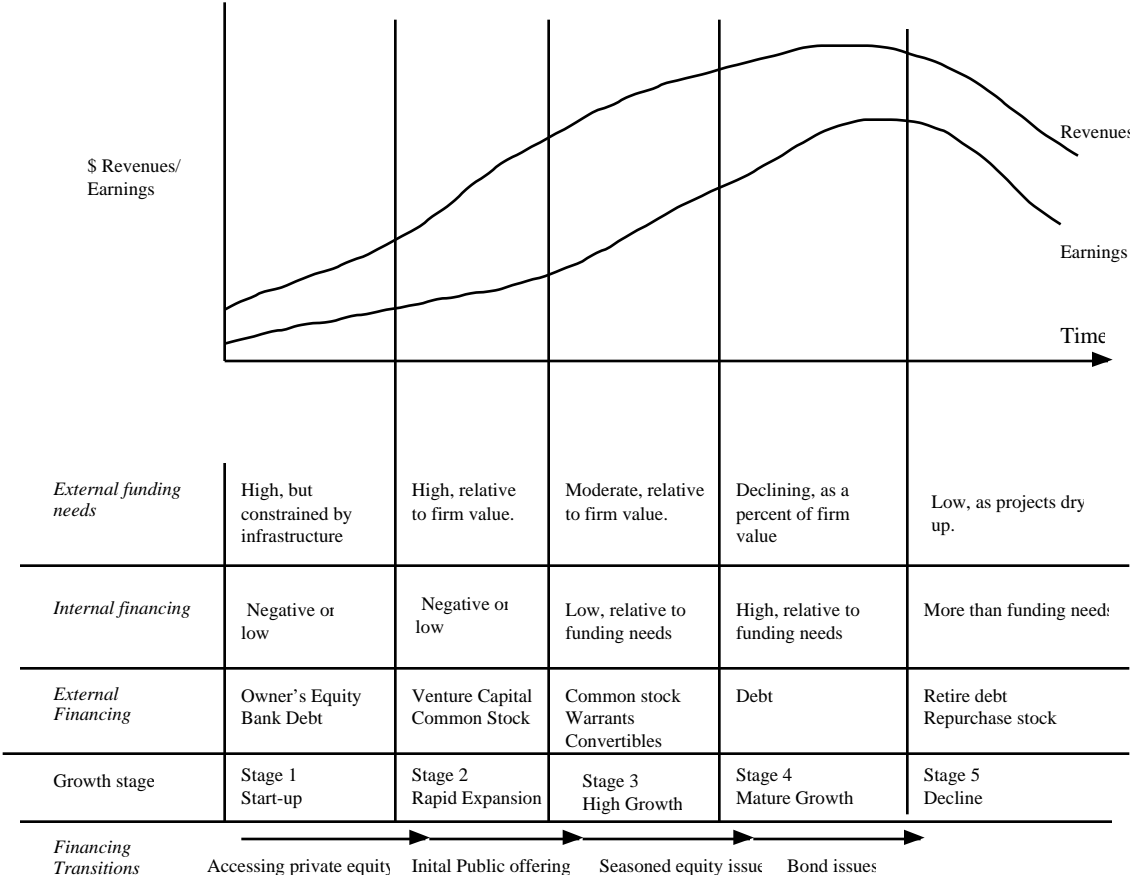


# The Choices

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- 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



# The Financing Mix Question

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- 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

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- 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:

$$\text{Debt to Capital Ratio} = \text{Debt} / (\text{Debt} + \text{Equity})$$

- 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

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

# Tax Benefits of Debt

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- 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

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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?

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

# Implications of The Tax Benefit of Debt

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- 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

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- 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

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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

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- 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

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- 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....

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- 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

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- 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

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

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

# Implications of Bankruptcy Cost Proposition

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- 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

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- 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 their 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

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

- r** A Large Pharmaceutical company
- r** A Large Regulated Electric Utility

Why?

## How agency costs show up...

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- 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..

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- 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

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- 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...

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- 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

<b>Factor</b>	<b>Ranking (0-5)</b>
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**

### *1. Tax Benefit:*

Higher tax rates --> Higher tax benefit

### *2. Added Discipline:*

Greater the separation between managers and stockholders --> Greater the benefit

## **Disadvantages of Borrowing**

### *1. Bankruptcy Cost:*

Higher business risk --> Higher Cost

### *2. Agency Cost:*

Greater the separation between stockholders & lenders --> Higher Cost

### *3. Loss of Future Financing Flexibility:*

Greater the uncertainty about future financing needs --> Higher Cost

# A Qualitative Analysis

<i>Item</i>	<i>Boeing</i>	<i>The Home Depot</i>	<i>InfoSoft</i>
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?

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- 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

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- 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

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- 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

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- (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?

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- 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

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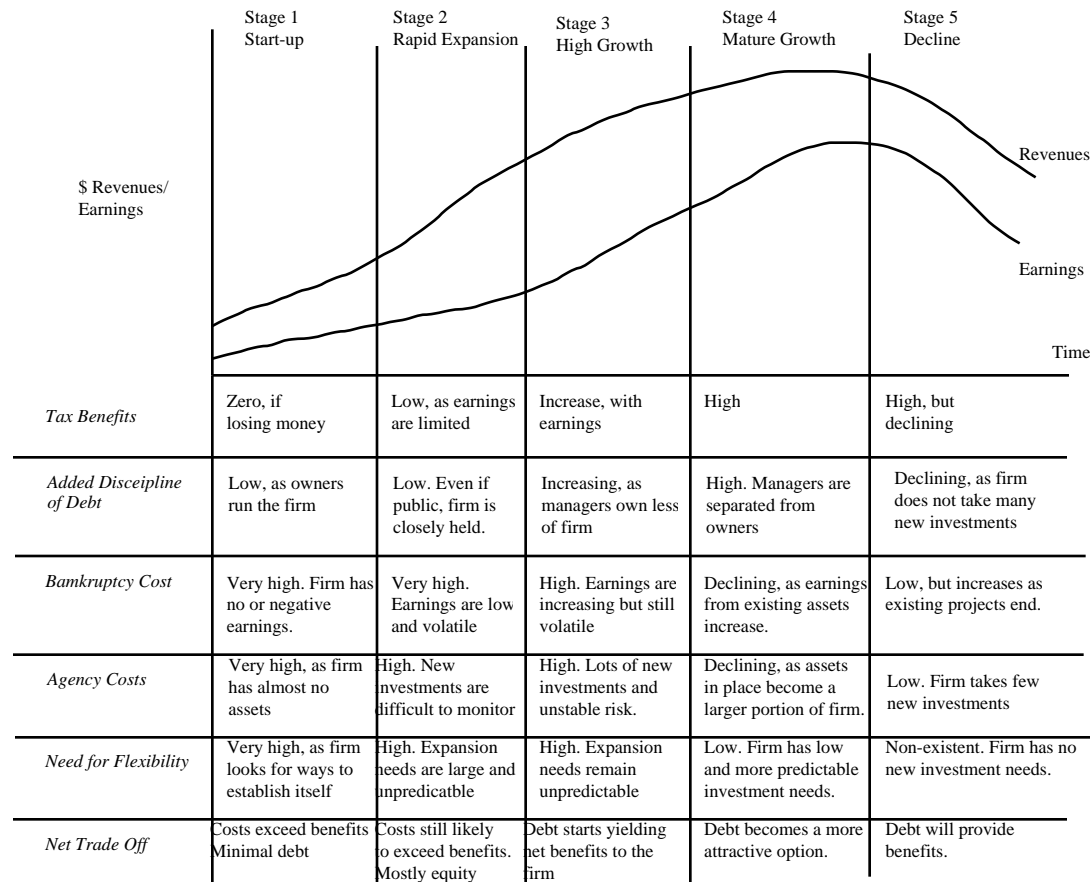
- The empirical evidence on whether leverage affects value is mixed.
  - Bradley, Jarrell, and Kim (1984) note that the debt ratio is lower for firms with more volatile operating income and for firms with substantial R&D and advertising expenses.
  - Barclay, Smith and Watts (1995) looked at 6780 companies 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?

