Valuation
Free Cash Flows

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Finance Theory II
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Valuation Tools

- A key task of managers is to undertake valuation exercises in order to allocate capital between mutually exclusive projects:
  - Is project A better than doing nothing?
  - Is project A better than project B?
  - Is the project’s version A than its modified version A’?

- The process of valuation and ultimately of capital budgeting generally involves many factors, some formal, some not (experience, hard-to-formalize information, politics, etc.).

- We will focus on financial tools for valuation.
Valuation Tools (cont.)

- These tools provide managers with numerical techniques to “keep score” and assist in the decision-making process.

- They build on modern finance theory and deal with cash flows, time, and risk.

- All rely on (often highly) simplified models of the business:
  - Technical limitations (less now with computers)
  - Versatility
  - Understandable and discussible
How to Value a Project/Firm?

- **Calculate NPV**
  - Estimate the expected cash-flows
  - Estimate the appropriate discount rate for each cash flow
  - Calculate NPV

- **Look up the price of a comparable project**

- **Use alternative criteria (e.g., IRR, payback method)**
  - You need to be an educated user of these
Comparables method

- Suppose you want to value a private company going public
  - EBITDA = $100 million
  - For a similar public company P/E = 10
  - You value the IPO company at $1,000 million

- What are the implicit assumptions?
  - Suppose that $P = \frac{E}{r - g}$
  - Then, $P/E = 1 / (r - g)$
  - Thus, we assume that
    - Earnings are expected to grow in perpetuity at a constant rate
    - Growth rates and discount rates are the same for both firms
Internal Rate of Return (IRR)

- **One-period project**
  - Investment = 100 at time 0   Payoff = 150 at time 1
  
  Rate of return = \( \frac{150}{100} - 1 = 50\% \)
  NPV = -100 + 150/discount rate = 0
  Discount rate =  150/100 = 50%

  - Rate of return is the discount rate that makes NPV = 0

- **Multiple period projects**
  - IRR is the discount rate that makes NPV = 0

  \[
  \text{NPV} = I_0 + \frac{C_1}{1 + \text{IRR}} + \frac{C_2}{(1 + \text{IRR})^2} + \ldots + \frac{C_T}{(1 + \text{IRR})^T} = 0
  \]

  Basic rule: Choose projects with IRR > opportunity costs of capital
Internal Rate of Return (IRR), cont.

- Suppose you choose among two mutually exclusive projects
  - E.g., alternative ways to use a particular piece of land
    - Project 1: cash flows -10 +20 IRR=100%
    - Project 2: cash flows: -20 +35 IRR=75%
  - Which project would you choose? (costs of capital = 10%)
    - Project 2 because it has a higher NPV

- Other pitfalls (BM, Chapter 5)
  - E.g., multiple IRR, lending vs. borrowing.

- Bottom line
  - NPV is easier to use than IRR
  - If used properly, IRR should give you the same answer as NPV
1. Calculating Cash Flows
The Free Cash Flow (FCF) Approach

- **FCF**: The expected after tax cash flows of an *all equity firm*
  - These cash flows ignore the tax savings the firm gets from debt financing (the deductibility of interest expense)

- **Plan of Attack:**
  - Step 1: Estimating the Free Cash Flows
  - Step 2: Account for the effect of financing on value

- **Preview**: Two ways to account for tax shield:
  - Adjust the discount rate (WACC method).
  - Adjust the cash-flow estimate (APV method).
Count all incremental, after-tax cash flows allowing for reasonable inflation.

- **All:**
  - Don’t just look at operating profits in the out years.
  - If project requires follow-on CAPX or additional working capital, take these into account.

- **After-tax:** The rest goes to the IRS.

- **Be consistent in your treatment of inflation:**
  - Discount nominal cash flows at nominal discount rates.
  - Reasons:
    - Nominal rates reflect inflation in overall economy, but inflation in cash flows may be different.
    - In fact, some items in cash flows, e.g., depreciation, may have no inflation.
Treatment of Inflation - Example

- T-Bill rate (nominal) = 8%
- Expected inflation rate = 6%
- Expected real rate = 1.08/1.06 = 1.9%

- Sales of widgets next year = $100 measured in today’s dollars
- You expect that the price of the widgets will go up by 6%
- What’s the PV of the widgets?

  nominal cash flows: \[ PV = \frac{100 \times (1.06)}{1.08} = 98.2 \]

  real cash flows: \[ PV = \frac{100}{1.08/1.06} = 98.2 \]
Equivalent Expressions for Free Cash Flows (see Finance Theory I)

FCF = (1 – t) × EBIT + Depreciation - CAPX - Change in NWC

FCF = (1 – t) × EBITD + t × Depreciation - CAPX - Change in NWC

FCF = (1 – t) × EBIT - Change in Net Assets

Note:
EBIT = Earnings before interest and taxes
EBITD = Earnings before interest and taxes and depreciation = EBIT + Depreciation
Change in NWC is sometimes called Investment in NWC.
Example of Free Cash Flow Calculation

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<td>Taxes (38%)</td>
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<td>Profit After taxes</td>
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<td>Inventories</td>
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<tr>
<td>Accounts Payable</td>
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</table>

In 1999: 
FCF = EBIT*(1-t) + Depreciation - CAPX - Change in NWC

EBIT = 1,200 - 850 - 35 = 315; Ch. NWC = (60+60-25) - (50+50-20) = 15

FCF = 315 * (1-.38) + 35 - 40 - 15 = 175.3
Beware!

- Note:
  - We ignored interest payments
  - We computed taxes on EBIT

- Do not take the effect of financing (e.g., interest) into account at this stage.

- Remember our plan:
  - First, determine the expected cash-flows as if the project were 100% equity financed.
  - Later, we will adjust for financing.

- If you count financing costs in cash-flow, you count them twice.
XYZ, a profitable widget producer ($100M annual after-tax profit) contemplates introducing new Turbo Widgets (TWs), developed in its labs at an R&D cost of $1M over the past 3 years.

New plant to produce TW would
- cost $20M today
- last 10 years with salvage value of $5M
- be depreciated to $0 over 5 years using straight-line

TWs need painting: Use 40% of the capacity of a painting machine
- currently owned and used by XYZ at 30% capacity
- with maintenance costs of $100,000 (regardless of capacity used)

Annual
- operating costs: $400,000
- operating income generated: $42M
- operating income of regular widgets would decrease by $2M

Working capital (WC): $2M needed over the life of the project

Corporate tax rate 36%
TW Example (cont.)

- Ignore the $100M after-tax profit and focus on incremental cash-flows
- R&D cost of $1M over the past three years: Sunk cost ==> Ignore it
- The plant’s $20M cost: It’s a CAPX ==> Count it
- Machine’s $100K maintenance cost: Not incremental ==> Ignore it
  - Incurred with or without TW production
  - True even if accounting charges TW production a fraction of these
- **Op. income of regular widgets decrease by $2M due to cannibalization**
  - Would not occur without TW production
  - It is an opportunity cost ==> Count it

<table>
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<th>Year</th>
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<th>2</th>
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<th>4</th>
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</table>
Use Incremental Cash Flows

- Compare firm value with and without the project
  \[ V(\text{project}) = V(\text{firm w/ project}) - V(\text{firm w/o project}) \]

- Use only cash flows (in and out) attributable to the project
  - Sunk costs should be ignored
    - They are spent w/ or w/o the project (bygones are bygones).
  - Opportunity costs should be accounted for
    - A project might exclude good alternatives (e.g., use of land).
  - Accounting illusions should be avoided
    - e.g. the project might be “charged” for a fraction of expenses that would be incurred anyway.
Use After-tax Cash Flows

- These are what you have left after paying capital suppliers
- Make sure to count the benefits of expensing, depreciation, etc.
- CAPX and Depreciation:
  - CAPX are not directly subtracted from taxable income
  - Instead, a fraction of CAPX (depreciation) is subtracted over a number of years
TW Example (cont.)

- Depreciation:
  - Straight line depreciation: Flat annual depreciation
  - Accelerated depreciation: Decreasing

- $20M CAPX is depreciated linearly over 5 years, down to zero.
  \[ D = \frac{(20 - 0)}{5} = $4M \]

- Salvage value $5M is fully taxable since book value is zero.

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## TW Example (cont.)

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**Note:** We do as if entire EBIT is taxable ==> We ignore (for now) the fact that interest payments are not taxable.
So far (but we’re not done yet):

\[
CF = \text{Incr. Profit} - \text{Taxes} - \text{CAPX}
\]

\[
= \text{Incr. Profit} - t \times (\text{Incr. Profit} - \text{Depr.}) - \text{CAPX}
\]

\[
= (1 - t) \times \text{Incr. Profit} + t \times \text{Depr.} - \text{CAPX}
\]

Example: We could have computed the CF in year 1 as

\[
(1 - 36\%) \times 39.6 + 36\% \times 4 - 0 = $26.8M
\]
Changes in (Net) Working Capital

Remark 1:
- Many projects need some capital to be tied up (working capital) which constitutes an opportunity cost.
- We need the Change in Working Capital implied by the project.

Remark 2:
- Accounting measure of earnings
  \[ \text{Sales} - \text{Cost of Goods Sold} \]
- Income and expense are reported when a sale is declared.
  - COGS in 2000 includes the costs of items sold in 2000 even if the cost was incurred in 1999 or hasn’t been incurred yet.
  - Sales in 2000 include the income from items sold in 2000 even if the payment has not been received yet.

\[ \text{Working Capital} = \text{Inventory} + \text{A/R} - \text{A/P} \]
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</table>
Putting It All Together

\[ \text{FCF} = (1 - t) \times \text{Incr. Profit} + t \times \text{Depr.} - \text{CAPX} - \Delta \text{NWC} \]

This can also be rewritten as

\[ \text{FCF} = (1 - t) \times \text{EBIT} + \text{Depr.} - \text{CAPX} - \Delta \text{NWC} \]
Finding the Value of the Cash Flows

- **Decision Rule**
  - Accept any project with positive NPV. The NPV tells you how much value the project creates.

\[
NPV = CF_0 + \frac{E[CF_1]}{(1+r)} + \frac{E[CF_2]}{(1+r)^2} + \frac{E[CF_3]}{(1+r)^3} + \frac{E[CF_4]}{(1+r)^4} + \ldots
\]

- We know how to find the expected *free cash flows*

- We need to find the appropriate *discount rate* for a project

- We need to account for the tax benefits of interest payments
  - Ignore this for now, and assume that the project is 100% equity financed
What is the appropriate discount rate for a project?

- The discount rate is the *opportunity cost of capital for the project*.

- It answers the question: What rate can investors earn on an investments with *comparable risk*?

- What does comparable risk mean?
Using the CAPM

- **What does ‘comparable risk’ mean?**
  - CAPM: risk = β

- **How does risk translate into a discount rate?**
  - CAPM: $E[r_E] = r_f + \beta E[R_M - r_f]$

- **Practical issues**
  - Estimating betas
  - Estimating the market risk premium
  - Leverage
Beta = regression slope
Leverage, returns, and risk

Firm is a portfolio of debt and equity

Therefore …

\[ r_A = \frac{D}{A} r_D + \frac{E}{A} r_E \quad \text{and} \quad \beta_A = \frac{D}{A} \beta_D + \frac{E}{A} \beta_E \]
Estimating Betas

- **Equity Beta**
  - Simply regress past stock returns on the market return

- **Asset Beta**
  - For an all-equity firm, equity beta = asset beta
  - How about levered firms?
  - Hint:
    - You can view the firm as a portfolio of debt and equity
    - Recall: portfolio beta = weighted average of individual asset betas
    - Question: What are the appropriate weights?
    - You can assume that debt is risk-free or that debt beta is between 0.1 and 0.3 (based on empirical studies)
The Big Picture: Part I - Financing

A. Identifying Funding Needs
- Feb 6    Case: Wilson Lumber 1
- Feb 11   Case: Wilson Lumber 2

B. Optimal Capital Structure: The Basics
- Feb 13   Lecture: Capital Structure 1
- Feb 20   Lecture: Capital Structure 2
- Feb 25   Case: UST Inc.
- Feb 27   Case: Massey Ferguson

C. Optimal Capital Structure: Information and Agency
- Mar 4    Lecture: Capital Structure 3
- Mar 6    Case: MCI Communications
- Mar 11   Financing Review
- Mar 13   Case: Intel Corporation
The Key Questions of Corporate Finance

- **Valuation**: How do we distinguish between good investment projects and bad ones?

- **Financing**: How should we finance the investment projects we choose to undertake?

Financing Policy

- Real investment policies imply funding needs.

- We have tools to forecast the funding needs to follow a given real investment policy (from Wilson Lumber)

- But what is the best source of funds?
  - Internal funds (i.e., cash)?
  - Debt (i.e., borrowing)?
  - Equity (i.e., issuing stock)?

- Moreover, different kinds of ...
  - internal funds (e.g., cash reserves vs. cutting dividends)
  - debt (e.g., Banks vs. Bonds)
  - equity (e.g., VC vs. IPO)
Capital Structure

- Capital Structure represents the mix of claims against a firm’s assets and free cash flow.

- Some characteristics of financial claims:
  → Payoff structure (e.g., fixed promised payment)
  → Priority (debt paid before equity)
  → Maturity
  → Restrictive Covenants
  → Voting rights
  → Options (convertible securities, call provisions, etc.)

- We focus on leverage (debt vs. equity) and how it can affect firm value.

Choosing an Optimal Capital Structure

- Is there an “optimal” capital structure, i.e., an optimal mix between debt and equity?

- More generally, can you add value on the RHS of the balance sheet, i.e., by following a good financial policy?

- If yes, does the optimal financial policy depend on the firm’s operations (Real Investment policy), and how?
**Companies and Industries Vary in Their Capital Structures**

<table>
<thead>
<tr>
<th>Industry</th>
<th>Debt Ratio* (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric and Gas</td>
<td>43.2</td>
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<tr>
<td>Food Production</td>
<td>22.9</td>
</tr>
<tr>
<td>Paper and Plastic</td>
<td>30.4</td>
</tr>
<tr>
<td>Equipment</td>
<td>19.1</td>
</tr>
<tr>
<td>Retailers</td>
<td>21.7</td>
</tr>
<tr>
<td>Chemicals</td>
<td>17.3</td>
</tr>
<tr>
<td>Computer Software</td>
<td>3.5</td>
</tr>
<tr>
<td><strong>Average over all industries</strong></td>
<td><strong>21.5%</strong></td>
</tr>
</tbody>
</table>

* Debt Ratio = Ratio of book value of debt to the sum of the book value of debt plus the market value of equity.
Returns

Average rates of return on Treasury bills, government bonds, corporate bonds, and common stocks, 1926-1997 (figures in percent per year)

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Average Annual Rate</th>
<th>Average Risk Premium (over T-Bills)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nominal</td>
<td>Real</td>
</tr>
<tr>
<td>Treasury bills</td>
<td>3.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Government bonds</td>
<td>5.6</td>
<td>2.6</td>
</tr>
<tr>
<td>Corporate bonds</td>
<td>6.1</td>
<td>3.0</td>
</tr>
<tr>
<td>Common stocks (S&amp;P 500)</td>
<td>13.0</td>
<td>9.7</td>
</tr>
<tr>
<td>Small-firm common stocks</td>
<td>17.7</td>
<td>14.2</td>
</tr>
</tbody>
</table>


Plan of Attack

1. Modigliani-Miller Theorem:
   → Capital Structure is irrelevant

2. What’s missing from the M-M view?
   → Taxes
   → Costs of financial distress
   → Other factors

3. “Textbook” view of optimal capital structure:
   → The choice between debt and equity

4. Apply/confront this framework to several business cases
   → Evaluate when its usefulness and its limitations
M-M’s “Irrelevance” Theorem

MM Theorem (without taxes for now).
- Financing decisions are irrelevant for firm value.
- In particular, the choice of capital structure is irrelevant.

Proof: From Finance Theory I,
- Purely financial transactions do not change the total cash flows and are therefore zero NPV investments.
- With no arbitrage opportunities, they cannot change the total price.
- Thus, they neither increase nor decrease firm value. Q.E.D.

Example
Consider two firms with identical assets (in $M):

<table>
<thead>
<tr>
<th>Asset (economic, not book) value next year:</th>
<th>Firm A</th>
<th>Firm B</th>
</tr>
</thead>
<tbody>
<tr>
<td>In state 1:</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>In state 2:</td>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>

- Firm A is all equity financed:
  - Firm A’s value is \( V(A) = E(A) \)

- Firm B is financed with a mix of debt and equity:
  - Debt with one year maturity and face value $60M
  - Market values of debt \( D(B) \) and equity \( E(B) \)
  - Firm B’s value is (by definition) \( V(B) = D(B) + E(B) \)

- MM says: \( V(A) = V(B) \)
Proof 1

- Firm A’s equity gets all cash flows
- Firm B’s cash flows are split between its debt and equity with debt being senior to equity.

<table>
<thead>
<tr>
<th>Claim’s value next year:</th>
<th>Firm A’s Equity</th>
<th>Firm B’s Debt</th>
<th>Firm B’s Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>In state 1:</td>
<td>160</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>In state 2:</td>
<td>40</td>
<td>40</td>
<td>0</td>
</tr>
</tbody>
</table>

- In all (i.e., both) states of the world, the following are equal:
  → The payoff to Firm A’s equity
  → The sum of payoffs to Firm B’s debt and equity

- By value additivity, \( D(B) + E(B) = E(A) \)
  Q.E.D.

M-M Intuition 1

- If Firm A were to adopt Firm B’s capital structure, its total value would not be affected (and vice versa).

- This is because ultimately, its value is that of the cash flows generated by its operating assets (e.g., plant and inventories).

- The firm’s financial policy divides up this cashflow “pie” among different claimants (e.g., debtholders and equityholders).

- But the size (i.e., value) of the pie is independent of how the pie is divided up.
Proof 2

In case you forgot where value additivity comes from…

- Assume for instance that market values are:
  - \( D(B) = $50M \)
  - \( E(B) = $50M \)

- MM says: \( V(A) = D(B) + E(B) = $100M \)

- Suppose instead that \( E(A) = $105M \).
- Can you spot an arbitrage opportunity?
Proof 2 (cont.)

- Arbitrage strategy:
  - → Buy 1/1M of Firm B’s equity for $50
  - → Buy 1/1M of Firm B’s debt for $50
  - → Sell 1/1M of Firm A’s equity for $105

<table>
<thead>
<tr>
<th></th>
<th>Today</th>
<th>Next year State 1</th>
<th>Next year State 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm B’s equity</td>
<td>-$50</td>
<td>+$100</td>
<td>$0</td>
</tr>
<tr>
<td>Firm B’s debt</td>
<td>-$50</td>
<td>+$60</td>
<td>+$40</td>
</tr>
<tr>
<td>Subtotal</td>
<td>-$100</td>
<td>+$160</td>
<td>+$40</td>
</tr>
<tr>
<td>Firm A’s equity</td>
<td>+$105</td>
<td>-$160</td>
<td>-$40</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>+$5</td>
<td>$0</td>
</tr>
</tbody>
</table>

Note: Combining Firm B’s debt and equity amounts to “undoing Firm B’s leverage” (see bolded cells).

M-M: Intuition 2

- Investors will not pay a premium for firms that undertake financial transactions that they can undertake themselves (at the same cost).

- For instance, they will not pay a premium for Firm A over Firm B for having less debt.

- Indeed, by combining Firm B’s debt and equity in appropriate proportions, any investor can in effect “unlever” Firm B and reproduce the cashflow of Firm A.
The Curse of M-M

- M-M Theorem was initially meant for capital structure.

- But it applies to all aspects of financial policy:
  - capital structure is irrelevant.
  - long-term vs. short-term debt is irrelevant.
  - dividend policy is irrelevant.
  - risk management is irrelevant.
  - etc.

- Indeed, the proof applies to all financial transactions because they are all zero NPV transactions.

Using M-M Sensibly

- M-M is not a literal statement about the real world. It obviously leaves important things out.

- But it gets you to ask the right question: How is this financing move going to change the size of the pie?

- M-M exposes some popular fallacies such as the “WACC fallacy”.
Tax savings of debt: value implications

With corporate taxes (but no other complications), the value of a levered firm equals:

\[ V_L = V_U + PV(\text{interest tax shields}) \]

Discount rate for tax shields = \( r_d \)

If debt is a perpetuity:

\[ PV(\text{interest tax shields}) = \frac{\text{tax shields per year}}{\text{interest rate}} = \frac{\tau}{r_d} D = \tau D \]

\[ V_L = V_U + \tau D \]
Valuing the Tax Shield (to make things clear)

- Firm A: is all equity financed
  - has a perpetual before-tax, expected annual cash flow $X$
    
    $$C_A = (1 - \tau)X$$

- Firm B: is identical but maintains debt with value $D$
  - It thus pays a perpetual expected interest $r_d \cdot D$

    $$C_B = (1 - \tau)(X - r_d D) + r_d D = (1 - \tau)X + \tau \cdot r_d \cdot D \Rightarrow$$

    $$C_B = C_A + \tau \cdot r_d \cdot D$$

- Note: the cash flows differ by the tax shield $\tau \cdot r_d \cdot D$
To make things clear (cont.)