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- **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 Hierarchy:** 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



# Comparable Firms

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- 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

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- 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

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<b>Ranking</b>	<b>Source</b>	<b>Score</b>
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

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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?

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



# The Search for an Optimal Financing Mix: Approaches

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- **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.

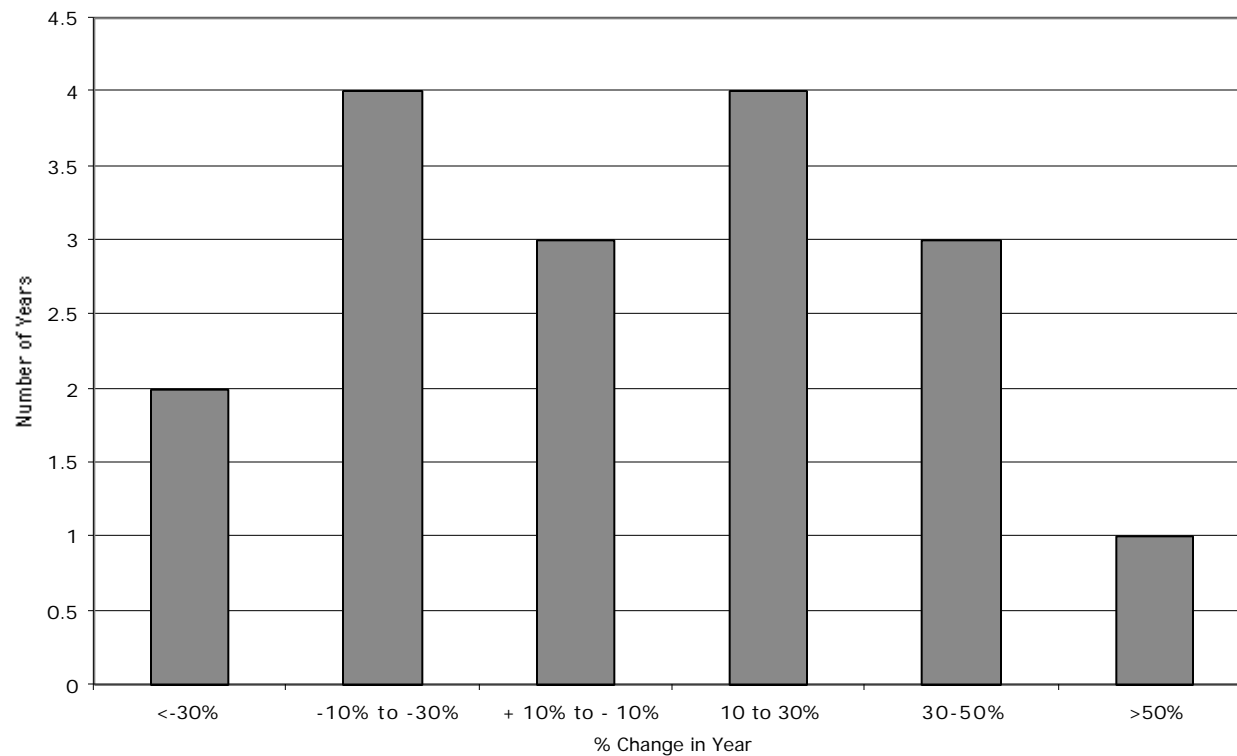
# I. The Operating Income Approach

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- 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

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- 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.

$$\begin{aligned}\text{Additional Debt Payment} &= \text{Interest Expense} && + \text{Sinking Fund Payment} \\ &= 0.06 * 5,000 && + .05 * 5,000 && = \$ 550 \text{ million}\end{aligned}$$

- 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.

$$\begin{aligned}\text{Total Debt Payment} &= \text{Interest on Existing Debt} + \text{Additional Debt Payment} \\ &= \$ 453 \text{ million} + \$ 550 \text{ million} = \$ 1,003 \text{ million}\end{aligned}$$

## Estimating Probability of Default

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- 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) /  $\sigma_{OI}$  (Current Operating Income)

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

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

# Management Constraints and Maximum Debt Capacity

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- 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.

$$\begin{aligned} \text{Optimal Debt} &= \text{Break Even Debt Payment} / (\text{Interest Rate} + \text{Sinking Fund Rate}) \\ &= \$ 1,329 / (.06 + .05) = \$ 12,082 \text{ million} \end{aligned}$$

## II. The Cost of Capital Approach

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- 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.

$$\text{WACC} = k_e (E/(D+E)) + k_d (D/(D+E))$$

# Recapping the Measurement of cost of capital

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- 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

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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

**r** Yes

**r** No

Can equity ever be cheaper than debt?

**r** Yes

**r** No

## Issue: Use of Book Value

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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?)

- r** Yes
- r** No

# Why does the cost of capital matter?

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- 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

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- 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:

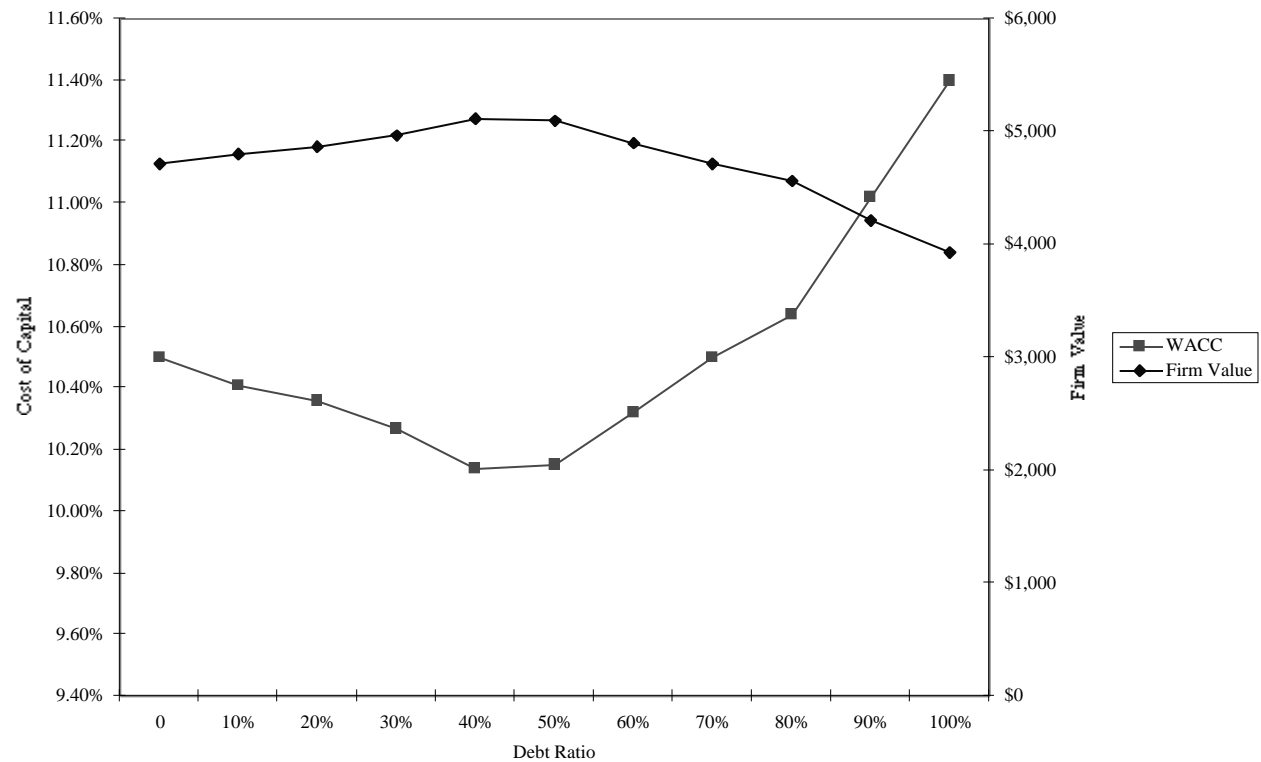
$$\begin{aligned}\text{Firm Value} &= \text{Cash flow to the firm} (1+g)/(\text{Cost of capital} - g) \\ &= 200 (1.06)/(\text{Cost of capital} - .06)\end{aligned}$$

# Cost of Capital and Firm Value

<i>D/(D+E)</i>	<i>Cost of Equity</i>	<i>Cost of Debt</i>	<i>WACC</i>	<i>Firm Value</i>
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

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- The beta for Boeing's stock in March 1999 was 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%:

$$\begin{aligned}\text{Cost of Equity} &= \text{Riskfree rate} + \text{Beta} * (\text{Market Premium}) \\ &= 5.00\% + 1.01 (5.5\%) = 10.58\%\end{aligned}$$

- 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%.

$$\begin{aligned}\text{After-tax Cost of debt} &= \text{Pre-tax interest rate} (1 - \text{tax rate}) \\ &= 5.50\% (1 - 0.35) = 3.58\%\end{aligned}$$

- $\text{Cost of Capital} = \text{Cost of Equity} (\text{Equity}/(\text{Equity} + \text{Debt})) + \text{After-tax Cost of Debt} (\text{Debt}/(\text{Debt} + \text{Equity}))$   
 $= 10.58\% [32,595/(32595+8194)] + 3.58\% [8,194/(32595+8194)] = 9.17\%$

# Mechanics of Cost of Capital Estimation

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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

	<i>AAA</i>	<i>AA</i>	<i>A</i>	<i>BBB</i>	<i>BB</i>	<i>B</i>	<i>CCC</i>
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

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- 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

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- 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

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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

<i>Rating</i>	<i>Spread</i>	<i>Interest Rate on Debt</i>
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

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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:

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

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

$$\text{Cost of Equity} = \text{Riskfree rate} + \text{Beta} * \text{Risk Premium}$$

# 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%

$t=35\%$

<i>Debt Ratio</i>	<i>Beta</i>	<i>Cost of Equity</i>
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?

				Second Iteration
D/(D+E)	0.00%	10.00%	20%	
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%	10%	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

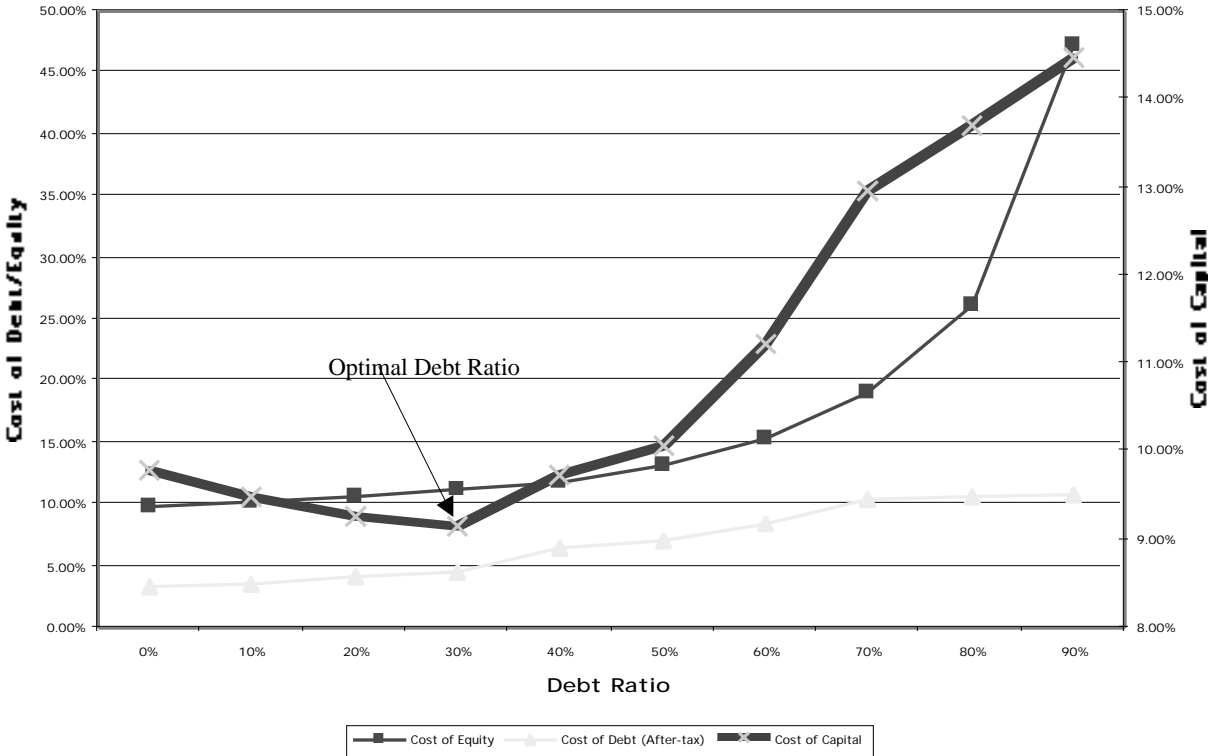
	40%	50%
EBIT	\$ 1,751	\$ 1,751
Interest Expense	\$ 1,632	\$ 2,039
Coverage ratio	1.07	0.86
Rating	CCC	CCC
Interest rate	10.00%	10.00%
Tax Rate	35.00%	30.05%
Cost of Debt	6.50%	7.00%
Maximum Tax Benefit = 35% of \$1,751 = \$613 million		
Tax Rate to use for cost of debt = $613/2039 = 30.05\%$		

# 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

Costs of Equity, Debt and Capital: Boeing



# 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

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- Re-estimate firm value at each debt ratio, using the new cost of capital.