- We want to value firm B knowing that:
  \[ C_B = C_A + \tau \cdot r_d \cdot D \]

- **Apply value additivity:** Value separately \( C_A \) and \( \tau r_d D \)
  
  - The value of firm A is:
    \[ PV(C_A) = V_A \]
  
  - The present value of tax shields is:
    \[ PV(TS) = \frac{\tau \cdot r_d \cdot D}{r_d} = \tau \cdot D \]
  
- So, the value of firm B is:
  \[ V_B = V_A + \tau \cdot D \]
Leverage and firm value

![Graph showing the relationship between leverage and firm value.](image-url)
Remarks

- Raising debt does not create value, i.e., you can’t create value by borrowing and sitting on the excess cash.

- It creates value relative to raising the same amount in equity.

- Hence, value is created by the tax shield when you:
  → finance an investment with debt rather than equity
  → undertake a recapitalization, i.e., a financial transaction in which some equity is retired and replaced with debt.
Back to the Microsoft example…

What would be the value of tax shields for Microsoft?

- Interest expense = $50 \times 0.07 = $3.5 billion
- Interest tax shield = $3.5 \times 0.34 = $1.19 billion
- \( PV\text{(tax shields)} = \frac{1.19}{0.07} = 50 \times 0.34 = $17 \text{ billion} \)
- \( V_L = V_u + PV\text{(tax shields)} = $440 \text{ billion} \)
Is This Important or Negligible?

- Firm A has no debt and is worth $V(\text{all equity})$.
- Suppose Firm A undertakes a leveraged recapitalization:
  - issues debt worth $D$,
  - and buys back equity with the proceeds.

- Its new value is:
  $$\frac{V_L}{V_U} = 1 + \tau \cdot \frac{D}{V_U}$$

- Thus, with corporate tax rate $\tau = 35\%$:
  - for $D = 20\%$, firm value increases by about 7\%.
  - for $D = 50\%$, it increases by about 17.5\%.
Bottom Line

- Tax shield of debt matters, potentially a lot.

- Pie theory gets you to ask the right question: *How does this financing choice affect the IRS’ bite of the corporate pie?*

- It is standard to use $\tau*D$ for the capitalization of debt’s tax break.

- **Caveats:**
  - Not all firms face full marginal tax rate
  - Personal taxes
Marginal tax rate (MTR)

- Present value of current and expected future taxes paid on $1 of additional income

- Why could the MTR differ from the statutory tax rate?
  - Current losses
  - Tax-Loss Carry Forwards (TLCF)
Tax-Loss Carry Forwards (TLCF)

- Current losses can be carried backward/forward for 3/15 years
  - Can be used to offset *past profits* and get tax refund
  - Can be used to offset *future profits* and reduce future tax bill

- Valuing TLCF, need to incorporate time value of money

- Bottom line: More TLCF $\Rightarrow$ Less debt
Tax-Loss Carry Forwards (TLCF): Example

<table>
<thead>
<tr>
<th>time (t)</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>-500</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Carryforward</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>200</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Tax paid at time t</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tax refund</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>105</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Suppose Net Income increases by $1 in year 0

<table>
<thead>
<tr>
<th>time (t)</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>-499</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Carryforward</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>199</td>
<td>99</td>
<td>0</td>
</tr>
<tr>
<td>Tax paid at time t</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>0</td>
<td>0</td>
<td>0.35</td>
</tr>
<tr>
<td>Tax refund</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>105</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**MTR at time 0 = PV (Additional Taxes) = 0.35/1.1^2 = 0.29**
(assuming that r = 10%)
Marginal Tax Rates for U.S. firms

Please see the graph showing Marginal Tax Rate, Percent of Population, and Year in:

Personal Taxes

- **Investors’ return from debt and equity are taxed differently**
  - Interest and dividends are taxed as ordinary income
  - Capital gains are taxed at a lower rate
  - Capital gains can be deferred (contrary to dividends and interest)
  - Corporations have a 70% dividend exclusion

- **So: For personal taxes, equity dominates debt.**
## Pre Clinton

<table>
<thead>
<tr>
<th></th>
<th>Debt</th>
<th>Equity with deferred capital gains*</th>
<th>Equity with dividends</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Corporate level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start with $100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Tax rate = 34%</td>
<td>0</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td><strong>Net</strong></td>
<td>100</td>
<td>66</td>
<td>66</td>
</tr>
<tr>
<td><strong>Personal level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax rate = 31%</td>
<td>31</td>
<td>0</td>
<td>20.46</td>
</tr>
<tr>
<td><strong>Bottom line</strong></td>
<td>69</td>
<td>66</td>
<td>45.54</td>
</tr>
</tbody>
</table>

* Extreme assumption: No tax on capital gains
## Post Clinton

<table>
<thead>
<tr>
<th></th>
<th>Debt</th>
<th>Equity with deferred capital gains*</th>
<th>Equity with dividends</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Corporate level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start with $100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Tax rate = 35%</td>
<td>0</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Net</td>
<td>100</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td><strong>Personal level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax rate = 40%</td>
<td>40</td>
<td>0</td>
<td>26</td>
</tr>
<tr>
<td><strong>Bottom line</strong></td>
<td>60</td>
<td>65</td>
<td>39</td>
</tr>
</tbody>
</table>

* Extreme assumption: No tax on capital gains
Bottom Line

- Taxes favor debt for most firms
- We will lazily ignore personal taxation in the rest of the course
- But, beware of particular cases
The Dark Side of Debt: Cost of Financial Distress

- If taxes were the only issue, (most) companies would be 100% debt financed

- Common sense suggests otherwise
  - If the debt burden is too high, the company will have trouble paying
  - The result: financial distress
“Pie” Theory

- Equity
- Debt
- Destroyed in Financial Distress
- Taxes
Costs of Financial Distress

- Firms in financial distress perform poorly
  - Is this poor performance an effect or a cause of financial distress?

- Financial distress sometimes results in partial or complete liquidation of the firm’s assets
  - Would this not occur otherwise?

Do not confuse causes and effects of financial distress. Only the effects should be counted as costs!
Costs of Financial Distress

Direct Bankruptcy Costs:
- Legal costs, etc…

Indirect Costs of Financial Distress:
- Debt overhang: Inability to raise funds to undertake good investments
  - Pass up valuable investment projects
  - Competitors may take this opportunity to be aggressive
- Risk taking behavior - gambling for salvation
- Scare off customers and suppliers
## Direct bankruptcy costs


<table>
<thead>
<tr>
<th></th>
<th>Month*</th>
<th>Costs as % of change in value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>-36</td>
</tr>
<tr>
<td>High</td>
<td>9.1</td>
<td>5.9</td>
</tr>
<tr>
<td>Low</td>
<td>1.7</td>
<td>0.4</td>
</tr>
<tr>
<td>Mean</td>
<td>5.6</td>
<td>2.6</td>
</tr>
</tbody>
</table>

* Bankruptcy occurs in month 0.
Direct bankruptcy costs and firm size
Direct Bankruptcy Costs

What are direct bankruptcy costs?
- Legal expenses, court costs, advisory fees…
- Also opportunity costs, e.g., time spent by dealing with creditors

How important are direct bankruptcy costs?
- Prior studies find average costs of 2-6% of total firm value
- Percentage costs are higher for smaller firms
- But this needs to be weighted by the bankruptcy probability!
- Overall, expected direct costs tend to be small
Debt Overhang

- XYZ has assets in place (with idiosyncratic risk) worth:

<table>
<thead>
<tr>
<th>State</th>
<th>Probability</th>
<th>Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>1/2</td>
<td>100</td>
</tr>
<tr>
<td>Bad</td>
<td>1/2</td>
<td>10</td>
</tr>
</tbody>
</table>

- In addition, XYZ has $15M in cash
  - This money can be either paid out as a dividend or invested

- XYZ’s project is:
  - Today: Investment outlay $15M, next year: safe return $22M

- Should XYZ undertake the project?
  - Assume: risk-free rate = 10%
  - \[ NPV = -15 + \frac{22}{1.1} = $5M \]
Debt Overhang (cont.)

- XYZ has debt with face value $35M due next year

<table>
<thead>
<tr>
<th>Project?</th>
<th>State</th>
<th>Proba.</th>
<th>Assets</th>
<th>Creditors</th>
<th>Shareholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Good</td>
<td>1/2</td>
<td>100</td>
<td>35</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Bad</td>
<td>1/2</td>
<td>10</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>YES</td>
<td>Good</td>
<td>1/2</td>
<td>100+22=122</td>
<td>35</td>
<td>65+22=87</td>
</tr>
<tr>
<td></td>
<td>Bad</td>
<td>1/2</td>
<td>10+22=32</td>
<td>10+22=32</td>
<td>0</td>
</tr>
</tbody>
</table>

- Will XYZ’s shareholders fund the project?
  → If not, they get the dividend = $15M
  → If yes, they get: \([(1/2)*22 + (1/2)*0]/1.1 = $10\]

- What’s happening?
Debt Overhang (cont.)

- Shareholders would:
  - Incur the full investment cost: - $15M
  - Receive only part of the return (22 only in the good state)

- Existing creditors would:
  - Incur none of the investment cost
  - Still receive part of the return (22 in the bad state)

- So, existing risky debt acts as a “tax on investment”

Shareholders of firms in financial distress may be reluctant to fund valuable projects because most of the benefits would go to the firm’s existing creditors.
Debt Overhang (cont.)

- What if the probability of the bad state is 2/3 instead of 1/2?
- The creditor grab part of the return even more often.
- The “tax” of investment is increased.
- The shareholders are even less inclined to invest.

Companies find it increasingly difficult to invest as financial distress becomes more likely.
What Can Be Done About It?

- New equity issue?
- New debt issue?
- Financial restructuring?
  - Outside bankruptcy
  - Under a formal bankruptcy procedure
Raising New Equity?

- Suppose you raise outside equity

- New shareholders must break even:
  - They may be paying the investment cost
  - But only because they receive a fair payment for it

- This means someone else is de facto incurring the cost:
  - The existing shareholders!
  - So, they will refuse again

Firms in financial distress may be unable to raise funds from new investors because most of the benefits would go to the firm’s existing creditors.
Financial Restructuring?

- In principle, restructuring could avoid the inefficiency:
  - debt for equity exchange
  - debt forgiveness or rescheduling

- Suppose creditors reduce the face value to $24M
  - conditionally on the firm raising new equity to fund the project

<table>
<thead>
<tr>
<th>Restructure?</th>
<th>State</th>
<th>Proba.</th>
<th>Assets</th>
<th>Creditors</th>
<th>Shareholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>Good</td>
<td>1/2</td>
<td>100</td>
<td>35</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Bad</td>
<td>1/2</td>
<td>10</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>YES</td>
<td>Good</td>
<td>1/2</td>
<td>122</td>
<td>24</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>Bad</td>
<td>1/2</td>
<td>32</td>
<td>24</td>
<td>8</td>
</tr>
</tbody>
</table>

- Will shareholders go ahead with the project?
Financial Restructuring? (cont.)

- Incremental cash flow to shareholders from restructuring:
  - $98 - 65 = $33M with probability 1/2
  - $8 - 0 = $8M with probability 1/2

- They will go ahead with the restructuring deal because:
  - $-15 + [(1/2)*33 + (1/2)*8]/1.1 = $3.6M > 0
  - Recall our assumption: discount everything at 10%

- Creditors are also better-off because they get:
  - $5 - 3.6 = $1.4M
Financial Restructuring? (cont.)

- When evaluating financial distress costs, account for the possibility of (mutually beneficial) financial restructuring.

- In practice, perfect restructuring is not always possible.

- But you should ask: *What are limits to restructuring?*
  - Banks vs. bonds
  - Few vs. many banks
  - Bank relationship vs. arm’s length finance
  - Simple vs. complex debt structure (e.g., number of classes with different seniority, maturity, security, ....)
Issuing New Debt

- Issuing new debt with **lower seniority** as the existing debt
  - Will not improve things: the “tax” is unchanged

- Issuing debt with **same seniority**
  - Will mitigate but not solve the problem: a (smaller) tax remains

- Issuing debt with **higher seniority**
  - Avoids the tax on investment because gets a larger part of payoff
  - Similar: debt with shorter maturity (de facto senior)
  - **However, this may be prohibited by covenants**
Bankruptcy

- This analysis has implications which are recognized in the Bankruptcy Law.

- Bankruptcy under Chapter 11 of the Bankruptcy Code:
  - Provides a formal framework for financial restructuring
  - Debtor in Possession: Under control by the court, the company can issue debt senior to existing claims despite covenants
Debt Overhang: Preventive Measures

- Firms which are likely to enter financial distress should avoid too much debt

- If you cannot avoid leverage, at least you should structure your liabilities so that they are easy to restructure if needed:
  - Active management of liabilities
  - Bank debt
  - Few banks
Example

- Your firm has $50 in cash and is currently worth $100.
- You have the opportunity to acquire an internet start-up for $50.
  - The start-up will either be worth $0 (prob = 2/3) or $120 (prob = 1/3) in one year.
  - Assume the discount rate is 0%.

Would you invest in the start-up if your firm is all-equity financed?

What if the firm has debt outstanding with a face value of $80?

If all equity

Expected payoff = 0.66 \times 0 + 0.33 \times 120 = $40

NPV = -50 + 40 = -$10 \quad \rightarrow \quad \text{Reject!}
Example, cont.

If leveraged (debt=$80):

- Without project: equity = $20, debt = $80

  Lucky (p=1/3)
  \[ V = $170 \]
  \[ E = $90 \]
  \[ D = $80 \]

  With project

  Unlucky (p=2/3)
  \[ V = $50 \]
  \[ E = $0 \]
  \[ D = $50 \]

- With project: equity = $30, debt = $60 \[ \rightarrow \text{ Accept!} \]
- What is happening?
Excessive Risk-Taking

- The project is a bad gamble (NPV<0) but the shareholders are essentially gambling with the creditors’ money.

- Implication: Firms in distress will adopt excessively risky strategies to “go for broke”.

- Firms will tend to liquidate assets too late and remain in business for too long.
Excessive Risk-Taking: Intuition

Equity holders have unlimited upside potential but bounded losses
Summary: Expected costs of financial distress

![Graph showing the expected distress costs as a function of leverage. The costs increase rapidly with increasing leverage.]
Summary: Capital structure choice

![Diagram of capital structure choice]

- $V_L$ with tax shields, but no distress
- $V_L$ with tax shields and distress
- $V_U$ according to MM
- Optimal capital structure
Textbook View of Optimal Capital Structure

1. Start with M-M Irrelevance

2. Add two ingredients that change the size of the pie.
   → Taxes
   → Expected Distress Costs

3. Trading off the two gives you the “static optimum” capital structure. ("Static" because this view suggests that a company should keep its debt relatively stable over time.)
Practical Implications

- Companies with “low” expected distress costs should load up on debt to get tax benefits.

- Companies with “high” expected distress costs should be more conservative.
Expected Distress Costs

Thus, all substance lies in having an idea of what industry and company traits lead to potentially high expected distress costs.

\[
\text{Expected Distress Costs} = (\text{Probability of Distress}) \times (\text{Distress Costs})
\]
Identifying Expected Distress Costs

- **Probability of Distress**
  - Volatile cash flows
    - industry change
    - technology change
  - macro shocks
  - start-up

- **Distress Costs**
  - Need external funds to invest in CAPX or market share
  - Financially strong competitors
  - Customers or suppliers care about your financial position
    (e.g., because of implicit warranties or specific investments)
  - Assets cannot be easily redeployed
Setting Target Capital Structure: A Checklist

- **Taxes**
  - Does the company benefit from debt tax shield?

- **Expected Distress Costs**
  - Cashflow volatility
  - Need for external funds for investment
  - Competitive threat if pinched for cash
  - Customers care about distress
  - Hard to redeploy assets
Does the Checklist Explain Observed Debt Ratios?

<table>
<thead>
<tr>
<th>Industry</th>
<th>Debt Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric and Gas</td>
<td>43.2</td>
</tr>
<tr>
<td>Food Production</td>
<td>22.9</td>
</tr>
<tr>
<td>Paper and Plastic</td>
<td>30.4</td>
</tr>
<tr>
<td>Equipment</td>
<td>19.1</td>
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<tr>
<td>Retailers</td>
<td>21.7</td>
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<tr>
<td>Chemicals</td>
<td>17.3</td>
</tr>
<tr>
<td>Computer Software</td>
<td>3.5</td>
</tr>
</tbody>
</table>
What Does the Checklist Explain?

- Explains capital structure differences at broad level, e.g., between Electric and Gas (43.2%) and Computer Software (3.5%). In general, industries with more volatile cash flows tend to have lower leverage.

- Probably not so good at explaining small difference in debt ratios, e.g., between Food Production (22.9%) and Manufacturing Equipment (19.1%).

- Other factors, such as sustainable growth, are also important.
Key Points

- Recall the tension in Wilson Lumber between product market goals (fast growth) and financial goals (modest leverage).

- Fast growing companies reluctant to issue equity end up with debt ratios greater than the target implied by the checklist.

- Slowly growing companies reluctant to buy back equity or increase dividends end up with debt ratios below the target implied by the checklist.
Key Points

- O.K. to stray somewhat from target capital structure.

- But keep in mind: Fast growth companies that stray too far from the target with excessive leverage, risk financial distress.

- Ultimately, must have a consistent product market strategy and financial strategy.
Capital Structure:
Informational and Agency Considerations

The Big Picture: Part I - Financing

A. Identifying Funding Needs
- Feb 6 Case: Wilson Lumber 1
- Feb 11 Case: Wilson Lumber 2

B. Optimal Capital Structure: The Basics
- Feb 13 Lecture: Capital Structure 1
- Feb 20 Lecture: Capital Structure 2
- Feb 25 Case: UST Inc.
- Feb 27 Case: Massey Ferguson

C. Optimal Capital Structure: Information and Agency
- Mar 4 Lecture: Capital Structure 3
- Mar 6 Case: MCI Communications
- Mar 11 Financing Review
- Mar 13 Case: Intel Corporation
What’s Missing from the Simple M-M Story?

- Taxes:
  - Corporate taxes
  - Personal taxes

- Costs of Financial Distress

- No transaction costs for issuing debt or equity

Part I: Asymmetric Information between Firms and Investors

- In practice, companies are reluctant to issue equity.

- They follow a “pecking order” in which they finance investment:
  - first with internally generated funds
  - then with debt
  - and finally with equity.

- They may even forgo positive NPV investments because of reluctance to raise additional external financing.

- The willingness to issue equity fluctuates over time.

Something is missing from the “trade-off theory” view
Where does the Pecking Order come from?

- The irrelevance of financing in the Modigliani-Miller framework comes from the fact that existing shareholders (represented by managers) and new shareholders agree on the value of financial claims.
  → Everyone agrees on the size of the pie.

- This ensures that financial transactions have $\text{NPV} = 0$.

- But this may not always be a good description of reality:
  → Inefficient markets
  → Irrational managers
  → Managers with more information than investors
Managers with more information than investors
- The Lemons Problem:

Suppose that managers have more information about the firm than outside investors.

- Managers prefer to issue equity when equity is overvalued.
- Thus, equity issues signal to investors that equity is overvalued.
- Thus, stock price declines at equity issue announcements.
- Consequently, managers avoid issuing equity.
- In some cases, they may even forgo positive NPV projects rather than issue equity.

Example:
(let’s set aside taxes and financial distress)

- XYZ’s assets in place are subject to idiosyncratic risk:

<table>
<thead>
<tr>
<th>Asset value</th>
<th>p=0.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

- New investment project:
  - Discount rate: 10%
  - Investment outlay: $12M
  - Safe return next year: $22M ==> PV = 22/1.1 = $20M
    \[ NPV = -12 + 20 = $8M \]

- Should undertake the project
  - if XYZ has enough cash available?
  - if XYZ needs to raise external funds?
Case 1: Managers know as much as outside investors

- Suppose that XYZ has $12M in cash for investment
  → If internally financed with cash, existing shareholders realize the full $8M NPV of the investment.

- Suppose that XYZ does not have the cash but can issue $12M in equity
  → Once the project funded, the firm is worth $120M
  → Raise $12M by selling 10% of shares (after issue)
  → Existing shareholders get 90% * 120 = $108M
  → To be compared with $100M if did not invest
  --> Existing shareholders gain $8M

With no information asymmetries, managers are indifferent between internal and external financing.

---

Case 2: Managers know more than outside investors

<table>
<thead>
<tr>
<th>Assets value from the perspective of Shareholders</th>
<th>Managers</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 p=0.5</td>
<td>150 p=1</td>
</tr>
<tr>
<td>50  p=0.5</td>
<td></td>
</tr>
</tbody>
</table>

- **Internal financing:** As before, existing shareholders gain $8M.

- **Equity financing:** Raise $12M by selling 10% of shares (after issue), valued by the market at 120 (i.e., 100 + 20).
  → Existing shareholders get 90% * (150 + 20) = $153M.
  → Existing shareholders gain only $3M.

- **Why?**
  → 10% shares: Sold for $12M but really worth 10%*170=$17M
  → $8M gain on investment - $5M loss from under-pricing = $3M
Key Point:

• An equity issue by an undervalued firm entails a loss of value for its current shareholders:

"When equity is undervalued, managers prefer internal financing to issuing equity to outside investors."

Question: How does this help to understand the Pecking Order?

• Explains why internal funds are preferred to equity for many firms.
• But why is debt preferred to equity?
• Are other financial securities less sensitive to information asymmetries than equity?
  → Debt?
  → Hybrid securities (e.g. convertible debt)?