- For a stable growth firm, this would be

$$\text{Firm Value} = \text{CF to Firm} (1 + g) / (\text{WACC} - g)$$

- 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 =  $(\text{Cost of capital}_{\text{before}} - \text{Cost of capital}_{\text{after}}) \text{ Firm Value}$

- If you assume no growth in firm value, this would yield

$$\text{Annual Saving} / \text{Cost of capital}_{\text{after}}$$

- If you assume perpetual growth in savings, this would yield

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

## But what growth rate do we use? One solution

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- 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  $(1+g) / (\text{Cost of capital} - g)$

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

Solving for  $g$ ,

Implied growth rate = .0611 or 6.11%

## Change in Firm Value for Boeing: Firm Valuation Approach

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- 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<sub>b</sub> = 9.17%      Annual Cost =  $\$62,068 * 12.22\% = \$7,583$  million
  - WACC<sub>a</sub> = 9.16%      Annual Cost =  $\$62,068 * 11.64\% = \$7,226$  million
  - 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

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- Firm Value before the change =  $85,668 + 4,081 = \$ 89,749$  million
  - WACC<sub>b</sub> = 9.51%      Annual Cost =  $\$89,749 * 9.51\% = \$ 8,537$  million
  - WACC<sub>a</sub> = 9.23%      Annual Cost =  $\$89,749 * 9.23\% = \$ 8,281$  million
  - 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

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- 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

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- 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

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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

<i>% Drop in EBITDA</i>	<i>EBITDA</i>	<i>Optimal Debt Ratio</i>
0%	\$ 3,268	30%
5%	\$ 3,105	20%
10%	\$ 2,941	20%
15%	\$ 2,778	10%
20%	\$ 2,614	0%

# Constraints on Ratings

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- 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

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- 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..

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- 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

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- 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

<i>Long Term Interest Coverage Ratio</i>	<i>Rating is</i>	<i>Spread is</i>	<i>Operating Income Decline</i>
< 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

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- 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

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- 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

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- 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:

$$\text{Firm Value} = \$ 3 \text{ million} * 21.8 = \$ 65.4 \text{ million}$$

- 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:

$$\text{Interest Coverage Ratio} = \text{EBIT} / \text{Interest Expense} = \$ 2 \text{ million} / \$ 315,000 = 6.35$$

# Interest Coverage Ratios, Spreads and Ratings: Small Firms

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<i>Interest Coverage Ratio</i>	<i>Rating</i>	<i>Spread over T Bond Rate</i>
> 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

<i>Debt Ratio</i>	<i>Beta</i>	<i>Cost of Equity</i>	<i>Rating</i>	<i>Interest rate</i>	<i>Cost of Debt (After-tax)</i>	<i>Cost of Capital</i>
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

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## ■ 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

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- 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

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- 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

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- 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,  $\text{Unlevered Firm Value} = \text{Current Market Value of Firm} - \text{Tax Benefits of Debt (Current)} + \text{Expected Bankruptcy cost from Debt}$
- 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
  - $\text{Tax benefits} = \text{Dollar Debt} * \text{Tax Rate}$
- 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

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## ■ 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

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<b>Rating</b>	<b>Default Risk</b>
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

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

$$\begin{aligned} \text{PV of Tax Savings from Existing Debt} &= \text{Existing Debt} * \text{Tax Rate} \\ &= \$8,194 * 0.35 = \$2,868 \text{ million} \end{aligned}$$

- 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.

$$\begin{aligned} \text{PV of Expected Bankruptcy Cost} &= \text{Probability of Default} * \text{Bankruptcy} \\ \text{cost} &= 0.28\% * (0.30 * (40,789 - 2,868)) = \$32 \end{aligned}$$

- 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

---

<i>Debt Ratio</i>	<i>\$ Debt</i>	<i>Tax Rate</i>	<i>Tax Benefits</i>
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

<i>Debt Ratio</i>	<i>Bond Rating</i>	<i>Probability of Default</i>	<i>Expected Bankruptcy Cost</i>
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

<i>Debt Ratio</i>	<i>Unlevered Value</i>	<i>Tax Benefits</i>	<i>Bankruptcy Costs</i>	<i>Value of Levered Firm</i>
0%	\$37,953	\$0	\$32	\$37,921
10%	\$37,953	\$1,428	\$32	\$39,349
20%	\$37,953	\$2,855	\$161	\$40,648
<b>30%</b>	<b>\$37,953</b>	<b>\$4,283</b>	<b>\$1,389</b>	<b>\$40,847</b>
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

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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

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	<i>Boeing</i>	<i>Aerospace</i>	<i>Home Depot</i>	<i>Building Supplies</i>
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

<i>Company Name</i>	<i>Market D/(D+E)</i>	<i>Net Plant/Total Assets</i>	<i>Cap Ex/Total Assets</i>
Building Materials	47.23%	34.74%	3.90%
Catalina Lighting	51.17%	28.21%	1.95%
Cont'I 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

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

$$\text{Debt} = 0.174 + 0.50 (\text{Net Plant/Firm Value}) - 1.39 (\text{Cap Exp/ Assets})$$

(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:

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

- 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 –

$$\text{DFR} = 0.1608 - 0.3411 \text{ OISTD} + .2153 \text{ CLSH} - 0.3159 \text{ CPXFR} + 1.4185 \text{ E/V}$$

(26.41<sup>a</sup>) (3.15<sup>a</sup>)                      (1.95<sup>b</sup>)                      (1.68<sup>b</sup>)                      (8.21<sup>a</sup>)

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

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	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