External Finance: Debt or Equity?

• With debt financing:
  → Raise $12M and repay (1.1) * 12 = $13.2M next year
  → Existing shareholders get the full $8M because:
    150 + (22 - 13.2)/1.1 = $158M

Implication:

• Good firms (those with assets in place worth 150M) will not want to issue equity, but will finance with debt.
• Investors would infer that equity issues are from bad firms (those with assets worth only $50M).
• Consistent with finding that stock price falls on announcement of equity issue.
Why Is Safe Debt Better Than Equity?

• Its value is independent of the information
• Managers and the market give it the same value
• Safe debt is fairly priced, hence no under-pricing

Note: Risky debt is underpriced, but less so than equity. Will still want to issue risky debt instead of equity. However, for high leverage, costs of financial distress should be taken into account. Equity might dominate debt in this case.

Example (cont.): Underinvestment

• Suppose investment outlay is $18M not $12M.
  \[ \text{NPV} = -18 + \frac{22}{1.1} = 2 \text{M} \]

• Raising $18M requires selling 15% of shares (after issue), valued by the market at 120 (i.e., 100 + 20).
  → Existing shareholders get 85% * (150 + 20) = $144.5M
  → They lose $5.5M relative to $150M if did not invest.

• Another way to see this:
  → Loss due to under-valuation 15%*(170-120) = $7.5M
  → Exceeds the project's value of $2M

=> XYZ will not issue equity to fund project.
Example (cont.): Market Reaction to Equity Issues

- Consider again the case of an investment outlay of $18M.
- Assume that the firm has no cash and cannot issue debt.
- If assets are worth $150M, the firm does not invest.
- Upon seeing the firm issuing equity, the market infers that it must be sitting on negative info: assets are worth only $50M.
- Given the market’s expectations that the firm was worth $100M, the firm’s market value drops to $70M when the firm announces the equity issue.

Take Away 1: The Value of a Project Depends on its Financing

Asymmetric information makes outside financing costly.

Internal vs. External Finance
- The same project is worth more with internal than external financing

Debt vs. Equity Financing
- The same project is worth more with debt than equity financing (unless already highly leveraged)

Implications:
- Some projects will be undertaken only if funded internally or with relatively safe debt but not if financed with risky debt or equity.
Take Away 2: Information Content of Financial Policy

- Stock issues convey negative information about the firm.
- This explains why the market reacts negatively to equity issues.
- More generally:
  - Firms’ financial policies convey information.
  - Stock prices will react to changes in financial policy (e.g., dividends, issues, etc.)

Empirical Evidence:

- When risky securities are offered, investors infer that managers’ believe that the equity is overvalued (or at least not undervalued).
- As a result the market value of the firm falls:
  -3.0% for equity (25% of proceeds)
  -2.0% for convertible debt (9% of proceeds)
  0.0% for debt
  +2.0% for bank loans (huh?)
- Stock repurchases: +4%
Take Away 3 - The Pecking Order Theory of Capital Structure:

- Financing choices are driven by the desire to minimize losses due to asymmetric information.

- When funding their investment projects, firms will:
  1) First use retained earnings;
  2) Then borrow from debt markets (unless already highly leveraged);
  3) As a last resort, issue equity.

- Firms with more information asymmetries are more reluctant to issue equity, and try to preserve borrowing capacity.

Implications:

- If Pecking Order holds, a company’s leverage ratio results:
  → not from an attempt to approach a target ratio;
  → but rather from series of incremental financing decisions.

- Contrary to the Target Capital Structure Approach, the Pecking Order implies that capital structure can move around a lot.

- The Pecking Order Theory also implies that profitable firms will lower their leverage ratios to build up “financial slack”. The idea is to avoid future equity issues in case unexpected funding needs arise.
Dividend and Payout Policy
(for you to read)

Dividend Policy (aka Payout Policy)

- Firms transfer funds to shareholders through:
  - cash dividends
  - share repurchases

- Payout Policy:
  - How is money being paid out?
  - How often is money being paid out?
  - How much money is being paid?

- Main question: What payout policy should a firm follow?

- We need to know:
  - Whether a firm’s value depends on its dividend policy?
  - If so, why and how?
Payout Method 1: Cash Dividends

- The level of dividends is not fixed (contrary to interest) and can be changed by the firm at any time.
- Usually, dividends are paid quarterly.
- Companies distinguish between
  - Regular dividends: expected to be maintained in the future
  - Special dividends: less likely to be repeated
- Dividends are reported in three equivalent ways:
  - Dividend per share (DPS): dollar amount per share
  - Dividend yield: DPS divided by share price
  - Payout ratio: DPS divided by EPS

Payout Method 2: Share Repurchases

- There are different forms of share repurchases:
  - Open market purchases
  - Fixed price tender offers
  - Dutch auctions
- Note that in a share repurchase:
  - Shares purchased belong to the firm’s remaining shareholders.
  - Usually, they are kept in the firm’s treasury.
  - They may be resold when the firm needs to issue new shares.
- In many countries, repurchases are not allowed.
M-M Dividend Irrelevance

- What does M&M say?

**In perfect capital markets the value of a firm is independent of its payout policy.**

**Proof:**
- Paying dividends is a Zero NPV transaction — so the value of the firm before paying dividends must equal the value of the firm after paying dividends plus the value of the dividends.
- In perfect capital markets, investors who want dividends can replicate dividends by selling part of their holdings in companies that don’t pay dividends.
- In perfect capital markets, investors who don’t want dividends can replicate a no-dividend stock by reinvesting their dividends.

Q.E.D.

Example of Dividend Irrelevance:

- XYZ generates a $1M annual perpetuity and the required return on its stock is 10%. It has 100,000 shares outstanding.

- The current dividend policy is given by:
  - Pay out all cash flows as annual cash dividends, i.e., DPS = $10
  - Then XYZ’s market value is: $1M / 10% = $10M, and the stock price is $100

- Now consider an alternative dividend policy:
  - Increase next year’s cash dividend (only) to $15
  - Raise the necessary $500,000 by issuing new equity

- M-M says: The stock price should be unchanged.
Example (cont.):

• Since operations are unchanged, XYZ continues to generates $1M per year.

• Because the new shares are subject to the same risk as the old ones, they require the same rate of return: 10%.

• To raise $500,000, XYZ needs to promise new shareholders a $50,000 perpetuity since $50,000 / 10% = $500,000.

• After next year, the annual dividends accruing to old shareholders will be $1M - $50,000 = $950,000, a DPS of $9.5.

• Hence, next year’s price of old (and new) shares will be $95.

• **QUESTION:** What is today’s stock price under the alternative policy?


Example (cont.):

• Calculate today’s stock price:

\[ P_0 = \frac{E_o[D_1]}{1 + r} = \frac{$95 + $15}{1.1} = $100 \]

where \( E_o \) stands for “expectations today”.

**Conclusion:**

• The value of the old shares is unaffected by the change in policy.

• Changing the dividend policy is a zero NPV transaction.

• This is **not** surprising to you: It is a purely financial transaction.
Using this Result Sensibly

- The MM insight about dividend irrelevance helps us to avoid fallacies and illusions about payout policy.

- It also gets us to ask the right question: How does a change in payout policy affect the size of the pie?
  - Different tax implications of different policies.
  - Different policies may send different signals about the firm to outside investors.
  - Some policies might constrain managers’ ability to waste funds on negative NPV projects.

Aside: The Bird-in-the-Hand Fallacy

This popular fallacy goes something like this:
- A dividend today is safer than the promise of future payments.
- Investors will pay a premium for dividend-paying firms.
- Hence, dividends increase firm value.

What is wrong with this argument?
- Everything! A change in dividend policy does not change the size of the pie and hence does not affect value.
- The popularity of this fallacy is based on the intuition that investors would rather receive the cash than have managers invest it into negative NPV projects.
- But note that any increase in value is really caused by a change in investment policy (foregone negative NPV projects) and not by a change of dividend policy.
- To see this, note that if managers paid the dividend but raised funds for the bad projects through new equity issues, no value would be created.
Dividends and Taxes

• In the US tax system, there is double taxation of cash dividends:
  → At the corporate level, dividends are paid out of after-tax net income.
  → At the personal level, dividends are again taxed, this time as ordinary income.
  → (Note: There is 70% tax exemption for companies receiving dividends.)

This raises the following puzzles:

• Why pay dividends when interest payments are tax exempt?
• Why dividends when capital gains are taxed at a lower rate?
• If a firm really wants to pay out cash to shareholders, why as a dividend and not a share repurchase?

Puzzle 1: Dividends vs. Debt Interest Payments:

• Cash dividends and interest payments are taxed at the same rate at the investor level.

• BUT: Dividends are taxed at the corporate level, while interest payments are not.

• Thus, as a means of paying out cash to investors, interest payments seem to clearly dominate dividends.
Puzzle 2: Dividends vs. Capital Gains

- Investors are taxed at a lower tax rate on capital gains compared to dividends.

- Moreover, because tax on capital gains is paid when the gain is realized, investors can delay the tax. Paying taxes later is "cheaper" because of the time value of money.

- Hence, cash dividends seem dominated by capital gains.

- Note: If a shareholder needs cash, she can sell a percentage of her shares equal to the dividend yield she desires.

Puzzle 3: Dividends vs. Stock Repurchase

- At the personal level, the payment received in a share repurchase is taxed as capital gain (just as if the shareholder was selling his shares on the market to another investor).

- Thus, if a firm really wants to pay out cash to investors, cash dividends seem dominated by a share repurchase.

- Aside: If the IRS sees that share repurchases are regular and proportional to value, they will declare that the firm is really issuing dividends and charge the income tax rate. Despite this, more and more companies are using repurchases instead of dividends.
Fewer Firms are paying Dividends

Percent of Public Firms Paying Dividends
(Source: Fama-French, 2000)

More Firms are using Repurchases

Repurchases/Earnings Ratio for Public Firms
(Source: Fama-French, 2000)
Bottom Line:

- Cash dividends are expensive in terms of taxes.

- Every manager should ask herself:
  - *Why am I paying this dividend?*
  - *Does this justify the tax burden?*
  - *Can I achieve the same with another method?*

- Frankly, we still do not have much clever to say about why and how companies pay dividends.

Some Explanations for Dividends beyond M-M:

The Signaling Hypothesis:

- Firms can signal positive information through dividends.
  - High quality firms can afford to pay dividends.
  - Low quality firms cannot afford to mimic high quality firms.
  - Therefore, by paying (or increasing) dividends, a firm can signal that it is a high quality firm.

- The logic is that “good” firms can undertake costly (=inefficient) actions to signal private information and separate from “bad” firms because “good” firms suffer less from the costs of these inefficient actions.
Some Explanations for Dividends beyond M-M:

**The Free Cash Flow Hypothesis:**

- Firms may be able to mitigate agency problems by paying dividends.
- Excess cash can lead to agency problems if managers are empire-builders:
  - Managers are reluctant to return excess cash to investors.
  - May instead increase their sphere of influence ("Empire Building") through negative NPV projects and takeovers.
  - May waste money on perks.
- Paying excess cash to investors makes managers run the firm more efficiently.
- Dividends are a way to get money back to investors, preventing managers from wasting the money on negative NPV projects.
- Caveat: Dividends are discretionary.
  - Using interest payments on debt to return excess cash is a much stronger commitment, since firms would go into default by missing interest payments.
  - Nevertheless investors expect dividends to be continued; hence they are a stronger commitment to continuous payouts than repurchasing shares.

Appendix
(for your information)
Chronology of Cash Dividends

- **Declaration date**: The firm announces its next dividend, as well as its record and payment dates.
- **Cum-Dividend Date**: Last day when shares are traded with the right to receive the dividend. (5 days before record date)
- **Ex-Dividend Date**: First day when shares are traded without the right to receive the dividend. (Day after the Cum-Dividend date)
- **Record Date**: Shareholders are recorded to receive dividends.
- **Payment Date**: Dividend checks mailed out.

◊ **Example**: On May 15, XYZ announces a 2nd quarter dividend of $0.20/share, with record date June 1, and payment date June 15. The cum dividend date is May 25, and ex-dividend date May 26.

Different Repurchase Methods 1

- **Open market purchase**: The firm buys its own shares on the market.
- **Fixed price tender offer**: The firm offers to buy up to a pre-specified number of shares at a pre-specified price during a pre-specified period of time.

◊ **Example**: XYZ announces that it is going to buy up to 200,000 of its 5M shares of common stock at $28 per share.

- **Note**: If more than the maximum number of shares are tendered, shares are acquired on a pro-rata basis.

◊ **Example**: If 100,000 shares are tendered to XYZ, it buys them all. If 400,000 shares are tendered, it buys half the shares tendered by each shareholder.
Different Repurchase Methods 2

- **Dutch Auction:** Each shareholder is invited to submit a bid price at which they are willing to tender (some of) their shares. The firm states the number of shares it buys during a pre-specified period of time, and sets a range of bids it accepts. The repurchase price is the lowest price necessary to acquire the number of shares sought.

  ◊ **Example:** XYZ announces it will buy up to 200,000 of its 5M shares in a Dutch auction and invites shareholders to bid prices below $28. Suppose that:
  
  → 50,000 shares were tendered at $25
  → 150,000 shares were tendered at $26
  → 80,000 shares were tendered at $27

  Then XYZ buys at $26 all the shares tendered at or below $26.

Aside: Stock Dividends and Stock Splits

- **Stock Dividend:** Additional shares are sent to all shareholders.

  ◊ **Example:** Every year, XYZ sends you 5 shares for every 100 shares you already hold. This is a 5% stock dividend.

- **Stock Split:** Each existing share is split into several shares.
  - A stock dividend is similar to a stock split, but usually involves less shares.

  ◊ **Example:** A two-for-one split is equivalent to a 100% stock dividend.

- **Stock dividends are different from cash dividends:** They do not result in cash exiting the firm. Hence they are not part of the payout policy. Do not be misled by the similarity of names.
Capital Structure

Katharina Lewellen
Finance Theory II
February 18 and 19, 2003
The Key Questions of Corporate Finance

- **Valuation:** How do we distinguish between good investment projects and bad ones?

- **Financing:** How should we finance the investment projects we choose to undertake?
(Real) Investment Policy

- "Which projects should the firm undertake?"
  - Open a new plant?
  - Increase R&D?
  - Scale operations up or down?
  - Acquire another company?

- We know that real investments can create value
  - Discounted Cash Flow (DCF) analysis
  - Positive NPV projects add value
  - We revisit this in the course’s "Valuation" module (Part II)
Financing Policy

- Real investment policies imply funding needs
  - We have tools to forecast the funding needs to follow a given real investment policy (from Wilson Lumber)

- But what is the best source of funds?
  - Internal funds (i.e., Cash)?
  - Debt (i.e., borrowing)?
  - Equity (i.e., issuing stock)?

- Moreover, different kinds of ...
  - Internal funds (e.g., cash reserves vs. cutting dividends)
  - Debt (e.g., Banks vs. Bonds)
  - Equity (e.g., VC vs. IPO)
Choosing an Optimal Capital Structure

- Is there an “optimal” capital structure, i.e., an optimal mix between debt and equity?

- More generally, can you add value on the RHS of the balance sheet, i.e., by following a good financial policy?

- If yes, does the optimal financial policy depend on the firm’s operations (Real Investment policy), and how?

- We study this in the course’s “Financing” module (Part I).

Capital structure, International 1991

<table>
<thead>
<tr>
<th>Country</th>
<th>Book leverage</th>
<th>Market leverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>45</td>
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<td>30</td>
</tr>
<tr>
<td>France</td>
<td>50</td>
<td>45</td>
</tr>
<tr>
<td>Germany</td>
<td>10</td>
<td>15</td>
</tr>
</tbody>
</table>
Sources of Funds: US Corporations 1980-2000

The diagram shows the sources of funds for US corporations from 1980 to 2000. It includes data on interest (int), debt, and equity. The x-axis represents the years 1980 to 2000, while the y-axis indicates the percentage of total financing.
Sources of Funds: International 1990-94
Examples: Capital structure, 1997

<table>
<thead>
<tr>
<th>Industry</th>
<th>Debt / (Debt + Equity) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High leverage</strong></td>
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<tr>
<td>Building construction</td>
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<tr>
<td>Hotels and lodging</td>
<td>55.4</td>
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<tr>
<td>Air transport</td>
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</tr>
<tr>
<td>Primary metals</td>
<td>29.1</td>
</tr>
<tr>
<td>Paper</td>
<td>28.2</td>
</tr>
<tr>
<td><strong>Low leverage</strong></td>
<td></td>
</tr>
<tr>
<td>Drugs and chemicals</td>
<td>4.8</td>
</tr>
<tr>
<td>Electronics</td>
<td>9.1</td>
</tr>
<tr>
<td>Management services</td>
<td>12.3</td>
</tr>
<tr>
<td>Computers</td>
<td>9.6</td>
</tr>
<tr>
<td>Health services</td>
<td>15.2</td>
</tr>
</tbody>
</table>
Plan of Attack

1. Modigliani-Miller Theorem:
   → Capital Structure is irrelevant

2. What’s missing from the M-M view?
   → Taxes
   → Costs of financial distress

3. “Textbook” view of optimal capital structure:
   → The choice between debt and equity

4. Apply/confront this framework to several business cases
   → Evaluate when its usefulness and its limitations
M-M’s “Irrelevance” Theorem

Assume

- Market efficiency and no asymmetric information
- No taxes
- No transaction or bankruptcy costs
- Hold constant the firm’s investment policies

Then

- The value of the firm is independent of its capital structure
  - Financing decisions do not matter!
MM Theorem: Proof 1 (pie theory)*

* Credit to Yogi Berra
MM Theorem: Proof 2 (market efficiency)

Your firm decides to raise $100 million.

- **Debt financing**
  - You sell bonds worth $100 million and receive $100 million in cash.

- **Equity financing**
  - You sell stock worth $100 million and receive $100 million in cash.
MM Theorem: Proof 2 (market efficiency)

- All purely financial transactions are zero NPV investments, i.e., no arbitrage opportunity.
- Thus, they neither increase nor decrease firm value.
MM Theorem: Example

Current

Assets $1 billion
Equity $800M
Debt $200M

Issue new debt

Assets $1.1 billion
Equity $800M
Old Debt $200M
New Debt $100M

Issue new equity

Assets $1.1 billion
Old Eq $800M
New Eq $100M
Debt $200M
MM Theorem: Proof 3

Consider two firms with identical assets (in $M):

- Firm A is all equity financed:
  - Firm A’s value is $V(A) = E(A)$

- Firm B is financed with a mix of debt and equity:
  - Debt with one year maturity and face value $60M
  - Market values of debt $D(B)$ and equity $E(B)$
  - Firm B’s value is (by definition) $V(B) = D(B) + E(B)$

MM says: $V(A) = V(B)$
MM Theorem: Proof 3

- Firm A’s equity gets all cash flows
- Firm B’s cash flows are split between its debt and equity with debt being senior to equity.

<table>
<thead>
<tr>
<th>Claim’s value next year</th>
<th>Firm A (Equity)</th>
<th>Firm B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Debt</td>
<td>Equity</td>
</tr>
<tr>
<td>In state 1: 160</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>In state 2: 40</td>
<td>40</td>
<td>0</td>
</tr>
</tbody>
</table>

- In all (i.e., both) states of the world, the following are equal:
  - The payoff to Firm A’s equity
  - The sum of payoffs to Firm B’s debt and equity

- By value additivity, \( E(A) = D(B) + E(B) \)
M-M Intuition 1

- If Firm A were to adopt Firm B’s capital structure, its total value would not be affected (and vice versa).

- This is because ultimately, its value is that of the cash flows generated by its operating assets (e.g., plant and inventories).

- The firm’s financial policy divides up this cashflow “pie” among different claimants (e.g., debtholders and equityholders).

- But the size (i.e., value) of the pie is independent of how the pie is divided up.
Example, cont.

- In case you forgot where value additivity comes from…

- Assume for instance that market values are:
  - \( D(B) = \$50M \)
  - \( E(B) = \$50M \)

- MM says: \( V(A) = D(B) + E(B) = \$100M \)

- Suppose instead that \( E(A) = \$105M \).
- Can you spot an arbitrage opportunity?
Example, cont.

- Arbitrage strategy:
  - Buy 1/1M of Firm B’s equity for $50
  - Buy 1/1M of Firm B’s debt for $50
  - Sell 1/1M of Firm A’s equity for $105

<table>
<thead>
<tr>
<th></th>
<th>Today</th>
<th>Next year State 1</th>
<th>Next year State 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm B’s equity</td>
<td>-$50</td>
<td>+$100</td>
<td>$0</td>
</tr>
<tr>
<td>Firm B’s debt</td>
<td>-$50</td>
<td>+$60</td>
<td>+$40</td>
</tr>
<tr>
<td>Subtotal</td>
<td>-$100</td>
<td>+$160</td>
<td>+$40</td>
</tr>
<tr>
<td>Firm A’s equity</td>
<td>+$105</td>
<td>-$160</td>
<td>-$40</td>
</tr>
<tr>
<td>Total</td>
<td>+$5</td>
<td>$0</td>
<td>$0</td>
</tr>
</tbody>
</table>

- Note: Combining Firm B’s debt and equity amounts to “undoing Firm B’s leverage” (see shaded cells).
M-M: Intuition 2

- Investors will not pay a premium for firms that undertake financial transactions that they can undertake themselves (at the same cost).