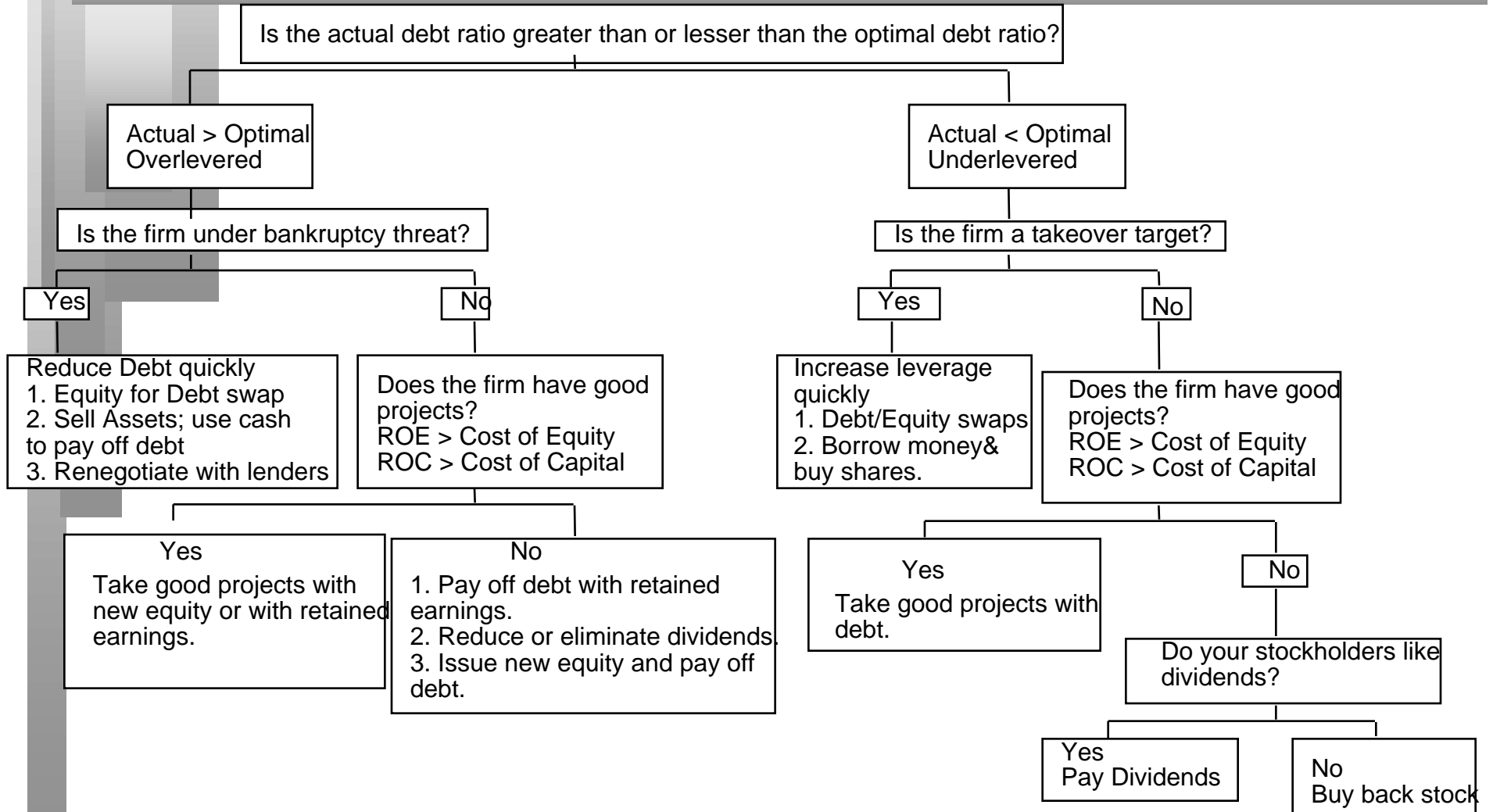
	<i>Boeing</i>	<i>The Home Depot</i>
<i>Actual Debt Ratio</i>		
-Without operating leases	18.97%	1.65%
- With operating leases	20.09%	4.55%
<i>Optimal</i>		
I. Operating Income	28.41%	17.56%
II. Cost of Capital		
With no constraints	30.00%	20.00%
With BBB constraint	20.00%	15.00%
III. Return Differential	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

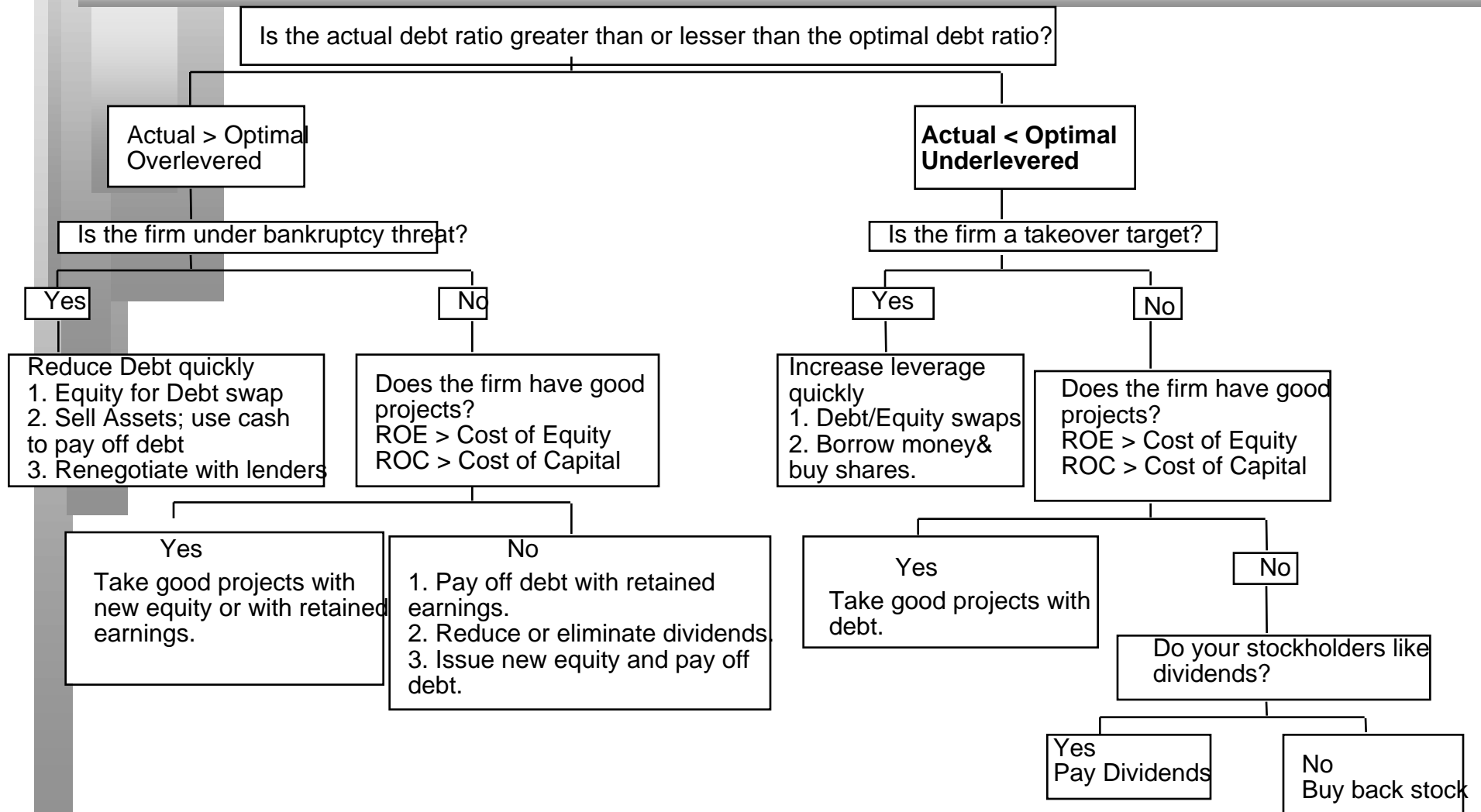
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- Boeing is close to its optimal debt ratio.
- The Home Depot is under levered. Even with a BBB rating constraint, the Home Depot can afford to borrow significantly more than it does now.

# A Framework for Getting to the Optimal



# The Home Depot: Applying the Framework







## Application Test: Getting to the Optimal

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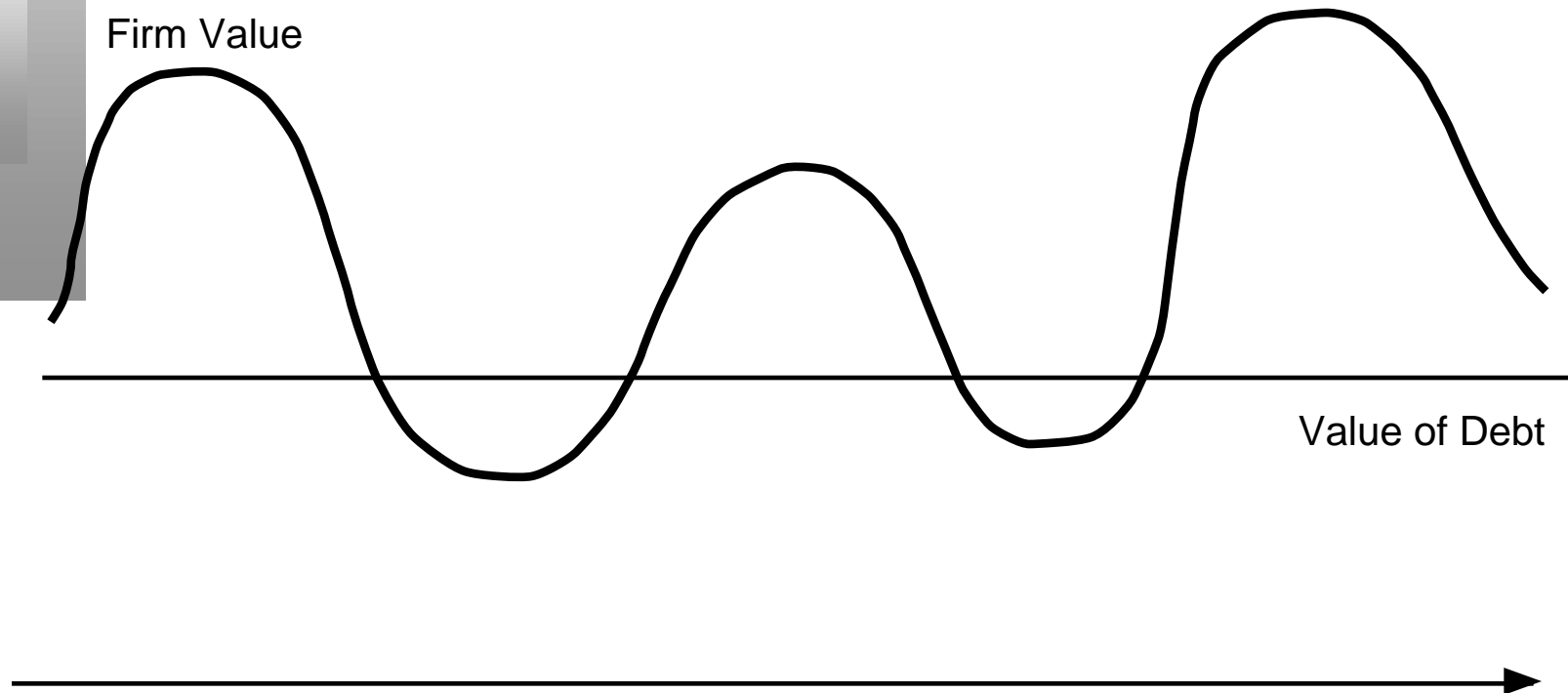
- Based upon your analysis of both the firm's capital structure and investment record, what path would you map out for the firm?
  - Immediate change in leverage
  - Gradual change in leverage
  - No change in leverage
- Would you recommend that the firm change its financing mix by
  - Paying off debt/Buying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

# Designing Debt: The Fundamental Principle

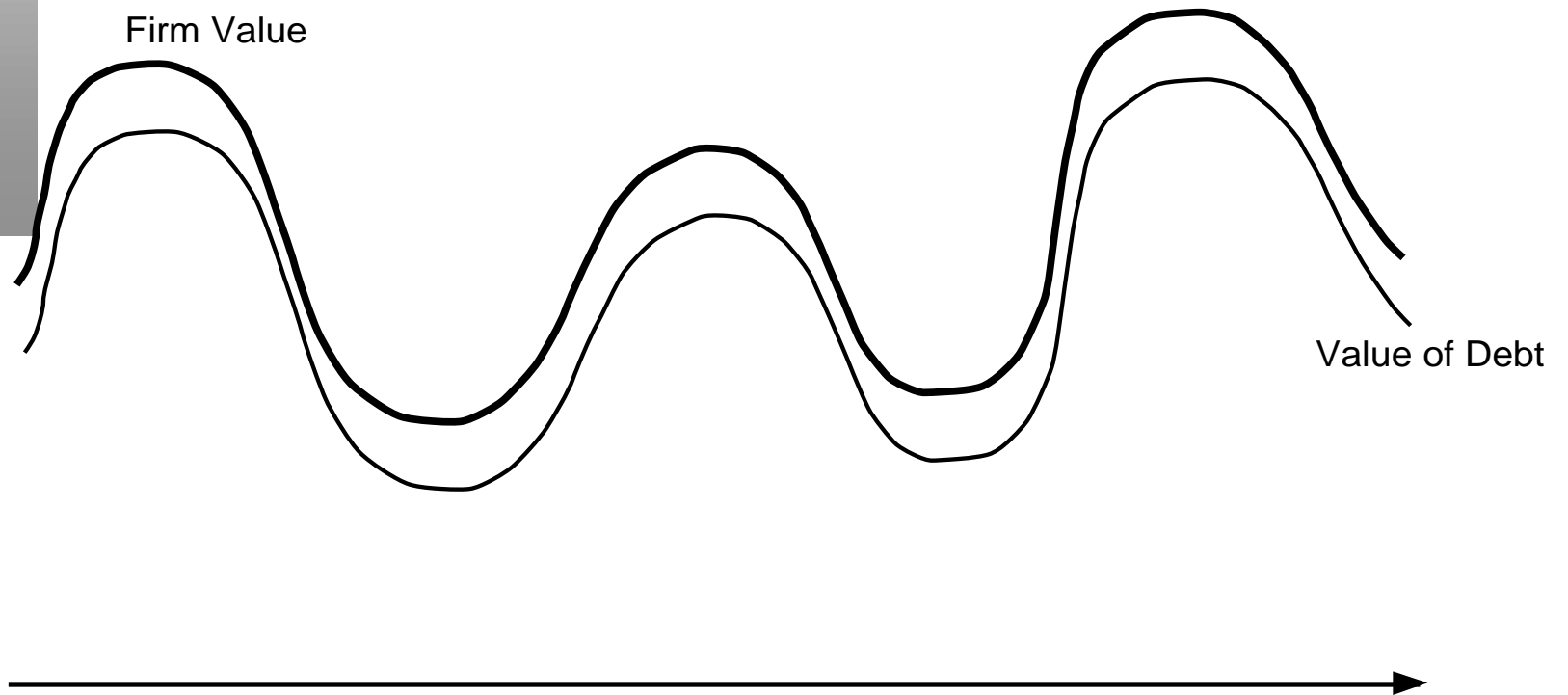
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- The objective in designing debt is to make the cash flows on debt match up as closely as possible with the cash flows that the firm makes on its assets.
- By doing so, we reduce our risk of default, increase debt capacity and increase firm value.