- For instance, they will not pay a premium for Firm A over Firm B for having less debt.

- Indeed, by combining Firm B’s debt and equity in appropriate proportions, any investor can in effect “unlever” Firm B and reproduce the cashflow of Firm A.
The Curse of M-M

- M-M Theorem was initially meant for capital structure.

- But it applies to all aspects of financial policy:
  - capital structure is irrelevant.
  - long-term vs. short-term debt is irrelevant.
  - dividend policy is irrelevant.
  - risk management is irrelevant.
  - etc.

- Indeed, the proof applies to all financial transactions because they are all zero NPV transactions.
Using M-M Sensibly

- M-M is not a literal statement about the real world. It obviously leaves important things out.

- But it gets you to ask the right question: How is this financing move going to change the size of the pie?

- M-M exposes some fallacies such as:
  - WACC fallacy
  - Win-Win fallacy
  - EPS fallacy
WACC Fallacy: “Debt is Better Because Debt Is Cheaper Than Equity.”

- Because (for essentially all firms) debt is safer than equity, investors demand a lower return for holding debt than for holding equity. (True)

- The difference is significant: 4% vs. 13% expected return!

- So, companies should always finance themselves with debt because they have to give away less returns to investors, i.e., debt is cheaper. (False)

- What is wrong with this argument?
WACC Fallacy (cont.)

- This reasoning ignores the “hidden” cost of debt:
  - Raising more debt makes existing equity more risky
  - Is it still true when default probability is zero?

- Milk analogy: Whole milk = Cream + Skimmed milk

- People often confuse the two meanings of “cheap”:
  - Low cost
  - Good deal

- More on this in the “Valuation” module (Part II).
EPS Fallacy: “Debt is Better When It Makes EPS Go Up.”

- EPS can go up (or down) when a company increases its leverage. (True)

- Companies should choose their financial policy to maximize their EPS. (False)

- What is wrong with this argument?
EPS Fallacy (cont.)

- EBI(T) is unaffected by a change in capital structure (Recall that we assumed no taxes for now).
- Creditors receive the safe (or the safest) part of EBIT.
- Expected EPS might increase but EPS has become riskier!

Remarks:
- Also tells us to be careful when using P/E ratios, e.g. comparing P/E ratios of companies with different capital structures.
- Further confusing effect in share-repurchases: The number of shares changes as well as expected earnings.
Leverage, returns, and risk

Firm is a portfolio of debt and equity

Therefore …

\[ r_A = \frac{D}{A} r_D + \frac{E}{A} r_E \]

and

\[ \beta_A = \frac{D}{A} \beta_D + \frac{E}{A} \beta_E \]
Leverage, returns, and risk

Asset risk is determined by the type of projects, not how the projects are financed

- Changes in leverage do not affect \( r_A \) or \( \beta_A \)
- Leverage affects \( r_E \) and \( \beta_E \)

\[
\beta_A = \frac{D}{V} \beta_D + \frac{E}{V} \beta_E \\
\beta_E = \beta_A + \frac{D}{E} (\beta_A - \beta_D) \\
\]

\[
r_A = \frac{D}{V} r_D + \frac{E}{V} r_E \\
r_E = r_A + \frac{D}{E} (r_A - r_D) \
\]
Leverage and beta

Beta vs. Debt to equity ratio

- \( \beta_D \)
- \( \beta_A \)
- \( \beta_E \)
Leverage and required returns

![Graph showing the relationship between debt to equity ratio and required returns.](image)

- \( r_E \) (required return for equity)
- \( r_A \) (required return for common stock)
- \( r_D \) (required return for debt)
Example

Your firm is all equity financed and has $1 million of assets and 10,000 shares of stock (stock price = $100). Earnings before interest and taxes next year will be either $50,000, $125,000, or $200,000 depending on economic conditions. These earnings are expected to continue indefinitely. The payout ratio is 100%.

The firm is thinking about a leverage recapitalization, selling $300,000 of debt and using the proceeds to repurchase stock. The interest rate is 10%.

How would this transaction affect the firm’s EPS and stock price? Ignore taxes.
## Current: all equity

<table>
<thead>
<tr>
<th></th>
<th>Bad</th>
<th>Expected</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td># of shares</td>
<td>10,000</td>
<td>10,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Debt</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>EBIT</td>
<td>$50,000</td>
<td>$125,000</td>
<td>$200,000</td>
</tr>
<tr>
<td>Interest</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Net income</td>
<td>$50,000</td>
<td>$125,000</td>
<td>$200,000</td>
</tr>
<tr>
<td>EPS</td>
<td>$5</td>
<td>$12.50</td>
<td>$20</td>
</tr>
</tbody>
</table>

Expected EPS = $12.5

Stock price = $100

\[ r_E = \frac{\text{DPS}}{\text{price}} = \frac{\text{EPS}}{\text{price}} = 12.5\% \]
Recap: 30% debt

<table>
<thead>
<tr>
<th></th>
<th>Bad</th>
<th>Expected</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td># of shares</td>
<td>7,000</td>
<td>7,000</td>
<td>7,000</td>
</tr>
<tr>
<td>Debt (r=10%)</td>
<td>$300,000</td>
<td>$300,000</td>
<td>$300,000</td>
</tr>
<tr>
<td>EBIT</td>
<td>$50,000</td>
<td>$125,000</td>
<td>$200,000</td>
</tr>
<tr>
<td>Interest</td>
<td>30,000</td>
<td>30,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Net income</td>
<td>$20,000</td>
<td>$95,000</td>
<td>$170,000</td>
</tr>
<tr>
<td>EPS</td>
<td>$2.86</td>
<td>$13.57</td>
<td>$24.29</td>
</tr>
</tbody>
</table>

Expected EPS = $13.57

\[
r_E = r_A + D/E (r_A - r_D) = 0.125 + (0.30/0.70) (0.125 - 0.10) = 13.57%\]

Stock price = DPS / \(r_E = EPS / r_E = $100\)
Win-Win Fallacy: “Debt Is Better Because Some Investors Prefer Debt to Equity.”

- Investors differ in their preferences and needs, and thus want different cash flow streams. (True)

- Example: Young professionals vs. Retirees

- The sum of what all investors will pay is greater if the firm issues different securities (e.g., debt and equity) tailored for different clienteles of investors (Financial Marketing). (False)

- What is wrong with this argument?
Win-Win Fallacy (cont.)

- This reasoning assumes incomplete markets, i.e., that:
  - There are indeed clienteles for different securities
  - These clienteles are “unsatisfied”, i.e., that investors cannot replicate the security at the same or even lower cost.

- A large unsatisfied clientele for corporate debt is unlikely, as there exist close substitutes to any particular firm’s debt.

- Also, financial intermediaries are in the business of identifying unsatisfied clientele.

- Win-Win situation is more likely for more exotic securities or sophisticated financial arrangement.
Practical Implications

- When evaluating a decision (e.g., the effect of a merger):
  - Separate financial (RHS) and real (LHS) parts of the move
  - MM tells that most value is created on LHS

- When evaluating an argument in favor of a financial decision:
  - Understand that it is wrong under MM assumptions
  - What departures from MM assumptions does it rely upon?
  - If none, then this is very dubious argument.
  - If some, try to assess their magnitude.
What’s Missing from the Simple M-M Story?

- Taxes:
  - Corporate taxes
  - Personal taxes

- Costs of Financial Distress
Capital Structure and Corporate Taxes

- Different financial transactions are taxed differently:
  - Interest payments are tax exempt for the firm.
  - Dividends and retained earnings are not.
  - Etc.

- Financial policy matters because it affects a firm’s tax bill.
Debt Tax Shield

**Claim:** Debt increases firm value by reducing the tax burden.

- **Example:** XYZ Inc. generates a safe $100M annual perpetuity. Assume risk-free rate of 10%. Compare:
  - 100% debt: perpetual $100M interest
  - 100% equity: perpetual $100M dividend or capital gains

<table>
<thead>
<tr>
<th></th>
<th>100% Debt</th>
<th>100% Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income before tax</td>
<td>Interest Income $100M</td>
<td>Equity income $100M</td>
</tr>
<tr>
<td>Corporate tax rate 35%</td>
<td>0</td>
<td>-$35M</td>
</tr>
<tr>
<td>Income after tax</td>
<td>$100M</td>
<td>$65M</td>
</tr>
<tr>
<td>Firm value</td>
<td>$1,000M</td>
<td>$650M</td>
</tr>
</tbody>
</table>
Intuition

- MM still holds: The pie is unaffected by capital structure.

  \[ \text{Size of the pie} = \text{Value of before-tax cashflows} \]

- But the IRS gets a slice too

- Financial policy affects the size of that slice.

- Interest payments being tax deductible, the PV of the IRS’ slice can be reduced by using debt rather than equity.
“Pie” Theory

Equity

Debt

Taxes
Example

In 2000, Microsoft had sales of $23 billion, earnings before taxes of $14.3 billion, and net income of $9.4 billion. Microsoft paid $4.9 billion in taxes, had a market value of $423 billion, and had no long-term debt outstanding.

Bill Gates is thinking about a recapitalization, issuing $50 billion in long-term debt (rd = 7%) and repurchasing $50 billion in stock. How would this transaction affect Microsoft’s after-tax cashflows and shareholder wealth?
Microsoft: Balance sheet in $ millions

<table>
<thead>
<tr>
<th>Item</th>
<th>1997</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td>8,966</td>
<td>13,927</td>
<td>17,236</td>
<td>23,798</td>
</tr>
<tr>
<td>Current assets</td>
<td>10,373</td>
<td>15,889</td>
<td>20,233</td>
<td>30,308</td>
</tr>
<tr>
<td>Current liabs</td>
<td>3,610</td>
<td>5,730</td>
<td>8,718</td>
<td>9,755</td>
</tr>
<tr>
<td>LT debt</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bk equity</td>
<td>9,797</td>
<td>15,647</td>
<td>27,485</td>
<td>41,368</td>
</tr>
<tr>
<td>Mkt equity</td>
<td>155,617</td>
<td>267,700</td>
<td>460,770</td>
<td>422,640</td>
</tr>
<tr>
<td>Sales</td>
<td>11,358</td>
<td>14,484</td>
<td>19,747</td>
<td>22,956</td>
</tr>
<tr>
<td>EBIT</td>
<td>5,314</td>
<td>7,117</td>
<td>11,891</td>
<td>14,275</td>
</tr>
<tr>
<td>Taxes</td>
<td>1,860</td>
<td>2,627</td>
<td>4,106</td>
<td>4,854</td>
</tr>
<tr>
<td>Net income</td>
<td>3,454</td>
<td>4,490</td>
<td>7,785</td>
<td>9,421</td>
</tr>
<tr>
<td>Oper CF</td>
<td>4,689</td>
<td>6,880</td>
<td>10,003</td>
<td>13,961</td>
</tr>
</tbody>
</table>
## Microsoft, 2000 ($ millions)

<table>
<thead>
<tr>
<th></th>
<th>No Debt</th>
<th>Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBIT</td>
<td>$14,275</td>
<td>$14,275</td>
</tr>
<tr>
<td>Interest (r \times 50,000)</td>
<td>0</td>
<td>3,500</td>
</tr>
<tr>
<td>Earnings before taxes</td>
<td>$14,275</td>
<td>$10,775</td>
</tr>
<tr>
<td>Taxes (34%)</td>
<td>4,854</td>
<td>3,664</td>
</tr>
<tr>
<td>After-tax earnings</td>
<td>$9,421</td>
<td>$7,111</td>
</tr>
<tr>
<td>Cashflow to debtholders</td>
<td>$0</td>
<td>$3,500</td>
</tr>
<tr>
<td>Cashflow to equityholders</td>
<td>$9,421</td>
<td>$7,111</td>
</tr>
<tr>
<td>Total cashflows to D &amp; E</td>
<td>$9,421</td>
<td>$10,611</td>
</tr>
</tbody>
</table>
Tax savings of debt

Marginal tax rate = $\tau$

Taxes for unlevered firm………………..$\tau$ EBIT
Taxes for levered firm………………….$\tau$ (EBIT – interest)

Interest tax shield  …………………….$\tau$ interest

Interest = $r_d D$

Interest tax shield (each year) = $\tau r_d D$

Note: only interest, not principal, payments reduce taxes
Capital Structure, cont.

Katharina Lewellen
Finance Theory II
March 5, 2003
Target Capital Structure Approach

1. Start with M-M Irrelevance

2. Add two ingredients that change the size of the pie.
   - Taxes
   - Expected Distress Costs

3. Trading off the two gives you the “static optimum” capital structure. (“Static” because this view suggests that a company should keep its debt relatively stable over time.)
Target Capital Structure Approach, cont.
Implications of the “target leverage” approach

- **Firms should:**
  - Issue equity when leverage rises above the target level
  - Buy back stock (or pay dividends) when leverage falls below the target capital structure

- **Stock market should:**
  - React positively (or neutrally) to announcements of securities issues
What really happens?

- Stock prices drop (on average) at the announcements of equity issues
- Companies are reluctant to issue equity
- They follow a “pecking order” in which they finance investment:
  - first with internally generated funds
  - then with debt
  - and finally with equity
- Willingness to issue equity fluctuates over time

⇒ Something is missing from the “target-leverage” view
Stock price reaction to equity issue announcements

Average cumulative excess returns from 10 days before to 10 days after announcement for 531 common stock offerings (Asquith and Mullins (1986))
Sources of Funds: US Corporations 1979-97
Sources of Funds: International 1990-94

- Internal
- Debt
- Equity

US
Japan
UK
Canada
France
Seasoned Equity Offerings (SEOs) 1970-96

The graph shows the number of SEOs over the years from 1970 to 1996. The x-axis represents the date in the format of YearMonth (e.g., 7001 for 1970), and the y-axis represents the number of SEOs. The data indicates fluctuations in the number of SEOs over the years.
Initial Public Offerings (IPOs) 1960-99
Incorporating These Concerns

- The irrelevance of financing comes from the fact that existing shareholders (represented by managers) and new shareholders agree on the value of financial claims.
  - Everybody agrees on the size of the “pie”

- This ensures that financial transactions have NPV = 0.

- Departing from this framework:
  - Inefficient markets
  - Irrational managers
  - Managers with more information than investors
Managers with more information than investors - The Lemons Problem

Suppose that managers have more information about the firm than outside investors.

-Managers prefer to issue equity when equity is overvalued
-Thus, equity issues signal to investors that equity is overvalued
-Thus, stock price declines at equity issues announcements
-Consequently, managers avoid issuing equity
-In some cases, they may even forgo positive NPV projects rather than issue equity
Equity financing: Example
Let’s set aside taxes and financial distress

- XYZ’s assets in place are subject to idiosyncratic risk:

<table>
<thead>
<tr>
<th>Assets value</th>
<th>p=0.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

- New investment project:
  - Discount rate: 10%
  - Investment outlay: $12M
  - Safe return next year: $22M ==> PV = 22/1.1 = $20M

  \[
  NPV = -12 + 20 = $8M
  \]

- Should XYZ undertake the project?
Case 1: Managers know as much as outside investors

- Suppose that XYZ has $12M in cash for investment
  - If internally financed with cash, existing shareholders realize the full $8M NPV of the investment.

- Suppose that XYZ does not have the cash but can issue $12M in equity
  - Once the project funded, the firm is worth 100 + 20 = $120M
  - Raise $12M by selling 10% of shares (after issue)
  - Existing shareholders get 90% * 120 = $108M
  - To be compared with $100M if did not invest
  - Existing shareholders gain $8M

⇒ With no information asymmetries, managers are indifferent between internal and external financing
Case 2: Managers know more than outside investors

<table>
<thead>
<tr>
<th>Assets value from the perspective of</th>
<th>Shareholders</th>
<th>Managers</th>
</tr>
</thead>
<tbody>
<tr>
<td>p=0.5</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>p=0.5</td>
<td>50</td>
<td>150</td>
</tr>
</tbody>
</table>

- **Internal financing**
  - As before, existing shareholders gain $8M

- **Equity financing**
  - Raise $12M by selling 10% of shares (after issue), valued by the market at 120 (i.e., 100 + 20).
  - Existing shareholders get 90% * (150 + 20) = $153M.
  - Existing shareholders gain only $3M

⇒ When equity is undervalued, managers prefer to finance internally than to issue equity
Case 2 (cont.): How about debt financing?

- With debt financing:
  - Raise $12M and repay $(1.1) \times 12 = $13.2M$ next year
  - Existing shareholders get the full $8M because:

\[
150 + \frac{(22 - 13.2)}{1.1} = $158M
\]

⇒ When equity is undervalued, managers prefer to finance with debt than equity
Why Is Safe Debt Better Than Equity?

- Its value is independent of the information
- Managers and the market give it the same value
- Safe debt is fairly priced ⇒ no lemon’s problem
- Risky debt is somewhere “between” safe debt and equity
  - There is some lemon’s problem associated with risky debt but it is less severe than with equity
Lemon’s problem: Implications

- If your assets are worth $150M, you will not want to issue equity, but will finance internally or with debt.

- If you choose to issue equity, investors will know that your assets must be worth only $50M.

- Consequently, stock price will fall when you announce an equity issue.
  - By how much?
Example (cont.): Market Reaction

- Recall market’s expectations
  - Assets are $150 (prob. = ½) or $50 (prob. = ½)
  - So currently, assets are valued at $100

- Upon seeing an equity issue, the market infers that the firm is sitting on negative info:
  - assets are worth only $50M

- The firm’s market value drops to $50 + 20 = $70 when equity issue is announced and new equity is issued
Evidence on equity issue announcements

Average cumulative excess returns from 10 days before to 10 days after announcement for 531 common stock offerings (Asquith and Mullins (1986))
Evidence on announcement effects

- Stock price reaction to issues:
  - Straight Debt: Little or no effect
  - Convertible Debt: - 2% (9% of proceeds)
  - Equity: - 3% (25% of proceeds)

- Stock repurchases: +13%
Example (cont.): Underinvestment

- Suppose investment outlay is $18M not $12M.
  \[ \text{NPV} = -18 + \frac{22}{1.1} = $2M \]

- Raising $18M requires selling 15% of shares
  - Existing shareholders get \(85\% \times (150 + 20) = $144.5M\)
  - They lose $5.5M relative to $150M if did not invest.

\( \Rightarrow \text{XYZ will not issue equity to fund project.} \)
Key Point: Investment Depends on Financing

- Some projects will be undertaken only if funded internally or with relatively safe debt.
- Information asymmetries can lead companies to forgo good project.
- Companies with less cash and more leverage will be more prone to this underinvestment problem.
  - Issuing safe debt is more difficult at high leverage.
  - Also, issuing too much debt may lead to financial distress.
Pecking Order and Capital Structure

- Basic Pecking Order:
  - Firms will use cash when available
  - Otherwise use debt

- High cash-flow
  - No need to raise debt
  - In fact, can repay some debt
  - Leverage ratio decreases

- Low cash-flow
  - Need to raise debt
  - Reluctance to raise equity
  - Leverage ratio increases
Key Point

- If Pecking Order holds, a company’s leverage ratio results:
  - not from an attempt to approach a target ratio;
  - but rather from series of incremental financing decisions.

- Contrary to the Target Capital Structure Approach, the Pecking Order implies that capital structure can move around a lot.
Target Capital Structure Approach, cont.

Leverage

Firm value

$V_U$

$L$ with tax shields, but no distress

$L$ with tax shields and distress

$L$ according to MM

Optimal capital structure

Leverage
Key Point: Timing of Equity Issues

- There may be "good" and "bad" times to issue stock.
- Best not to issue when lots of information asymmetry -- i.e., should issue when price impact of issue is lowest.
Initial Public Offerings (IPOs) 1960-99
Evidence on timing of equity issues

- Firms tend to issue more equity in booms and less in busts
  - NPV of investment opportunities are higher, so firms are willing to incur the costs of issuing equity

- In fact, when lots of firms are issuing, the stock price impact of an equity issue is low

- Caveat: Is this because information problems are lower or because stock markets are inefficient -- i.e., systematically misprice equity?
Managerial Behavior and Capital Structure

- So far, we assumed that managers act in the interest of shareholders.
- But is it always true?
- Conflicts of interests between managers and shareholders are called *agency problems*
Agency Problems

- Agents do not always do their job => costs to principals
  - These costs are called “Agency Costs”
  - They are reflected in a lower share price

- Potential problems:
  - Shirking
  - Empire Building
  - Perks (private jets)
  - Risk avoidance
Avoiding Agency Costs

- Compensation policy

- Monitoring managers’ actions
  - Independent directors on the Board
  - Banks as lenders
  - Large block holders

- Market for Corporate Control (i.e. takeovers)

- Can leverage help to avoid agency costs?
A Classic Agency Problem: The Free Cash Flow Problem

- Free Cash Flow (FCF)
  - Cash flow in excess of that needed to fund all positive NPV projects

- Managers may be reluctant to pay out FCF to shareholders
  - Empire building through unprofitable acquisitions
  - Pet projects, prestige investments, perks

- This problem is more severe for “cash cows”
  - Firms with lots of cash (i.e., profitable firms)
  - And few good investment opportunities
Example of FCF Problems
Evidence from the Oil Industry (Jensen, 1986)

- From 1973 to 1979: tenfold increase in crude oil prices
  - Oil industry expanded
  - Oil consumption fell

- The oil industry at the end of 1970s
  - Lots of excess capacity
  - Lots of cash (because of high prices)

- What did managers do?
Example of FCF Problems (cont.)
What did managers do?

- They did not pay out cash to shareholders

- Continued spending on exploration and development (E&D)
  - Stock prices reacted negatively to the announcements of increases in E&D by oil companies during 1975 – 81

- Invested outside of industry
  - Mobile purchased Marcor (retail)
  - Exxon purchased Reliance Electric (manufacturing) and Vydec (office equipment)
  - These acquisitions turned out to be least successful of the decade
Can leverage reduce FCF problem?

- Debt = commitment to distribute cash flows in the future
  - If managers cannot keep the promise to pay interest (principal), bondholders can shut down the firm

- Thus, debt reduces FCF available to managers
  - Less opportunities for managers to waist cash

- How about commitment to pay dividends?
  - Dividends also reduce FCF
  - But a commitment to pay dividends cannot be enforced
Leveraged Buyouts (LBOs)

- **LBO is a going-private transaction**
  - Typically, incumbent management acquires all publicly-traded shares
  - LBOs are often financed with debt (D/E ratios of 10 are not uncommon)

- **Kaplan (1989 JFE) finds in a sample of 76 LBOs:**
  - Debt / Value went from 18.8% to 87.8%
  - 42% premium paid to shareholders to go private
  - In three years after the buyout
    - Operating Income / TA increased by 15%
    - Operating Income / Sales increased by 19%
    - Net cash flow increased and capital expenditures decreased

- **Do LBOs improve efficiency through the control function of debt?**
Capital Structure: An Extended Checklist

■ Taxes
  ➢ Does the company benefit from debt tax shield?

■ Information Problems
  ➢ Do outside investors understand the funding needs of the firm?
  ➢ Would an equity issue be perceived as bad news by the market?

■ Agency Problems
  ➢ Does the firm have a free cash flow problem?

■ Expected Distress Costs
  ➢ What is the probability of distress? (Cash flow volatility)
  ➢ What are the costs of distress?
    • Need funds for investment, competitive threat if pinched for cash, customers care about distress, assets difficult to redeploy?
Corporate Finance: Assets and Liabilities

Balance Sheet of P&G, as of 6/30/1999, in $Millions

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current assets</td>
<td>11,358 35% Current</td>
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<tr>
<td>Fixed assets</td>
<td>12,626 39% Long-term</td>
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<tr>
<td>Other long-term assets</td>
<td>8,129 25% Equity</td>
</tr>
<tr>
<td>Total assets</td>
<td>32,113 Total liabilities 32,113</td>
</tr>
</tbody>
</table>

Balance Sheet of Manufacturing Sector as of 1998Q4, in $Billions

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current assets</td>
<td>1,700 39% Current</td>
</tr>
<tr>
<td>Fixed assets</td>
<td>1,572 36% Long-term</td>
</tr>
<tr>
<td>Other long-term assets</td>
<td>1,132 26% Equity</td>
</tr>
<tr>
<td>Total assets</td>
<td>4,404 Total liabilities 4,404</td>
</tr>
</tbody>
</table>
The Liability Side (RHS): Financing

- "Financing": First, focus on liability side of Balance Sheet taking the firm’s assets as a given: How to finance the firm’s assets? Can we create value on the RHS?

- How can we forecast how much funding we need?

- Should we finance those funding needs with:
  → Debt?
  → Equity?
  → Other sources?

- If we have enough internally generated funds, what do we do with the excess?

- When should we raise funds from the capital markets?

The Asset Side (LHS): Valuation

- "Valuation": Then focus on how to maximize the value of the assets, taking into account their financing. How to create value on the LHS.

- How do we evaluate a corporate investment project, e.g.,
  → new plant and equipment
  → market entry

- How should we compare:
  → payoffs today vs. down the road?
  → projects with different risks?

- How do we value
  → an established company? a start-up?
  → a merger?
Our Approach

What we will do

- Acquire a set of general tools that are crucial to sound business decisions by:
  - Financial managers
  - General managers
- Apply and confront them to a number of real business cases.
  - Usefulness
  - Limitations

What we won’t do

- Pretend to be experts in any industry, financial or other.
- Discuss many institutional aspects in detail.
- Discuss in detail stuff you could learn just as well reading a book or an article (see “readings”).

Corporate Finance – Section A

- Lectures twice per week
- Texts:
  - Brealey & Myers, Principles of Corporate Finance, 7th edition,
  - Higgins, Analysis for Financial Management, 7th edition,
  - Case and Readings Packet
- Professor: Dirk Jenter
Corporate Finance – Section B

- Lectures twice per week
- Texts:
  - Brealey & Myers, *Principles of Corporate Finance, 7th edition*,
  - Case and Readings Packet
- Professor: Katharina Lewellen

Course Requirements

- Class Participation (10%)
  - Come prepared to discuss cases
  - Quality more important than quantity (!)
  - Willingness to participate as important as participation
  - Introduce background readings into the discussion
- Case Memoranda (30%)
  - A professional memo to the decision maker
  - Teams of three or four people
  - Hand in all write-ups, except two of your choice
  - Careful: Some cases are required!
  - Two pages (plus exhibits)
- Midterm (30%)
- Final (30%)
Case Memoranda

- Memoranda should be
  - Clearly written and professional
  - Handed in for all of the cases except two of your choice
  - Two pages (not counting charts and tables), Double spaced
    - Font of 11 or 12
  - Teams of three or four students
    - Hand in one copy per team
  - You may not work with students not on your team
  - One & two person teams are discouraged
  - Wilson (I & II) count as one case
  - Wilson, MCI, Dixon, and Ameritrade are required
  - Make sure you turn in 10 memoranda!

The Big Picture:

Lectures (12)
- Text: Brealey and Myers + Higgins
- Notes on the web before class (+ in class)

Cases (12)
- 10 Case write ups: 1-2 page write-ups
- Notes on the web after class (+ in class)
- Class participation is critical

Grades, etc.
- Case write-ups 30%
- Midterm (in class) 30%
- Final (TBA) 30%
- Class participation 10%

Part I: FINANCING
- Feb 6/11 Case: Wilson Lumber
- Feb 13 Lecture: Capital Structure 1
- Feb 20 Lecture: Capital Structure 2
- Feb 25 Case: UST Inc.
- Feb 27 Case: Massey Ferguson
- Mar 4 Lecture: Capital Structure 3
- Mar 6 Case: MCI Communications
- Mar 11 Financing Review
- Mar 13 Case: Intel Corp., 1992

Part II: VALUATION
- Apr 1 Lecture: Free Cash Flows
- Apr 3 Case: Ameritrade
- Apr 8 Lecture: WACC and APV
- Apr 10 Case: Dixon
- Apr 15 Case: Diamond Chemicals
- Apr 17 Lecture: Real Options
- Apr 24 Case: MW Petroleum
- Apr 29 Lecture: Valuing a Company
- May 1 Case: Cooper Industries
- May 6 Case: Southland

Topics
- May 8 Hedging & Risk Management
- May 13 Corporate Governance
- May 15 Course Wrap-up
The Big Picture: Part I Financing

A. Identifying Funding Needs
- Feb 6  Case: Wilson Lumber 1
- Feb 11 Case: Wilson Lumber 2

B. Optimal Capital Structure: The Basics
- Feb 13 Lecture: Capital Structure 1
- Feb 20 Lecture: Capital Structure 2
- Feb 25 Case: UST Inc.
- Feb 27 Case: Massey Ferguson

C. Optimal Capital Structure: Information and Agency
- Mar 4 Lecture: Capital Structure 3
- Mar 6 Case: MCI Communications
- Mar 11 Financing Review
- Mar 13 Case: Intel Corporation

The Case of the Unidentified Industries
### Industry Groups

- **Group 1:**
  - Advertising agency
  - Airline
  - Commercial bank
  - HMO
  - Electric and Gas Utility

- **Group 2:**
  - Department Store Chain
  - Retail Drug Chain
  - Retail Grocery Chain
  - Airline
  - Meat Packer

- **Group 3:**
  - Pharmaceutical Manufacturer
  - Software Developer
Group 1

- Advertising Agency
- Airline
- Commercial Bank
- HMO
- Utility

### Selected Financial Data

<table>
<thead>
<tr>
<th>Line</th>
<th>Type of Ratio</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>F</th>
<th>H</th>
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<tr>
<td>18</td>
<td>Current assets/current liabilities</td>
<td>1.11</td>
<td>1.03</td>
<td>1.13</td>
<td>0.63</td>
<td>2.35</td>
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<td>19</td>
<td>Inventory turnover</td>
<td>3,278</td>
<td>381</td>
<td>30</td>
<td>27</td>
<td>5</td>
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<td>20</td>
<td>Net sales</td>
<td>0.095</td>
<td>0.023</td>
<td>0.046</td>
<td>0.028</td>
<td>0.032</td>
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<tr>
<td>21</td>
<td>Net profit/total assets</td>
<td>0.013</td>
<td>0.000</td>
<td>0.017</td>
<td>0.014</td>
<td>0.013</td>
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<tr>
<td>22</td>
<td>Total assets/net worth</td>
<td>14.5</td>
<td>2.3</td>
<td>2.1</td>
<td>0.77</td>
<td>0.57</td>
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</table>

### Identified Industries in Group 1

- A Commercial Bank
- B Advertising Agency
- C Electric & Gas Utility
- F Airline
- H Health Maintenance Organization (H.M.O.)
### Identified Industries in Group 2

- **D** Department Store
- **E** Retail Drug Chain
- **F** Airline
- **G** Retail Grocery Chain
- **I** Meat Packer
Group 3

- Pharmaceutical Manufacturer
- Software Developer

<table>
<thead>
<tr>
<th>Line</th>
<th>Balance Sheet Percentages</th>
<th>J</th>
<th>K</th>
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<tbody>
<tr>
<td>#1</td>
<td>Cash and marketable securities</td>
<td>67</td>
<td>19</td>
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<tr>
<td>#2</td>
<td>Account receivables</td>
<td>9</td>
<td>13</td>
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<tr>
<td>#3</td>
<td>Inventories</td>
<td>2</td>
<td>12</td>
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<tr>
<td>#4</td>
<td>Other current assets</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>#5</td>
<td>Plant and equipment (net)</td>
<td>17</td>
<td>48</td>
</tr>
<tr>
<td>#6</td>
<td>Other assets</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>#7</td>
<td>Total assets</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>#8</td>
<td>Notes payable</td>
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<td>7</td>
</tr>
<tr>
<td>#9</td>
<td>Accounts payable</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>#10</td>
<td>Accrued taxes</td>
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<td>5</td>
</tr>
<tr>
<td>#11</td>
<td>Other current liabilities</td>
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<td>8</td>
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<tr>
<td>#12</td>
<td>Long-term debt</td>
<td>0</td>
<td>15</td>
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<tr>
<td>#13</td>
<td>Preferred stock</td>
<td>0</td>
<td>1</td>
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<tr>
<td>#14</td>
<td>Other liabilities</td>
<td>0</td>
<td>0</td>
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<tr>
<td>#15</td>
<td>Capital stock and capital surplus</td>
<td>28</td>
<td>16</td>
</tr>
<tr>
<td>#16</td>
<td>Retained earnings</td>
<td>55</td>
<td>46</td>
</tr>
<tr>
<td>#17</td>
<td>Total liabilities and stockholder equity</td>
<td>100</td>
<td>100</td>
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</table>

Selected Financial Data

<table>
<thead>
<tr>
<th>Line</th>
<th>Description</th>
<th>J</th>
<th>K</th>
</tr>
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<tbody>
<tr>
<td>#18</td>
<td>Current assets/current liabilities</td>
<td>4.72</td>
<td>2.31</td>
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<tr>
<td>#19</td>
<td>Cash, marketable securities and accounts receivables/current liabilities</td>
<td>4.59</td>
<td>2.03</td>
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<tr>
<td>#20</td>
<td>Inventory turnover (X)</td>
<td>7.5</td>
<td>7</td>
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<tr>
<td>#21</td>
<td>Receivables collection period</td>
<td>37</td>
<td>42</td>
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<tr>
<td>#22</td>
<td>Total debt/total assets</td>
<td>1</td>
<td>0.24</td>
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<tr>
<td>#23</td>
<td>Long-term debt/capitalization</td>
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<td>0.18</td>
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<tr>
<td>#24</td>
<td>Net sales/net assets</td>
<td>0.87</td>
<td>0.93</td>
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<tr>
<td>#25</td>
<td>Net profit/net sales</td>
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<td>#26</td>
<td>Net profit/total assets</td>
<td>0.214</td>
<td>0.28</td>
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<tr>
<td>#27</td>
<td>Total assets/net worth</td>
<td>1.28</td>
<td>1.56</td>
</tr>
<tr>
<td>#28</td>
<td>Net profit/net worth</td>
<td>0.25</td>
<td>0.11</td>
</tr>
</tbody>
</table>

The Identified Industries

- A Commercial Bank
- B Advertising Agency
- C Electric & Gas Utility
- D Department Store Chain
- E Retail Drug Chain
- F Airline
- G Retail Grocery Chain
- H H.M.O.
- I Meat Packers
- J Software Developer
- K Pharmaceutical Manufacturer

Citicorp
Interpublic
Consolidated Edison
Dayton-Hudson
Walgreen
AMR Corp.
American Stores
U.S. Healthcare
IBP, Inc.
Microsoft
Novo Nordisk
## Leverage

<table>
<thead>
<tr>
<th>Industry</th>
<th>Firm</th>
<th>Industry Mean</th>
<th>Industry Std Dev</th>
<th>Industry Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Airlines</td>
<td>0.44</td>
<td>0.32</td>
<td>0.20</td>
<td>0.31</td>
</tr>
<tr>
<td>Dayton Hudson</td>
<td>0.40</td>
<td>0.29</td>
<td>0.17</td>
<td>0.30</td>
</tr>
<tr>
<td>American Stores</td>
<td>0.31</td>
<td>0.35</td>
<td>0.20</td>
<td>0.32</td>
</tr>
<tr>
<td>Consolidated Edison</td>
<td>0.29</td>
<td>0.35</td>
<td>0.06</td>
<td>0.35</td>
</tr>
<tr>
<td>Novo Nordisk</td>
<td>0.08</td>
<td>0.22</td>
<td>0.02</td>
<td>0.08</td>
</tr>
<tr>
<td>IBP</td>
<td>0.19</td>
<td>0.31</td>
<td>0.24</td>
<td>0.30</td>
</tr>
<tr>
<td>Intersub</td>
<td>0.10</td>
<td>0.08</td>
<td>0.06</td>
<td>0.09</td>
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<td>Walgreens</td>
<td>0.00</td>
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<td>0.00</td>
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<tr>
<td>Microsoft</td>
<td>0.07</td>
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<td>US Healthcare</td>
<td>0.00</td>
<td>0.09</td>
<td>0.11</td>
<td>0.04</td>
</tr>
</tbody>
</table>
Wilson Lumber - Preliminaries

- Pro Forma statements are projections of the income statement and balance sheet.
- To project values, assumptions must be made. For example:
  - For Wilson, we make assumptions about Sales Growth and A/P
  - Often assume a historical average percent of sales (e.g., COGS are a fixed percent of sales)
  - Debt levels are sometimes assumed
    (e.g., debt ratio stays constant or new money raised is from debt)
  - Assumptions are made about dividends and repurchases
  - Balance sheet must balance!
    - If there is extra money, it can go to cash, dividends or repurchases
    - If money is needed, assume the firm raises cash through debt or equity offerings (In Wilson, assume it is from the Bank)

Pro Forma Statements

- Use financial ratios to help inform projections
  - Look at trends through time to see if you should use an historical average or not
  - If something changes dramatically, look for cause.
- The next classes include material on using financial ratios. But the information on the next overhead should help you with Wilson.
Ratio Analysis

- Types of ratios (Look at the definition not the name)
  - Operational Ratios
    - Days of Inventory = 365 (Inv / COGS)
    - Collection Period = 365 (AR / Sales)
    - Payables Period = 365 ((AP + Trade Credit) / Purchases)
  - Leverage Ratios
    - Liabilities / (Net Worth), Interest Coverage = EBIT / Interest
  - Profitability
    - Sales Growth = ∆Sales / Sales (Last Period)
    - Gross Profit Margin = (Sales - COGS) / Sales
    - Net Profit Margin = (EBIT - Tax) / Sales
    - ROA, ROE, COGS / Sales

Next Time

- Wilson Case is due at the beginning of class
- We will discuss Wilson in the next two classes
- Read
  - BM Chapter 29
  - Optional resource: Chapters 2-3 of Higgins
Finance Theory II
(Corporate Finance)

Katharina Lewellen
February 5, 2003
Today

- Preliminaries
- Introduction to the course
  - Corporate finance
  - Types of questions
  - Course outline
  - Course requirements
- Case of Unidentified Industries
Preliminaries

- Texts
  - Case and Readings Packet

- Professor
  - Katharina Lewellen
Introduction

Corporate finance

- **Investment policy**
  How the firm spends its money (real and financial assets)

- **Financing and payout policy**
  How the firm obtains funds (debt, equity) and disposes of excess cash
Balance sheet view of the firm

Assets

- Current Assets
- Fixed Assets
  1. Tangible
  2. Intangible

Liabilities

- Current Liabilities
- Long-term debt
- Shareholders’ Equity
Introduction, cont.

But we also need to understand…

- **Capital markets**
  - Types of securities (stocks, bonds, options…)
  - Trade-off between risk and return
  - Pricing

- **Taxes and government regulation**
Financial markets

Firms
- Curr assets
- Fixed assets

Financial Markets
- Debt
- Equity

Financial Intermediaries

Individuals

Government
Introduction, cont.

Finance is really about value
- Firms
- Projects and real investments
- Securities

Common characteristic
- Invest cash today in exchange for cash (hopefully) in the future

Central question
- How do we create value through investment and financing decisions?
Types of questions

Investment and financing decisions

- At the end of 1999, GM had $11.4 billion in cash.
  - Should it invest in new projects or return the cash to shareholders?
  - If it decides to return the cash, should it declare a dividend or repurchase stock?
  - If it decides to invest, what is the most valuable investment? What are the risks?
General Dynamic

- Major contractor in the defense industry
- Doing well during 1980s (cold war)
  - Growth in sales
  - Reasonable profitability
  - R&D and capital investment
- Beginning of 1990s
  - The end of cold war
  - Likely decline in defense spending
  - Strategy???
General Dynamics

[Chart showing General Dynamics' financial data from 1980 to 1990 for R&D + Cap Exp and Net Inc.]
Value of $100 invested in Jan. ‘80
General Dynamics

**Investment, 1980 – 1990**

- R&D + Capital expenditures: $3.7 billion
- If invested at 10%: $5.5 billion
- Ending market value: $1.0 billion

---

Value destroyed: $4.5 billion

Sales grew from $4.7 billion to $10.2 billion
Earnings in 1990 = -578 million
New strategy in 1991

William A. Anders (new CEO):

- Cuts capital expenditure and R&D
  - Cap. Exp. drops from $321 million in 1990 to $81 million in 1991

- Sells off divisions and subsidiaries

- Cuts workforce

- Distributes cash to shareholders
  - From 1991 through 1993, GD returns $3.4 billion to shareholders and debtholders

Net Inc

CapEx + R&D
Value of $100 invested Jan. ‘91
Types of questions

Investment and financing decisions

- Your firm needs to raise capital to finance growth.
  - Should you issue debt or equity or obtain a bank loan?
  - How will the stock market react to your decision?
  - If you choose debt, should the bonds be convertible? callable? Long or short maturity?
  - If you choose equity, what are the trade-offs between common and preferred stock?
Investment and financing decisions

- IBM recently announced that it would repurchase $2.5 billion in stock. Its price jumped 7% after the announcement. Why? How would the market have reacted if IBM increased dividends instead? Suppose Intel made the same announcement. Would we expect the same price response?