## Firm with mismatched debt



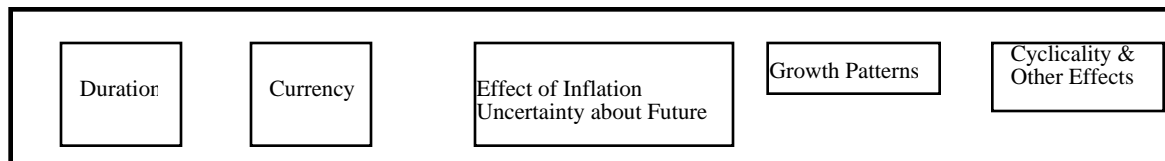
## Firm with matched Debt



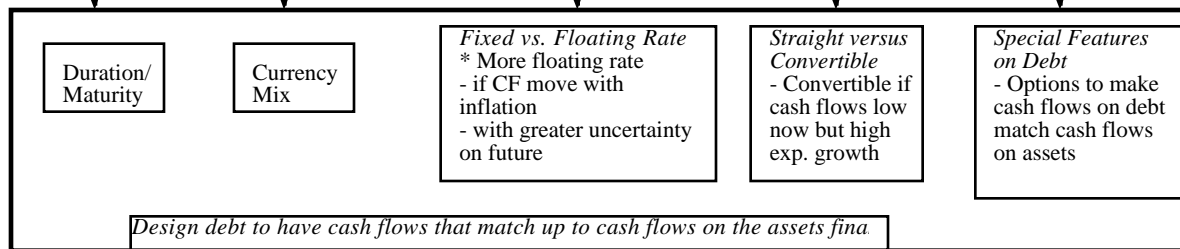
# Design the perfect financing instrument

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

*Start with the Cash Flows on Assets/ Projects*



*Define Debt Characteristics*

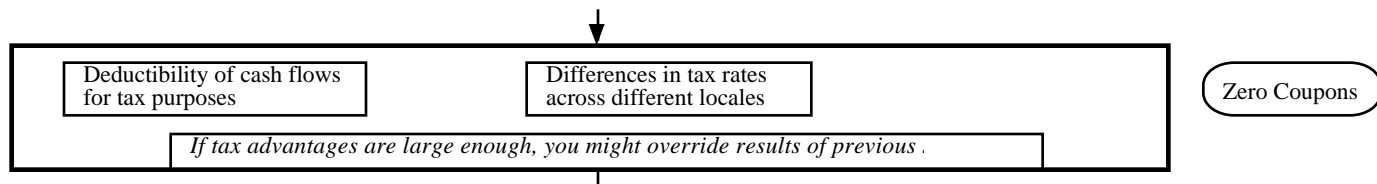


Commodity Bonds  
Catastrophe Notes

# 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.

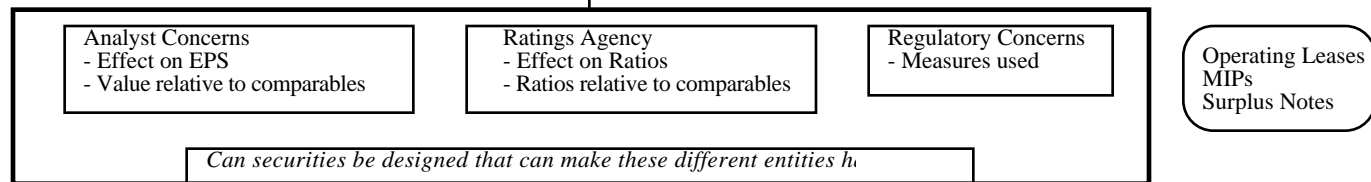
*Overlay tax preferences*



# 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

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- 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

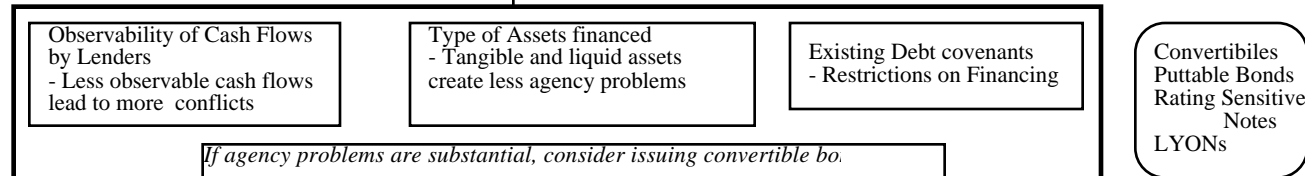
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- Assuming that trust preferred stock gets treated as equity by ratings agencies, which of the following firms is the most appropriate firm to be issuing it?
  - A firm that is under levered, but has a rating constraint that would be violated if it 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*