- Motorola wants to build a new chip factory in Ireland. How will fluctuations in the foreign exchange rate affect the value of the project? What are the risks? What actions can Motorola take to hedge the risks? More importantly, should it hedge the risks? What are the costs and benefits?
Our Approach

What we will do

- Acquire a set of general tools that are crucial to sound business decision
  - Financial managers
  - General managers
- Apply and confront them to a number of real business cases
  - Usefulness
  - Limitations

What we won’t do

- Pretend to be experts in any industry, financial or other
- Discuss many institutional aspects in detail
- Discuss in detail stuff you could learn just as well reading a book or an article (see “readings”)
Outline: Theory + Applications

- **Part I: Financing**
  - Capital structure
  - Payout policy

- **Part II: Valuation**
  - Project valuation (FCF, PV, Real Options)
  - Company valuation (M&A, Start-ups)

- **Part III: Selected topics in corporate finance**
  - Corporate governance
  - Hedging/Risk management
The tools of finance (15.401)

- Time Value of Money
- Portfolio Theory
- Asset Pricing Theory
- Efficient Markets Hypothesis
- Option Pricing Theory
- The Concept of No-Arbitrage
- Agency Theory (Micro-economics, Incentives and Contracts)
Course Requirements

- Class Participation (10%)
- Case Memoranda (30%)
  - Teams up to four people
  - Hand in all write-ups except two write-ups of your choice
  - A professional memo to the decision maker
- Midterm (30%)
- Final (30%)
The Case of the Unidentified Industries
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Industry Groups

Service providers
- Advertising agency
- Airline
- Commercial bank
- HMO

Zero inventories
- A, B, F, H
### Group 1:

- **Advertising Agency**
- **Airline**
- **Commercial Bank**
- **HMO**

### Balance Sheet Percentages

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Identified Industries in Group 1

A  Commercial Bank
B  Advertising Agency
F  Airline
H  Health Maintenance Organization (H.M.O.)
### Group 2

- **Computer software dev.**
- **Dept. store**
- **Electric & gas utility**
- **Meat packer**
- **Pharmaceutical manufacturer**
- **Retail drug**
- **Retail grocery**

#### Balance Sheet Percentages

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<td>6.47</td>
<td>0.87</td>
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<tr>
<td>25</td>
<td>Net profit/net sales</td>
<td>0.12</td>
<td>0.02</td>
<td>0.03</td>
<td>0.02</td>
<td>0.02</td>
<td>0.25</td>
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<tr>
<td>26</td>
<td>Net profit/total assets</td>
<td>0.05</td>
<td>0.04</td>
<td>0.10</td>
<td>0.05</td>
<td>0.10</td>
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<tr>
<td>27</td>
<td>Total assets/naworth</td>
<td>2.31</td>
<td>3.61</td>
<td>1.85</td>
<td>3.43</td>
<td>2.39</td>
<td>1.21</td>
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<tr>
<td>28</td>
<td>Net profit/net worth</td>
<td>0.12</td>
<td>0.13</td>
<td>0.18</td>
<td>0.17</td>
<td>0.23</td>
<td>0.26</td>
</tr>
</tbody>
</table>
Group 2: Inventory turnover

- Computer software dev.
- Dept. store
- Electric & gas utility
- Meat packer
- Pharmaceutical manufacturer
- Retail drug
- Retail grocery

<table>
<thead>
<tr>
<th>Industry</th>
<th>Inventory turnover</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>47.6</td>
</tr>
<tr>
<td>C</td>
<td>16.7</td>
</tr>
<tr>
<td>G</td>
<td>8.6</td>
</tr>
<tr>
<td>J</td>
<td>7.5</td>
</tr>
<tr>
<td>D</td>
<td>5.6</td>
</tr>
<tr>
<td>E</td>
<td>5.2</td>
</tr>
<tr>
<td>K</td>
<td>2.0</td>
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</table>
Group 2: Receivables collection period

- Computer software dev.
- Dept. store
- Pharmaceutical manufacturer
- Retail drug
- Retail grocery

<table>
<thead>
<tr>
<th>Industry</th>
<th>Collection period</th>
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<tbody>
<tr>
<td>K</td>
<td>74</td>
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<tr>
<td>J</td>
<td>37</td>
</tr>
<tr>
<td>D</td>
<td>31</td>
</tr>
<tr>
<td>E</td>
<td>8</td>
</tr>
<tr>
<td>G</td>
<td>6</td>
</tr>
</tbody>
</table>
Group 2: Inventory & PPE

- Computer software dev.
- Dept. store
- Pharmaceutical manufacturer

<table>
<thead>
<tr>
<th>Industry</th>
<th>INV (%)</th>
<th>PPE (%)</th>
</tr>
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<tbody>
<tr>
<td>D</td>
<td>24</td>
<td>55</td>
</tr>
<tr>
<td>K</td>
<td>12</td>
<td>48</td>
</tr>
<tr>
<td>J</td>
<td>2</td>
<td>17</td>
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## The Identified Industries

<table>
<thead>
<tr>
<th></th>
<th>Industries</th>
<th>Companies</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>Commercial Bank</td>
<td>Citicorp</td>
</tr>
<tr>
<td>B</td>
<td>Advertising Agency</td>
<td>Interpublic</td>
</tr>
<tr>
<td>C</td>
<td>Electric &amp; Gas Utility</td>
<td>Consolidated Edison</td>
</tr>
<tr>
<td>D</td>
<td>Department Store Chain</td>
<td>Dayton-Hudson</td>
</tr>
<tr>
<td>E</td>
<td>Retail Drug Chain</td>
<td>Walgreen</td>
</tr>
<tr>
<td>F</td>
<td>Airline</td>
<td>AMR Corp.</td>
</tr>
<tr>
<td>G</td>
<td>Retail Grocery Chain</td>
<td>American Stores</td>
</tr>
<tr>
<td>H</td>
<td>H.M.O.</td>
<td>U.S. Healthcare</td>
</tr>
<tr>
<td>I</td>
<td>Meat Packers</td>
<td>IBP, Inc.</td>
</tr>
<tr>
<td>J</td>
<td>Software Developer</td>
<td>Microsoft</td>
</tr>
<tr>
<td>K</td>
<td>Pharmaceutical Manuf.</td>
<td>Novo Nordisk</td>
</tr>
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### Line Balance Sheet Percentages

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<tbody>
<tr>
<td>#1</td>
<td>Cash and marketable securities</td>
</tr>
<tr>
<td>2</td>
<td>Account receivables</td>
</tr>
<tr>
<td>3</td>
<td>Inventories</td>
</tr>
<tr>
<td>4</td>
<td>Other current assets</td>
</tr>
<tr>
<td>5</td>
<td>Plant and equipment (net)</td>
</tr>
<tr>
<td>6</td>
<td>Other assets</td>
</tr>
<tr>
<td>7</td>
<td>Total assets</td>
</tr>
<tr>
<td>8</td>
<td>Notes payable</td>
</tr>
<tr>
<td>9</td>
<td>Accounts payable</td>
</tr>
<tr>
<td>10</td>
<td>Accrued taxes</td>
</tr>
<tr>
<td>11</td>
<td>Other current liabilities</td>
</tr>
<tr>
<td>12</td>
<td>Long-term debt</td>
</tr>
<tr>
<td>13</td>
<td>Preferred stock</td>
</tr>
<tr>
<td>14</td>
<td>Other liabilities</td>
</tr>
<tr>
<td>15</td>
<td>Capital stock and capital surplus</td>
</tr>
<tr>
<td>16</td>
<td>Retained earnings</td>
</tr>
<tr>
<td>17</td>
<td>Total liabilities and stockholder</td>
</tr>
</tbody>
</table>

### Selected Financial Data

<table>
<thead>
<tr>
<th>Line</th>
<th>Selected Financial Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>Current assets/current liabilities</td>
</tr>
<tr>
<td>19</td>
<td>Cash, marketable securities and accounts receivable/current liabilities</td>
</tr>
<tr>
<td>20</td>
<td>Inventory turnover (X)</td>
</tr>
<tr>
<td>21</td>
<td>Receivables collection period</td>
</tr>
<tr>
<td>22</td>
<td>Total debt/total assets</td>
</tr>
<tr>
<td>23</td>
<td>Long-term debt/capitalization</td>
</tr>
<tr>
<td>24</td>
<td>Net sales/total assets</td>
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</table>
## Leverage

<table>
<thead>
<tr>
<th>Industry Firm</th>
<th>Industry</th>
<th>Firm</th>
<th>Industry Mean</th>
<th>Industry Std Dev</th>
<th>Industry Median</th>
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<tbody>
<tr>
<td>American Airlines Airlines</td>
<td>0.44</td>
<td>0.32</td>
<td>0.20</td>
<td>0.31</td>
<td></td>
</tr>
<tr>
<td>Dayton Hudson Department Stores</td>
<td>0.40</td>
<td>0.29</td>
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<td></td>
</tr>
<tr>
<td>American Stores Grocery Stores</td>
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<td>0.35</td>
<td>0.20</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>Consolidated Edison Combination Utility Services</td>
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<td>0.35</td>
<td>0.05</td>
<td>0.35</td>
<td></td>
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<tr>
<td>Novo Nordisk Pharmaceuticals</td>
<td>0.22</td>
<td>0.24</td>
<td>0.92</td>
<td>0.08</td>
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<tr>
<td>IBP Meat Products</td>
<td>0.19</td>
<td>0.31</td>
<td>0.24</td>
<td>0.30</td>
<td></td>
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<tr>
<td>Interpublic Advertising Agencies</td>
<td>0.10</td>
<td>0.08</td>
<td>0.06</td>
<td>0.09</td>
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<tr>
<td>Walgreens Drug Stores</td>
<td>0.00</td>
<td>0.24</td>
<td>0.18</td>
<td>0.27</td>
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<tr>
<td>Microsoft Prepackaged Software</td>
<td>0.00</td>
<td>0.07</td>
<td>0.19</td>
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<tr>
<td>US Healthcare HMOs</td>
<td>0.00</td>
<td>0.09</td>
<td>0.11</td>
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<tr>
<td>Balance Sheet</td>
<td>Firm A</td>
<td>Firm B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------</td>
<td>--------</td>
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<tr>
<td>Accounts receivable</td>
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<td>3</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Inventories</td>
<td>5</td>
<td>52</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Other current assets</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant and equipment (net)</td>
<td>5</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Other assets</td>
<td>30</td>
<td>12</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Total assets</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notes payable</td>
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<td>Accounts payable</td>
<td>17</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Accrued taxes</td>
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<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other current liabilities</td>
<td>7</td>
<td>15</td>
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<tr>
<td>Long-term debt</td>
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<td>Other liabilities</td>
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</tr>
<tr>
<td>Preferred stock</td>
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<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital stock and capital surplus</td>
<td>47</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Retained earnings</td>
<td>(25)</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total liabilities and stockholder equity</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Capital Structure II

The Big Picture: Part I - Financing

A. Identifying Funding Needs
- Feb 6  Case: Wilson Lumber 1
- Feb 11 Case: Wilson Lumber 2

B. Optimal Capital Structure: The Basics
- Feb 13  Lecture: Capital Structure 1
- Feb 20  Lecture: Capital Structure 2
- Feb 25  Case: UST Inc.
- Feb 27  Case: Massey Ferguson

C. Optimal Capital Structure: Information and Agency
- Mar 4  Lecture: Capital Structure 3
- Mar 6  Case: MCI Communications
- Mar 11 Financing Review
- Mar 13 Case: Intel Corporation
Using M-M Sensibly

- M-M is not a literal statement about the real world. It obviously leaves important things out.

- But it gets you to ask the right question: How is this financing move going to change the size of the pie?

- M-M exposes some popular fallacies such as the “WACC fallacy”.

WACC Fallacy: “Debt is Better Because Debt Is Cheaper Than Equity.”

- Because (for essentially all firms) debt is safer than equity, investors demand a lower return for holding debt than for holding equity. (True)

- The difference is significant: 6% vs. 13% expected return!

- So, companies should always finance themselves with debt because they have to give away less returns to investors, i.e., debt is cheaper. (False)

- What is wrong with this argument?
WACC Fallacy (cont.)

- This reasoning ignores the “hidden” cost of debt: **Raising more debt makes existing equity more risky!**

**Note:** Unrelated to default risk, i.e., true even if debt is risk-free.

- Milk analogy: Whole milk = Cream + Skimmed milk

- People often confuse the two meanings of “cheap”:
  - → Low cost
  - → Good deal

---

Practical Implications of MM

When evaluating a decision (e.g., the effect of a merger):
- → Separate financial (RHS) and real (LHS) parts of the move
- → MM tells that most value is created on LHS

- When evaluating an argument in favor of a financial decision:
  - → Understand that it is wrong under MM assumptions
  - → What departures from MM assumptions does it rely upon?
  - → If none, then this is very dubious argument.
  - → If some, try to assess their magnitude.
What's Missing from the Simple M-M Story?

- **Taxes:**
  - Corporate taxes
  - Personal taxes

- **Costs of Financial Distress**

- No transaction costs for issuing debt or equity

- No asymmetric information about the firm's investments

- Capital structure does not influence managers' investment decisions

Capital Structure and Corporate Taxes

- Financial policy matters because it affects a firm’s tax bill.

- Different financial transactions are taxed differently.

- For a corporation:
  - Interest payments are considered a business expense, and are *tax exempt* for the firm.
  - Dividends and retained earnings are *taxed*.
Debt Tax Shield

Claim: Debt increases firm value by reducing the tax burden.

Example: XYZ Inc. generates a safe $100M annual perpetuity. Assume risk-free rate of 10%. Compare:

- 100% debt: perpetual $100M interest
- 100% equity: perpetual $100M dividend or capital gains

<table>
<thead>
<tr>
<th></th>
<th>100% Debt</th>
<th>100% Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income before tax</td>
<td>Interest Income $100M</td>
<td>Equity income $100M</td>
</tr>
<tr>
<td>Corporate tax rate 35%</td>
<td>0</td>
<td>-$35M</td>
</tr>
<tr>
<td>Income after tax</td>
<td>$100M</td>
<td>$65M</td>
</tr>
<tr>
<td>Firm value</td>
<td>$1,000M</td>
<td>$650M</td>
</tr>
</tbody>
</table>

Intuition

- MM still holds: The pie is unaffected by capital structure.
  
  Size of the pie = Value of before-tax cashflows

- But the IRS gets a slice too

- Financial policy affects the size of that slice.

- Interest payments being tax deductible, the PV of the IRS’ slice can be reduced by using debt rather than equity.
"Pie" Theory II

Tax savings of debt

Marginal tax rate = t

Taxes for unlevered firm: \[ t \times \text{EBIT} \]
Taxes for levered firm: \[ t \times (\text{EBIT} - \text{interest}) \]
Interest tax shield: \[ t \times \text{interest} \]

Interest = \( r_d \times D \)
Interest tax shield (each year) = \( t \times r_d \times D \)

If debt is a perpetuity:
(Discount rate for tax shields = \( r_d \))

\[
PV(\text{interest tax shields}) = \frac{\text{tax shields per year}}{\text{interest rate}} = \frac{t \times r_d \times D}{r_d} = t \times D
\]
MM with Corporate Taxes

- The contribution of debt to firm value is the tax shield’s PV:

\[ V_{\text{with debt}} = V_{\text{all equity}} + PV[\text{tax shield}] \]

- Often, we will use:

\[ PV[\text{tax shield}] = t \cdot D \]

where:
- \( t \) = corporate tax rate
- \( D \) = (an estimate of) the market value of the firm’s debt

Is This Important or Negligible?

- Firm A has no debt and is worth \( V_{\text{all equity}} \).
- Suppose Firm A undertakes a leveraged recapitalization:
  - issues debt worth \( D \),
  - and buys back equity with the proceeds.
- Its new value is:

\[ \frac{V_{\text{with debt}}}{V_{\text{all equity}}} = 1 + t \cdot \frac{D}{V_{\text{all equity}}} \]

- Thus, with corporate tax rate \( t = 35\% \):
  - for \( D = 20\% \), firm value increases by about 7%.
  - for \( D = 50\% \), it increases by about 17.5%.
**Bottom Line**

- Tax shield of debt matters, potentially quite a bit.

- Pie theory gets you to ask the right question: *How does a financing choice affect the IRS’ bite of the corporate pie?*

- It is standard to use $t^*D$ for the capitalization of debt’s tax break.

- **Caveats:**
  - Not all firms face full marginal tax rate. Definitely not OK for non-taxpaying companies.
  - Personal taxes

---

**Tax-Loss Carry Forwards (TLCF)**

- Many firms with TLCF continue to make losses and fail to take advantage of the debt tax shield.

- TLCF can be carried backward/forward for 3/5 years.
  - If paid taxes in the last three years, TLCF can be used to get a refund.
  - If cannot return to profitability in five years, TLCF expire unutilized.
  - Even if eventually utilized, need to incorporate time value of money.

- Bottom line: More TLCF → Less Debt
Personal Taxes

- Investors’ return from debt and equity are taxed differently

- Classical Tax Systems (e.g., US):
  - Interest and dividends are taxed as ordinary income.
  - Capital gains are taxed at a lower rate.
  - Capital gains can be deferred (contrary to dividends and interest)
  - Corporations have a 70% dividend exclusion

- Imputation Systems (e.g., most of Europe)
  - Tax credit for recipients of dividends (= fraction of corporate tax on profits) reduces the double taxation of dividends

- So: For personal taxes, equity dominates debt.

Maximize After-Tax Income:

<table>
<thead>
<tr>
<th></th>
<th>Debt</th>
<th>Equity with (Deferred) Capital Gains</th>
<th>Equity with All Dividends</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Corporate Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start with $1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Tax: $T_C$</td>
<td>0</td>
<td>$T_C$</td>
<td>$T_C$</td>
</tr>
<tr>
<td>Net</td>
<td>1</td>
<td>(1-$T_C$)</td>
<td>(1-$T_C$)</td>
</tr>
<tr>
<td><strong>Personal Level</strong></td>
<td>$T_P$</td>
<td>$T_{PE}$</td>
<td>$T_P$</td>
</tr>
<tr>
<td>Tax: $T_P$ and $T_{PE}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bottom Line</strong></td>
<td>(1-$T_P$)</td>
<td>(1-$T_C$)* (1-$T_{PE}$)</td>
<td>(1-$T_C$)* (1-$T_{PE}$)</td>
</tr>
</tbody>
</table>

Relative Tax Advantage of Debt: \((1-T_P) / (1-T_C)* (1-T_{PE})\)
### Post-Clinton I:

<table>
<thead>
<tr>
<th></th>
<th>Debt</th>
<th>Equity with Capital Gains*</th>
<th>Equity with All Dividends</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Corporate Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start with $100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Tax: 35%</td>
<td>0</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Net</td>
<td>100</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td><strong>Personal Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax: 39% (20%)</td>
<td>39%</td>
<td>20% * 65</td>
<td>39% * 65</td>
</tr>
<tr>
<td></td>
<td>39%</td>
<td>13</td>
<td>25.35</td>
</tr>
<tr>
<td><strong>Bottom Line</strong></td>
<td>61</td>
<td>52</td>
<td>39.65</td>
</tr>
</tbody>
</table>

*Extreme assumption: No deferral, 20% capital gains tax*

---

### Post-Clinton II: Some deferred capital gains

<table>
<thead>
<tr>
<th></th>
<th>Debt</th>
<th>Equity with Deferred Capital Gains*</th>
<th>Equity with All Dividends</th>
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<tbody>
<tr>
<td><strong>Corporate Level</strong></td>
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</tr>
<tr>
<td>Start with $100</td>
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<tr>
<td>Tax: 35%</td>
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<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Net</td>
<td>100</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td><strong>Personal Level</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Tax: 39% (10%)</td>
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<td>10% * 65</td>
<td>39% * 65</td>
</tr>
<tr>
<td></td>
<td>39%</td>
<td>6.50</td>
<td>25.35</td>
</tr>
<tr>
<td><strong>Bottom Line</strong></td>
<td>61</td>
<td>58.5</td>
<td>39.65</td>
</tr>
</tbody>
</table>

*Assumption: Effective capital gains tax rate of 10%*
Bottom Line

• Taxes favor debt for most firms.
• We will lazily ignore personal taxation in the rest of the course.
• ((most of the time)).
• But: beware of particular cases.

Implications. Leverage is good?

• Since taxes favor debt for most firms, should all firms be 100% debt financed?
• Why don’t all firms lever up and save on corporate taxes?
The Dark Side of Debt: Cost of Financial Distress

• If taxes were the only issue, (most) companies would be 100% debt financed.

• Common sense suggests otherwise: If the debt burden is too high, the company will have trouble paying.

• The result: financial distress.

Financial Distress: Causes and Effects

• Financial distress – Cash flow is not sufficient to cover current obligations, which starts a process of resolving the broken contract with creditors.
  → Private renegotiation or workout.
  → Bankruptcy, supervised by court.
    → Chapter 7 or Chapter 11.
    → See BM, Appendix to Chapter 25.

• It is important not to confuse the causes and effects of financial distress when identifying the potential "costs of financial distress"!

• Only those costs that would not arise outside financial distress should be counted:
  → Firms in financial distress perform poorly: Cause or effect?
  → Financial distress sometimes results in partial or complete liquidation of the firm’s assets: Would these not occur otherwise?
Another Irrelevance Result

- Assume:
  - No administrative costs of financial distress
  - Frictionless bargaining between the different claimholders

Financial distress has no effect on operating decisions, thus no effect on firm value.

Proof:
- “Financial Distress” simply states that current cash flows are insufficient to service the debt.
- Cash flows themselves do not change because of financial distress.
- Since value is determined by cash flows, financial distress per se does not affect value.

Q.E.D.
Using This Sensibly

- Like M-M, this is not a literal statement about the real world.
- But it provides a useful benchmark:
  - What are the transaction costs in financial restructuring?
  - What is preventing claimholders from reaching a mutually beneficial agreement?
- It also warns against hasty conclusions. Only those costs that would not arise outside financial distress should be counted:
  - The fact that firms in financial distress often have falling sales, bad operating and poor financial performance is usually the cause, not an effect of financial distress.

With This in Mind:
Costs of Financial Distress

Direct Bankruptcy Costs:
- Legal costs, etc...

Indirect Costs of Financial Distress:
- Debt overhang: Inability to raise funds to undertake good investments.
  - Pass up valuable investment projects
  - Competitors may take this opportunity to be aggressive
- Scare off customers and suppliers.
- Agency costs of financial distress.
Direct Bankruptcy Costs

- What are direct bankruptcy costs?
  - Legal expenses, court costs, advisory fees…
  - Also opportunity costs, e.g., time spent by dealing with creditors

- How important are direct bankruptcy costs?
  - Direct costs represent (on average) some 2-5% of total firm value for large companies and up to 20-25% for small ones.
  - But this needs to be weighted by the bankruptcy probability!
  - Overall, expected direct costs tend to be small

Indirect Costs: Debt Overhang

- XYZ’s assets in place (with idiosyncratic risk) worth:

<table>
<thead>
<tr>
<th>State</th>
<th>Probability</th>
<th>Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>1/2</td>
<td>100</td>
</tr>
<tr>
<td>Bad</td>
<td>1/2</td>
<td>10</td>
</tr>
</tbody>
</table>

- XYZ has a new investment project:
  - Today: Investment outlay $15M
  - Next year: Safe return $22M

- With 10% risk-free rate, XYZ should undertake the project:
  \[ \text{NPV} = -15 + 22/1.1 = 5M \]
Debt Overhang (cont.)

- XYZ has debt with face value $35M due next year.

<table>
<thead>
<tr>
<th>Without the Project</th>
<th>With the Project</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>State</strong></td>
<td><strong>Proba.</strong></td>
</tr>
<tr>
<td>Good</td>
<td>1/2</td>
</tr>
<tr>
<td>Bad</td>
<td>1/2</td>
</tr>
</tbody>
</table>

- XYZ’s shareholders will not fund the project because:
  \[-15 + [(1/2)*22 + (1/2)*0]/1.1 = -$5M\]

- What's happening?

Debt Overhang (cont.)

- Shareholders would:
  - Incur the full investment cost: - $15M
  - Receive only part of the return (22 only in the good state)

- Existing creditors would:
  - Incur none of the investment cost
  - Still receive part of the return (22 in the bad state)

- So, existing risky debt acts as a “tax on investment”

- Shareholders of firms in financial distress are reluctant to fund valuable projects because most of the benefits go to the firm’s existing creditors.

- This effect becomes stronger as the debt becomes more risky and financial distress more likely.
What Can Be Done About It?

- Issue new debt?
  → Senior or junior to the outstanding debt?

- Financial restructuring?
  → Outside bankruptcy
  → Under a formal bankruptcy procedure

Issuing New Debt

- Issuing new debt with lower seniority as the existing debt
  ➢ Will not improve things: the “tax” is unchanged

- Issuing debt with same seniority
  ➢ Will mitigate but not solve the problem: a (smaller) tax remains

- Issuing debt with higher seniority
  ➢ Avoids the tax on investment because gets a larger part of payoff
  ➢ Similar: debt with shorter maturity (de facto senior)

  ✤ However, this is often prohibited by covenants
Financial Restructuring?

• In principle, restructuring could avoid the inefficiency:
  → debt for equity exchange
  → debt forgiveness or rescheduling

• Say creditors reduce the face value to $24M (conditionally on the firm raising new equity to fund the project).

Without Restructuring

<table>
<thead>
<tr>
<th>State</th>
<th>Proba.</th>
<th>Assets</th>
<th>Creditors</th>
<th>Shareholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>1/2</td>
<td>100</td>
<td>35</td>
<td>65</td>
</tr>
<tr>
<td>Bad</td>
<td>1/2</td>
<td>10</td>
<td>10</td>
<td>0</td>
</tr>
</tbody>
</table>

With Restructuring

<table>
<thead>
<tr>
<th>State</th>
<th>Proba.</th>
<th>Assets</th>
<th>Creditors</th>
<th>Shareholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>1/2</td>
<td>122</td>
<td>24</td>
<td>98</td>
</tr>
<tr>
<td>Bad</td>
<td>1/2</td>
<td>32</td>
<td>24</td>
<td>8</td>
</tr>
</tbody>
</table>

• Will shareholders go ahead with the project?

Financial Restructuring? (cont.)

• Recall our assumption: Can discount all at same rate 10%.

• Compared to no restructuring (and no investment), shareholders get incremental cash flow of:
  → 98 - 65 = $33M with probability 1/2
  → 8 - 0 = $8M with probability 1/2

• The will go ahead with the restructuring deal because
  \[-15 + [(1/2)\ast 33 + (1/2)\ast 8]/1.1 = 3.6M > 0\]

• Creditors are also better-off because they get
  \[5 - 3.6 = 1.4M\]
Financial Restructuring? (cont.)

- When evaluating financial distress costs, account for the possibility of (mutually beneficial) financial restructuring.

- In practice, perfect restructuring is not always possible.

- But you should ask: What are limits to restructuring?
  - Banks vs. bonds
  - Few vs. many banks
  - Bank relationship vs. arm’s length finance
  - Simple vs. complex debt structure (e.g., number of classes with different seniority, maturity, security, ….)

Debt Overhang: Preventive Measures

- Firms which are likely to enter financial distress should avoid too much debt.

- Firms which anticipate the need to raise funds in the future should avoid too much debt.

- Firms which expect to have valuable investment opportunities in the future should avoid too much debt.

- If you cannot avoid leverage, at least you should structure your liabilities so that they are easy to restructure if needed:
  - Active management of liabilities
  - Bank debt
  - Few banks
Scaring off of customers and suppliers:

• If a firm is in or close to financial distress:
  → Suppliers may demand cash payment
  → This may put a firm into financial distress – Macy’s and the Garment Makers.
  → Customers may choose another vendor:
    → Why is this true?
    → For what types of companies is this not an issue?
    → Would it be a problem for Wilson Lumber?
    → Would it be a problem for Dell?

Agency Costs of Financial Distress

• Financial distress may motivate managers to act in (ex-ante) value-destroying ways.

• Examples:
  → Excessive risk-taking (gambling for resurrection).
  → Delay of (efficient) liquidation.
  → Cash-in-and-run: Take money out of company.

• Why are these strategies costly to shareholders?
  → Because debt-holders anticipate them and pay less for debt when issued.
Textbook View of Optimal Capital Structure

1. Start with M-M Irrelevance

2. Add two ingredients that change the size of the pie.
   → Taxes
   → Expected Distress Costs

3. Trading off the two gives you the “static optimum” capital structure. (“Static” because this view suggests that a company should keep its debt relatively stable over time.)
Practical Implications: Expected Distress Costs Matter!

- Companies with “low” expected distress costs should load up on debt to get tax benefits.
- Companies with “high” expected distress costs should be more conservative.
- Thus, all substance lies in having an idea of what industry and company traits lead to potentially high expected distress costs.

\[ \text{Expected Distress Costs} = (\text{Probability of Distress}) \times (\text{Distress Costs}) \]

Identifying Expected Distress Costs

- **Probability of Distress**
  - Volatile cash flows:
    - industry change
    - technology change
    - cyclical industry
  - macro shocks
  - start-up

- **Distress Costs**
  - Need external funds to invest in CAPX or market share
  - Financially strong competitors
  - Customers or suppliers care about your financial position (e.g., because of implicit warranties or specific investments)
  - Assets cannot be easily redeployed
Setting Target Capital Structure: A Checklist

- Taxes
  - Does the company benefit from debt tax shield?

- Expected Distress Costs
  - Cashflow volatility
  - Need for external funds for investment
  - Competitive threat if pinched for cash
  - Customers care about distress
  - Hard to redeploy assets

Does the Checklist Explain Observed Debt Ratios?

<table>
<thead>
<tr>
<th>Industry</th>
<th>Debt Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric and Gas</td>
<td>43.2</td>
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<tr>
<td>Food Production</td>
<td>22.9</td>
</tr>
<tr>
<td>Paper and Plastic</td>
<td>30.4</td>
</tr>
<tr>
<td>Equipment</td>
<td>19.1</td>
</tr>
<tr>
<td>Retailers</td>
<td>21.7</td>
</tr>
<tr>
<td>Chemicals</td>
<td>17.3</td>
</tr>
<tr>
<td>Computer Software</td>
<td>3.5</td>
</tr>
</tbody>
</table>
What Does the Checklist Explain?

• Explains capital structure differences at broad level, e.g., between Electric and Gas (43.2%) and Computer Software (3.5%). In general, industries with more volatile cash flows tend to have lower leverage.

• Probably not so good at explaining small difference in debt ratios, e.g., between Food Production (22.9%) and Manufacturing Equipment (19.1%).

• Other factors are also important (more on that later).

Appendix
(for your information)
Valuing the Tax Shield:

- Firm A has a perpetual before-tax, expected annual cash flow \( X \)
- It is 100% equity financed with required rate of return \( k \)

\[
C_A = (1 - t)X \quad \text{so that} \quad V(A) = \sum_{s=1}^{\infty} \frac{C_A}{(1 + k)^s} = \frac{(1 - t)X}{k}
\]

- Firm B is identical but maintains debt with value \( D \)
- It thus pays a perpetual expected interest \( i \)

\[
C_B = (1 - t)(X - i) + i = (1 - t)X + t \cdot i = C_A + t \cdot i
\]

- The cash flows differ by the tax shield \( t \cdot i \)

Valuing the Tax Shield (cont.)

- Apply value additivity: Value separately \( C_A \) and \( t \cdot i \)
- We already know

\[
PV[C_A] = V(A) = \frac{(1 - t)X}{k}
\]

- The TS's capitalized value is: \( PV[\text{tax shield}] = t \cdot PV[i] = t \cdot D \)

\[
V(B) = V(A) + tD = \frac{(1 - t)X}{k} + tD
\]
Tax Shields with Personal Taxes

- Every year, XYZ Inc.:
  → generates a safe EBIT of $X = 100 in perpetuity
  → has debt paying an interest of $i = 60 in perpetuity
  → and retains the remaining $X - i = 40

- Assume the following tax rates:
  → Corporate taxes: $t = 34\%$
  → Personal taxes on interests: $d = 31\%$
  → For simplicity, single personal tax rate on equity
    (dividends + retained earnings): $e = 10\%$

Example (cont.)

- Each year, XYZ’s debtholders receive:
  $60 - (31\% \times 60) = (1 - 31\%) \times 60$

- Each year, XYZ’s shareholders receive:
  $(1 - 10\%) \times (1 - 34\%) \times (100 - 60)$

- Each year, the sum of these can be rewritten as
  $(1 - 10\%) \times (1 - 34\%) \times 100 + [(1 - 31\%) - (1 - 34\%) (1 - 10\%)] \times 60$
M-M with Corporate and Personal Taxes

• More generally, XYZ’s investors after-tax cashflow is:

\[(1 - e)(1 - t)X + [(1 - d) - (1 - e)(1 - t)]i\]

• Note:
  → First term is cash flow if firm is all-equity financed
  → Second term is the revised tax shield of debt financing

• Capitalizing the tax shield yields the often used formula:

\[V(\text{with debt}) = V(\text{all equity}) + \left[1 - \frac{(1 - t)(1 - e)}{(1 - d)}\right]D\]

“Proof”:

• We need to capitalize the annual tax shield:

\[\left[(1 - d) - (1 - e)(1 - t)\right]i\]

• We know that a perpetuity of \((1 - d)I\) is worth \(D\)

• Consequently, a perpetuity of

\[\left[(1 - d) - (1 - e)(1 - t)\right]i = \left[\frac{(1 - d) - (1 - e)(1 - t)}{1 - d}\right](1 - d)i\]

must be worth

\[\left[\frac{(1 - d) - (1 - e)(1 - t)}{1 - d}\right]D\]
Debt or Equity?

- Given that
  \[
  V(\text{with debt}) = V(\text{all equity}) + \left[1 - \frac{(1 - t)(1 - e)}{(1 - d)}\right] \cdot D
  \]
  debt has an overall tax advantage over equity if
  \[
  \frac{(1 - t)(1 - e)}{(1 - d)} < 1
  \]
  - Otherwise, equity has an advantage over debt

Debt or Equity? (cont.)

- If equity pays large dividends, and \(d\) and \(e\) are similar, we can ignore personal taxes and debt dominates equity
  \[
  V(\text{with debt}) = V(\text{all equity}) + t \cdot D
  \]
- If equity can avoid large dividends, it does not look as bad. Indeed, with \(e < d\), the tax shield of debt is less than \(tD\)
- If shareholders can avoid capital gains taxation sufficiently (e.g., by delaying capital gains), equity can dominate debt
  \[
  \frac{(1 - t)(1 - e)}{(1 - d)} = \frac{(1 - t)}{(1 - d)} > 1 \quad \text{if} \quad t < d
  \]
Finance Theory II (15.402) – Spring 2003 – Dirk Jenter

The Big Picture: Part II - Valuation

A. Valuation: Free Cash Flow and Risk
   - April 1 Lecture: Valuation of Free Cash Flows
   - April 3 Case: Ameritrade

B. Valuation: WACC and APV
   - April 8 Lecture: WACC and APV
   - April 10 Case: Dixon Corporation
   - April 15 Case: Diamond Chemicals

C. Project and Company Valuation
   - April 17 Lecture: Real Options
   - April 24 Case: MW Petroleum Corporation
   - April 29 Lecture: Valuing a Company
   - May 1 Case: Cooper Industries, Inc.
   - May 6 Case: The Southland Corporation
What Next?

• We need to incorporate the effects of financial policy into our valuation models.

⇒ Question: How do we incorporate debt tax shields (if any) into our valuation?

Two Approaches:

Weighted Average Cost of Capital (WACC):
→ Discount the FCF using the weighted average of after-tax debt costs and equity costs

\[
WACC = k_D (1-t) \frac{D}{D+E} + k_E \frac{E}{D+E}
\]

• Adjusted Present Value (APV):
→ Value the project as if it were all-equity financed
→ Add the PV of the tax shield of debt and other side effects

Recall: Free Cash Flows are cash flows available to be paid to all capital suppliers ignoring interest rate tax shields (i.e., as if the project were 100% equity financed).
Weighted Average Cost of Capital (WACC)

- Step 1: Generate the Free Cash Flows (FCFs)
- Step 2: Discount the FCFs using the WACC

\[
WACC = k_d(1-t) \frac{D}{D+E} + k_e \frac{E}{D+E}
\]
WARNING!!!

- The common intuition for using WACC is:
  → “To be valuable, a project should return more than what it
costs us to raise the necessary financing, i.e., our WACC”
  → This intuition is wrong.

- Using WACC this way is OK sometimes... but “by accident”.
- Most of the time, it is plain wrong:
  → conceptually, i.e., the logic is flawed
  → practically, i.e. gives you a result far off the mark

Discount rates and hence the WACC are project specific!

Weighted Average Cost of Capital (WACC)

- Discount rates are project-specific

  ==> Imagine the project is a stand alone, financed as a
  separate firm.
  ==> The WACC inputs should be project-specific as well:

  \[
  \text{WACC} = k_D (1-t) \frac{D}{D+E} + k_E \frac{E}{D+E}
  \]

- Let's look at each WACC input in turn:
Leverage Ratio $D/(D+E)$

- $D/(D+E)$ should be the target capital structure (in market values) for the particular project under consideration.

- Common mistake 1:
  - Using a priori $D/(D+E)$ of the firm undertaking the project.

- Common mistake 2:
  - Use $D/(D+E)$ of the project’s financing
  - Example: Using 100% if project is all debt financed.

Caveat: We will assume that the target for A+B is the result of combining target for A and target for B. It’s OK most of the time.

Leverage Ratio (cont.)

- So how do we get that “target leverage ratio”?

- Use comparables to the project:
  - “Pure plays” in the same business as the project
  - Trade-off: Number vs. “quality” of comps

- Use the firm undertaking the project if the project is very much like the rest of the firm (i.e. if the firm is a comp for the project).

- Introspection, improved by checklist,...
Important Remark:

- If the project maintains a relatively stable D/V over time, then WACC is also stable over time.

- If not, then WACC should vary over time as well and we should compute a different WACC for each year.

- In practice, firms tend to use a constant WACC.

- So, in practice, the WACC method does not work well when the capital structure is expected to vary substantially over time.

Cost of Debt Capital: $k_D$ (cont.)

- Can often look it up: Should be close to the interest rate that lenders would charge to finance the project with the chosen capital structure.

- Caveat: Cannot use the interest rate as an estimate of $k_D$ when:
  - Debt is very risky. We would need default probabilities to estimate expected cash flows.
  - If there are different layers of debt. We would need to calculate the average interest rate.
Marginal Tax Rate: $t$

- It’s the marginal tax rate of the firm undertaking the project (or to be more precise, of the firm including the project).

- Note that this is the rate that is going to determine the tax savings associated with debt.

- We need to use the marginal as opposed to average tax rate $t$.
  - In practice, the marginal rate is often not easily observable.

Cost of Equity Capital: $k_E$

- Cannot look it up directly.

- Need to estimate $k_E$ from comparables to the project:
  - “Pure Plays”, i.e. firms operating only in the project’s industry.
  - If the firm undertaking the project is itself a pure play in the project’s industry, can simply use the $k_E$ of the firm.

- Problem:
  - A firm’s capital structure has an impact on $k_E$
  - Unless we have comparables with same capital structure, we need to work on their $k_E$ before using it.
Using CAPM to Estimate $k_E$

1) Finds comps for the project under consideration.

2) **Unlever** each comp’s $\beta_A$ (using the comp’s $D/(D+E)$) to estimate its $\beta_A$.
When its debt is not too risky (and its $D/V$ is stable), we can use:

$$\beta_A = \frac{E}{E+D}$$

3) Use the comps’ $\beta_A$ to estimate the project’s $\beta_A$ (e.g. take the average).

4) **Relever** the project’s estimated $\beta_A$ (using the project’s $D/(D+E)$) to estimate its $\beta_A$ under the assumed capital structure. When the project’s debt is not too risky (and provided its $D/V$ is stable), we can use:

$$\beta_A = \frac{E+D}{E} \beta_A = \left(1 + \frac{D}{E}\right) \beta_A$$

5) Use the estimated $\beta_A$ to calculate the project’s cost of equity $k_E$:

$$k_E = r_f + \beta_A \times \text{Market Risk Premium}$$

Remarks on Unlevering and Relevering:

- **Formulas:**
  → Relevering formulas are reversed unraveling formulas.

- **Procedure:**
  → Unlever each comp, i.e., one unraveling per comp.
  → Estimate one $\beta_A$ by taking the average over all comps’ $\beta_A$ possibly putting more weight on those we like best.
  → This is our estimate of the project’s $\beta_A$.
  → Relever that $\beta_A$.

- In the course, we use mostly the formula for a constant $D/(D+E)$. 
More on Business Risk and Financial Risk

\[ \beta_A = \frac{\beta_E}{E+D} \iff \beta_E = \left(1 + \frac{D}{E}\right) \beta_A \iff \beta_E - \beta_A = \frac{D}{E} \beta_A \]

- Comparable firms have similar Business Risk
  - Similar asset beta \( \beta_A \) and, consequently, similar unlevered cost of capital \( k_A \)

- Comparable firms can have different Financial Risk (different \( \beta_E - \beta_A \)) if they have different capital structures
  - Different equity beta \( \beta_E \) and thus different required return on equity \( k_E \)

- In general, equity beta \( \beta_E \) increases with D/E
  - Consequently the cost of equity \( k_E \) increases with leverage.

Business Risk and Financial Risk: Intuition

- Consider a project with \( \beta_A > 0 \)
- Its cash flows can be decomposed into:
  - Safe cash-flows
  - Risky cash-flows that are positively correlated with the market.

- As the level of debt increases (but remains relatively safe):
  - A larger part of the safe cash-flows goes to debtholders;
  - The residual left to equityholders is increasingly correlated with the market.

**Note:** If cash-flows were negatively correlated with the market (\( \beta_A < 0 \)), increasing debt would make equity more negatively correlated with the market and would reduce the required return on equity.
WACC – A simple example:

You are evaluating a new project. The project requires an initial outlay of $100 million and you forecast before-tax profits of $25 million in perpetuity. The marginal tax rate is 40%, the project has a target debt-to-value ratio of 25%, the interest rate on the project’s debt is 7%, and the cost of equity is 12%.

After-tax CFs = $25 \times 0.60 = $15 million

After-tax WACC = D/V \times (1-t) \times r_d + E/V \times r_e
= 0.25 \times 0.60 \times 0.07 + 0.75 \times 0.12 = 10.05\%

NPV = -100 + 15 / 0.1005 = $49.25 million

How Firms Tend to Use WACC:

They calculate their WACC using:
• Their current cost of debt $k_d$
• Their own current capital structure $D/(D+E)$
• Their own current cost of equity capital $k_e$
• The marginal tax rate they are facing

They discount all future FCF with:
• this (single) discount rate
• maybe adjusted for other things (e.g., project’s “strategic value”)

⇒ This practical approach can be very misleading, especially if the new project is very different from the firm undertaking it.
## Selected Industry Capital Structures, Betas, and WACCs

<table>
<thead>
<tr>
<th>Industry</th>
<th>Debt ratio (%)</th>
<th>Equity beta</th>
<th>Asset beta</th>
<th>WACC (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric and Gas</td>
<td>43.2</td>
<td>0.58</td>
<td>0.33</td>
<td>8.1%</td>
</tr>
<tr>
<td>Food production</td>
<td>22.90</td>
<td>0.85</td>
<td>0.66</td>
<td>11.0%</td>
</tr>
<tr>
<td>Paper and plastic</td>
<td>30.40</td>
<td>1.03</td>
<td>0.72</td>
<td>11.4%</td>
</tr>
<tr>
<td>Equipment</td>
<td>19.10</td>
<td>1.02</td>
<td>0.83</td>
<td>12.4%</td>
</tr>
<tr>
<td>Retailers</td>
<td>21.70</td>
<td>1.19</td>
<td>0.93</td>
<td>13.2%</td>
</tr>
<tr>
<td>Chemicals</td>
<td>17.30</td>
<td>1.34</td>
<td>1.11</td>
<td>14.7%</td>
</tr>
<tr>
<td>Computer software</td>
<td>3.50</td>
<td>1.33</td>
<td>1.28</td>
<td>16.2%</td>
</tr>
<tr>
<td><strong>Average of all industries</strong></td>
<td><strong>21.50</strong></td>
<td><strong>1.04</strong></td>
<td><strong>0.82</strong></td>
<td><strong>12.3%</strong></td>
</tr>
</tbody>
</table>

Assumptions: Risk-free rate 6%; market risk premium 8%; cost of debt 7.5%; tax rate 35%
Adjusted Present Value

- Separates the effects of financial structure on value from the estimation of asset values.