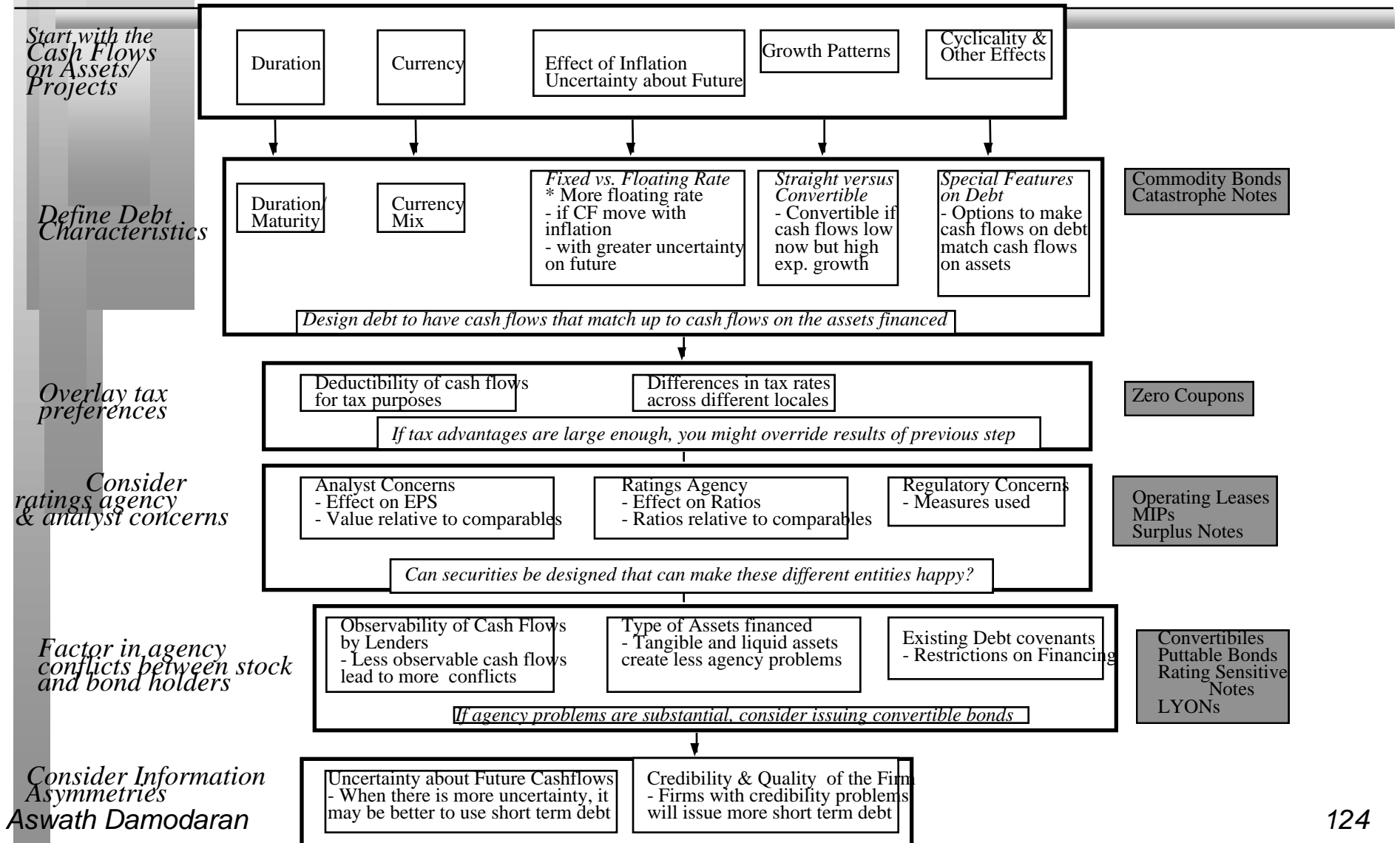


# And do not lock in market mistakes that work against you

---

- 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

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- 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

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- 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

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- 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

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- 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

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## 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.
- $\text{Change in Operating Income}(t) = a + b \text{ Change in Macro Economic Variable}(t)$
- 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

<i>Period</i>	<i>Operating Income</i>	<i>Firm Value</i>	<i>Change in LT Bond Rate</i>	<i>Change in GDP</i>	<i>Change in Inflation</i>	<i>Change in Currency</i>
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

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- 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

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

$$\text{Change in Firm Value} = 0.51 - 7.49 (\text{Change in Interest Rates})$$

(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 –

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

- 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.

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

where,

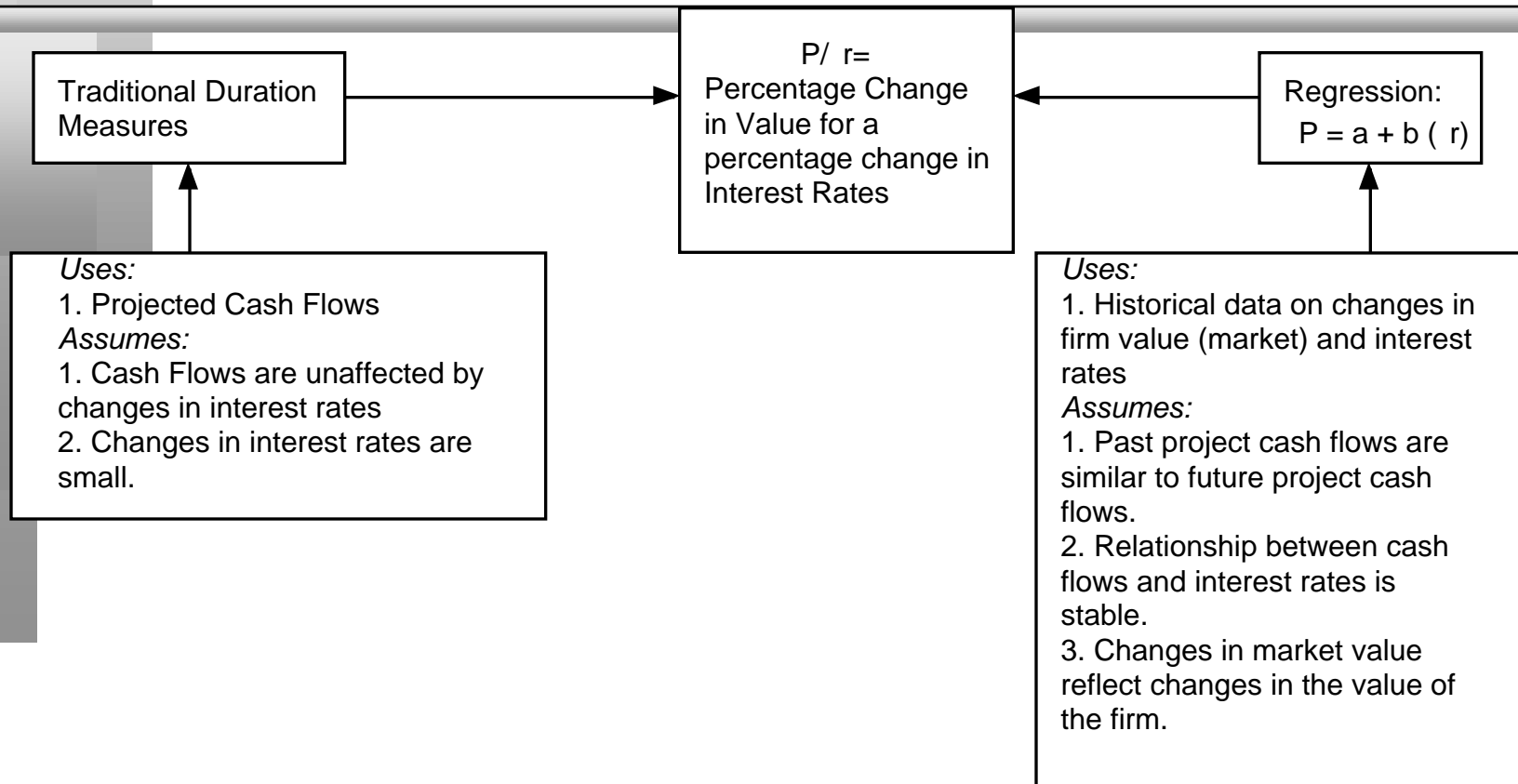
CF<sub>t</sub> = After-tax operating cash flow on the project in year t

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 than 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 –

$$\begin{array}{rcl} \text{Change in Firm Value} = & 0.74 & -7.82 \text{ ( GDP Growth)} \\ & (2.05) & (0.65) \end{array}$$

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

$$\begin{array}{rcl} \text{Change in Operating Income} = & 0.41 & - 2.25 \text{ ( GNP Growth)} \\ & (6.86) & (1.14) \end{array}$$

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

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

$$\text{Change in Firm Value} = 0.52 + \mathbf{1.13} (\text{Change in Dollar})$$

(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 –

$$\text{Change in Operating Income} = 0.35 - \mathbf{0.14} (\text{Change in Dollar})$$

(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 –

$$\begin{array}{l} \text{Change in Firm Value} \\ (2.78) \end{array} = 0.45 - \mathbf{23.39} \begin{array}{l} \text{(Change in Inflation Rate)} \\ (1.68) \end{array}$$

- 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 –

$$\begin{array}{l} \text{Change in Operating Income} \\ (10.37) \end{array} = 1.40 - 1.40 \begin{array}{l} \text{(Change in Inflation Rate)} \\ (0.50) \end{array}$$

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

# Bottom-up Estimates

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	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

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- 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

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	<i>Existing Debt</i>	<i>Optimal</i>
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.