- **Step 1**: Value the project or firm as if it were 100% equity financed.

- **Step 2**: Add the value of the tax shield of debt.

Note:
- This is simply applying MM-Theorem with taxes
- APV = Valuation by Components = ANPV

---

Step 1: Value as if 100% Equity Financed

- Cash-flows: Free Cash Flows are exactly what you need.

- You need the rate that would be appropriate to discount the firm’s cash flows if the firm were 100% equity financed.

- This rate is the expected return on equity if the firm were 100% equity financed.

- To get it, you need to:
  - Find comps, i.e., publicly traded firms in same business.
  - Estimate their expected return on equity if they were 100% equity financed.
Step 1: Value if 100% Equity Financed (cont.)

- Unlever each comp’s $\beta_e$ to estimate its asset beta (or all equity or unlevered beta) $\beta_A$ using the appropriate unlevering formula
  \[
  \beta_A = \beta_e \frac{E}{E+D} \quad \text{or} \quad \beta_A = \beta_e \frac{E}{E+(1-t)D}
  \]
- Use the comps’ $\beta_A$ to estimate the project’s $\beta_A$ (e.g. average).
- Use the estimated $\beta_A$ to calculate the all-equity cost of capital $k_A$
  \[
  k_A = r_f + \beta_A \times \text{Market Risk Premium}
  \]
- Use $k_A$ to discount the project’s FCF

Step 2: Add PV(Tax Shield of Debt)

- Cash-flow: The expected tax saving is $tk_0D$ where $k_0$ is the cost of debt capital (discussed earlier).
- If $D$ is expected to remain stable, then discount $tk_0D$ using $k_D$
  \[
  \text{PVTS} = tk_0D/ k_D = tD
  \]
- If $D/V$ is expected to remain stable, then discount $tk_0D$ using $k_A$
  \[
  \text{PVTS} = tk_0D/ k_A
  \]
- Intuition:
  \[\rightarrow\] If $D/V$ is constant, $D/(tk_0D)$ and thus moves up/down with $V$
  \[\rightarrow\] The risk of $tk_0D$ is similar to that of the firm’s assets: use $k_A$
Step 2: Add PVTS (cont.)

- For many projects, neither D nor D/V is expected to be stable.
- For instance, LBO debt levels are expected to decline.
- In general you can estimate debt levels using:
  → repayment schedule if one is available,
  → financial forecasting
  and discount by a rate between $k_D$ and $k_A$.

Extending the APV Method

- One good feature of the APV method is that it is easy to extend to take other effects of financing into account.
- For instance, one can value an interest rate subsidy separately as the PV of interest savings.

\[
\text{APV} = \text{NPV(all-equity)} + \text{PV(Tax Shield)} + \text{PV(other stuff)}
\]
WACC vs. APV

Pros of WACC: Most widely used
- Less computations needed (important before computers).
- More literal, easier to understand and explain (?)

Cons of WACC:
- Mixes up effects of assets and liabilities. Errors/approximations in effect of liabilities contaminate the whole valuation.
- Not very flexible: What if debt is risky? Cost of hybrid securities (e.g., convertibles)? Other effects of financing (e.g., costs of distress)? Non-constant debt ratios? Personal taxes?

Note: For non-constant debt ratios, could use different WACC for each year (see appendix) but this is heavy and defeats the purpose.

Advantages of APV:
- No contamination.
- Clearer: Easier to track down where value comes from.
- More flexible: Just add other effects as separate terms.

Cons of APV:
- Almost nobody uses it.

Overall:
- For complex, changing or highly leveraged capital structure (e.g., LBO), APV is much better.
- Otherwise, it doesn’t matter much which method you use.
Appendix I - Relation to MM Theorem

Relation to MM Theorem

• Without taxes, WACC is independent of leverage.
  • Indeed, for simplicity, think in terms of CAPM (although the result does not rely on CAPM being true).

\[ WACC = k_e \frac{E}{D+E} + k_d \frac{D}{D+E} \]

\[ = \left[ r_f + \beta_b \cdot \text{Mkt Prem.} \right] \frac{D}{D+E} + \left[ r_f + \beta_e \cdot \text{Mkt Prem.} \right] \frac{E}{D+E} \]

\[ = r_f + \beta_b \cdot \text{Mkt Prem.} \cdot \frac{D}{D+E} + \beta_e \cdot \text{Mkt Prem.} \cdot \frac{E}{D+E} \]

\[ = r_f + \beta_A \cdot \text{Mkt Prem.} \]

• The last expression does not contain leverage – WACC does not depend on it.
The WACC Fallacy (Revisited)

- The cost of debt is lower than the cost of equity (true).
- Does this mean that projects should be financed with debt?
  \[ WACC = k_D \frac{D}{D+E} + k_E \frac{E}{D+E} \]
- No: WACC is independent
- As you are tapping into cheap debt, you are increasing the cost of equity (its financial risk increases).

Without taxes, WACC is independent of leverage:

![Diagram showing WACC, cost of equity, and cost of debt as functions of debt-to-equity ratio.]( financetheoryii.png )
Cost of Capital

Katharina Lewellen
Finance Theory II
April 9, 2003
What Next?

- We want to value a project that is financed by both debt and equity

- Our approach:
  - Calculate expected Free Cash Flows (FCFs) from the project
  - Discount FCFs at a rate that reflects opportunity costs of capital of all capital suppliers
  - Incorporate the interest tax shields
    - Adjust the discount rate (WACC)
    - Adjust cash flows (APV)

Recall: **Free Cash Flows** are cash flows available to be paid to all capital suppliers ignoring interest rate tax shields (i.e., as if the project were 100% equity financed).
Two Approaches

- **Weighted Average Cost of Capital (WACC):**
  - Discount the FCF using the weighted average of after-tax debt costs and equity costs
  
  $$\text{WACC} = k_D(1-t) \frac{D}{D+E} + k_E \frac{E}{D+E}$$

- **Adjusted Present Value (APV):**
  - Value the project as if it were all-equity financed
  - Add the PV of the **tax shield** of debt and other side effects
1. WACC
Weighted Average Cost of Capital (WACC)

- Step 1: Generate the Free Cash Flows (FCFs)
- Step 2: Discount the FCFs using the WACC

\[
WACC = k_D (1 - t) \frac{D}{D + E} + k^E \frac{E}{D + E}
\]
WACC - Example

You are evaluating a new project. The project requires an initial outlay of $100 million and you forecast before-tax profits of $25 million in perpetuity. The tax rate is 40%, the firm has a target debt-to-value ratio of 25%, the interest rate on the firm’s debt is 7%, and the cost of equity is 12%.

After-tax CFs = $25 \times 0.60 = $15 million

After-tax WACC = \frac{D}{V} (1-\tau) r_d + \frac{E}{V} r_e
= 0.25 \times 0.60 \times 0.07 + 0.75 \times 0.12 = 10.05\%

NPV = -100 + 15 / 0.1005 = $49.25 million
WARNING!!!

- The common intuition for using WACC is:
  - “To be valuable, a project should return more than what it costs us to raise the necessary financing, i.e., our WACC”
  - This intuition is wrong.

- Using WACC this way is OK sometimes... but “by accident”.
- Sometimes, this is plain wrong:
  - conceptually, i.e., the logic may be flawed
  - practically, i.e., gives you a result far off the mark

- Need to understand this concept (more tricky than it appears).
**Weighted Average Cost of Capital (WACC)**

- Recall: **Discount rates are project-specific** => Imagine the project is a stand alone, i.e., financed as a separate firm.

- Debt worth $D$ (i.e. market value) and with expected return $k_D$ (i.e., cost of debt) if against that project only

- Equity worth $E$ (i.e. market value) and with expected return $k_E$ (i.e., cost of equity) if against that project only

- $t$ is the marginal tax rate of the firm undertaking the project
Why WACC?

- Consider a one-year project (stand-alone) such that:
  - expected cash-flow at the end of year 1 (BIT) = X

- Today (year 0) the projects has:
  - debt outstanding with market value $D_0$
  - equity outstanding with market value $E_0$
  - project’s total value is $V_0 = D_0 + E_0$

- We are looking for the discount rate $r$ such that:

$$V_0 = \frac{\text{Aftertax CFs (if all equity financed)}}{1+r} = \frac{(1-t)X_1}{1+r}$$

$$r = \frac{(1-t)X_1 - V_0}{V_0}$$
Why WACC? (cont.)

The expected increase in value from year 0 to year 1 is:

\[ k_D D_0 + k_E E_0 = k_D D_0 + (1-t)(X_1 - k_D D_0) - V_0 \]

\[ CF \text{ to debt-holders } \quad CF \text{ to share-holders} \]

\[ k_E E_0 + (1-t)k_D D_0 = (1-t)X_1 - V_0 \]

\[ k_E \frac{E_0}{V_0} + (1-t)k_D \frac{D_0}{V_0} = \frac{(1-t)X_1 - V_0}{V_0} \]

\[ r = \text{WACC} \]
Leverage Ratio $\frac{D}{(D+E)}$

- $\frac{D}{(D+E)}$ should be the target capital structure (in market values) for the particular project under consideration.

- **Common mistake 1:**
  - Using a priori $\frac{D}{(D+E)}$ of the firm undertaking the project.

- **Common mistake 2:**
  - Use $\frac{D}{(D+E)}$ of the project’s financing
  - Example: Using 100% if project is all debt financed.

Caveat: We will assume that the target for A+B is the result of combining target for A and target for B. It’s OK most of the time.
Leverage Ratio (cont.)

- So how do we get that ratio?

- Comparables to the project:
  - “Pure plays” in the same business as the project
  - Trade-off: Number vs. “quality” of comps

- The firm undertaking the project if the project is very much like the rest of the firm (i.e., if the firm is a comp for the project).

- Introspection, improved by checklist,...
Important Remark

- If the project maintains a relatively stable D/V over time, then WACC is also stable over time.

- If not, then WACC should vary over time as well so you should compute/forecast a different WACC for each year.

- In practice, firms tend to use a constant WACC.

- So, in practice, WACC method is not great when capital structure is expected to vary substantially over time.
Cost of Debt Capital: $k_D$

- **When default probability is low**
  - We can estimate $k_D$ using CAPM (empirical evidence suggests using debt betas between 0.2 and 0.3)
  - $k_D$ should be close to the interest rate that lenders would charge to finance the project with the chosen capital structure

- **When default probability is high**
  - We would need default probabilities to estimate expected cash flows to debtholders
Marginal Tax Rate: $t$

- It’s the marginal tax rate of the firm undertaking the project (or to be more precise, of the firm + project).

- Indeed, this is the rate that is going to determine the tax savings associated with debt.

- Marginal as opposed to average tax rate $t$
Cost of Equity Capital: $k_E$

- Need to estimate $k_E$ from comparables to the project:
  - “Pure Plays”, i.e. firms operating only in the project’s industry
  - The firm undertaking the project (if the firm is a pure play)

- Problem:
  - A firm’s capital structure has an impact on $k_E$
  - Unless we have comparables with same capital structure, we need to work on their $k_E$ before using it.
Using CAPM to Estimate $k_E$

1) Finds comps for the project under consideration.

2) **Unlever** each comp’s $\beta_E$ (**using the comp’s $D/(D+E)$**) to estimate its $\beta_A$:

$$\beta_A = \frac{E}{V}\beta_E + \frac{D}{V}\beta_D$$

3) Use the comps’ $\beta_A$ to estimate the project’s $\beta_A$ (e.g. take the average).

4) **Relever** the project’s estimated $\beta_A$ (**using the project’s $D/(D+E)$**) to estimate its $\beta_E$ under the assumed capital structure:

$$\beta_E = \beta_A + \frac{D}{E}(\beta_A - \beta_D)$$

5) Use the estimated $\beta_E$ to calculate the project’s cost of equity $k_E$:

$$k_E = r_f + \beta_E * \text{Market Risk Premium}$$
Remarks

- **Formulas:**
  - Relevering formulas are reversed unlevering formulas.
  - The appendix shows where they come from.

- **Most of the time:**
  - Unlever each comp, i.e., one unlevering per comp.
  - Estimate one $\beta_A$ by taking the average over all comps’ $\beta_A$ possibly putting more weight on those we like best.
  - This is our estimate of the project’s $\beta_A$.
  - Relever that $\beta_A$ only, i.e., just one relevering.

- In the course, we use mostly the formula for a constant D/V.
More on Business Risk and Financial Risk

- Comparable firms have similar *Business Risk*
  - Similar asset beta $\beta_A$ and, consequently, similar unlevered cost of capital $k_A$

- Comparable firms can have different *Financial Risk* $(\beta_E - \beta_A)$ if they have different capital structures
  - Different equity beta $\beta_E$ and thus different required return on equity $k_E$

- In general, equity beta $\beta_E$ increases with D/E
  - Consequently the cost of equity $k_E$ increases with leverage
Leverage, returns, and risk

Asset risk is determined by the type of projects, not how the projects are financed

- Changes in leverage do not affect \( r_A \) or \( \beta_A \)
- Leverage affects \( r_E \) and \( \beta_E \)

\[
\beta_A = \frac{D}{V} \beta_D + \frac{E}{V} \beta_E
\]

\[
\beta_E = \beta_A + \frac{D}{E} (\beta_A - \beta_D)
\]

\[
r_A = \frac{D}{V} r_D + \frac{E}{V} r_E
\]

\[
r_E = r_A + \frac{D}{E} (r_A - r_D)
\]
Leverage and beta

![Graph showing the relationship between debt to equity ratio and beta.]

- $\beta_E$
- $\beta_A$
- $\beta_D$

Beta

Debt to equity ratio

0 0.2 0.4 0.6 0.8 1 1.2 1.4
Leverage and required returns

Debt to equity ratio vs. required return

- \( r_E \)
- \( r_A \)
- \( r_D \)
Consider a project with $\beta_A > 0$

- Its cash flows can be decomposed into:
  - Safe cash-flows
  - Risky cash-flows that are positively correlated with the market.

- As the level of debt increases (but remains relatively safe):
  - A larger part of the safe cash-flows goes to debtholders;
  - The residual left to equityholders is increasingly correlated with the market.

**Note:** If cash-flows were negatively correlated with the market ($\beta_A < 0$), increasing debt would make equity more negatively correlated with the market and would reduce the required return on equity.
General Electric’s WACC

- Assume $r_f = 6\%$

- We can get GE’s $\beta_E = 1.10$ which implies

$$k_E = 6\% + 1.10 \times 8\% = 14.8\%$$

- $k_D = 7.5\%$

- $D/(D+E) = .06$

- $t = 35\%$

$$WACC = .06 \times 7.5\% \times (1-35\%) + .094 \times 14.8\% = 14.2\%$$
When Can GE Use This WACC in DCF?

- When the project under consideration has the same basic risk as the rest of the company (i.e., when the company is a good comp for its project).

- And, the project will be financed in the same way as the rest of the company.

- For example, if GE is expanding the scale of entire operations then it should use its own WACC.

- But, if planning to expand in only one of its many different businesses then it’s not the right cost of capital.
  - In that case: Find publicly-traded comps and do unlevering / levering.
Important Warning

• Cost of capital is an attribute of an investment, *not* the company

• Few companies have a single WACC that they can use for all of their businesses.

**GE’s businesses:**
- Financial services
- Power systems
- Aircraft engines
- Industrial
- Engineered plastics
- Technical products
- Appliances
- Broadcasting
How Firms Tend to Use WACC

They calculate their WACC using:
- Their current cost of debt $k_D$
- Their own current capital structure $D/(D+E)$
- Their own current cost of equity capital $k_E$ (more on this soon).
- The marginal tax rate they are facing

They discount all future FCF with:
- this (single) discount rate
- maybe adjusted for other things (e.g., project’s “strategic value”)
# Selected Industry Capital Structures, Betas, and WACCs

<table>
<thead>
<tr>
<th>Industry</th>
<th>Debt ratio (%)</th>
<th>Equity beta</th>
<th>Asset beta</th>
<th>WACC (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric and Gas</td>
<td>43.2</td>
<td>0.58</td>
<td>0.33</td>
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<tr>
<td>Food production</td>
<td>22.90</td>
<td>0.85</td>
<td>0.66</td>
<td>11.0%</td>
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<td>Paper and plastic</td>
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<td>1.03</td>
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<td>11.4%</td>
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<tr>
<td>Equipment</td>
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<td>1.02</td>
<td>0.83</td>
<td>12.4%</td>
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<td>21.70</td>
<td>1.19</td>
<td>0.93</td>
<td>13.2%</td>
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<tr>
<td>Chemicals</td>
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<td>1.34</td>
<td>1.11</td>
<td>14.7%</td>
</tr>
<tr>
<td>Computer software</td>
<td>3.50</td>
<td>1.33</td>
<td>1.28</td>
<td>16.2%</td>
</tr>
<tr>
<td><strong>Average of all industries</strong></td>
<td><strong>21.50</strong></td>
<td><strong>1.04</strong></td>
<td><strong>0.82</strong></td>
<td><strong>12.3%</strong></td>
</tr>
</tbody>
</table>

Assumptions: Risk-free rate 6%; market risk premium 8%; cost of debt 7.5%; tax rate 35%
Relation to MM:
W/o taxes, WACC is independent of leverage
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- The cost of debt is lower than the cost of equity (true).

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\[ \text{WACC} = k_D \frac{D}{D+E} + k_E \frac{E}{D+E} \]

- No: WACC is independent of leverage.

- As you are tapping into cheap debt, you are increasing the cost of equity (its financial risk increases).
With taxes, WACC declines with leverage
2. APV
Adjusted Present Value

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$$k_A = r_f + \beta_A \times \text{Market Risk Premium}$$
- Use $k_A$ to discount the project’s FCF.
Example

- Johnson and Johnson operate in several lines of business: Pharmaceuticals, consumer products and medical devices.

- To estimate the all-equity cost of capital for the medical devices division, we need a comparable, i.e., a pure play in medical devices (we should really have several).

- Data for Boston Scientific:
  - Equity beta = 0.98
  - Debt = $1.3b
  - Equity = $9.1b.
**Example (cont.)**

- Compute Boston Scientific’s asset beta:
  \[ \beta_A = \beta_E \frac{E}{E+D} = 0.98 \cdot \frac{9.1}{9.1+1.3} = 0.86 \]

- Let this be our estimate of the asset beta for the medical devices business.

- Use CAPM to calculate the all-equity cost of capital for that business (assuming 6% risk-free rate, 8% market risk premium):
  \[ k_A = 6\% + 0.86 \times 8\% = 12.9\% \]
Step 2: Add PV(Tax Shield of Debt)

- **Cash-flow:** The expected tax saving is $tk_D D$ where $k_D$ is the cost of debt capital (discussed earlier).

- If $D$ is expected to remain stable, then discount $tk_D D$ using $k_D$
  \[ PV_{TS} = \frac{tk_D D}{k_D} = tD \]

- If $D/V$ is expected to remain stable, then discount $tk_D D$ using $k_A$
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  - If $D/V$ is constant, $D$ ($tk_D D$) moves up/down with $V$
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- For complex, changing or highly leveraged capital structure (e.g., LBO), APV is much better.
- Otherwise, it doesn’t matter much which method you use.
Appendix
Appendix A: Unlevering Formula for a Constant Debt Ratio D/V

- Consider a firm with perpetual expected cash-flows, X.
- Capital structure: Debt worth D and equity worth E

\[ E + D = V_{\text{all-equity}} + PVTS \]

- By definition, the all-equity cost of capital is the rate \( k_A \) that is appropriate for discounting the project’s FCF, \((1-t)X\).

- Moreover, since the firm’s D/V is stable, \( PVTS = \frac{tDk_D}{k_A} \)

\[ E + D = \frac{(1-t)X}{k_A} + \frac{t k_D D}{k_A} \quad \text{or} \quad k_A = \frac{(1-t)X + t k_D D}{E + D} \]
Appendix A: Unlevering Formula for a Constant Debt Ratio D/V (cont.)

- Debt- and equity-holders share each year’s (expected) cash-flows

\[
\frac{\text{Expected after-tax cashflow if 100% equity financed}}{(1-t)X} + \frac{\text{Annual tax shield of debt}}{tk_D D} = \frac{\text{Expected payment to debt}}{k_D D} + \frac{\text{Expected payment to equity}}{k_E E}
\]

- Eliminating \( X \), we get:

\[
k_A = k_D \frac{D}{E+D} + k_E \frac{E}{E+D}
\]

- Translating into betas (all relationships being linear) yields:

\[
\beta_A = \beta_D \frac{D}{E+D} + \beta_E \frac{E}{E+D}
\]

and so if \( \beta_D \approx 0 \) we have \( \beta_A = \beta_E \frac{E}{E+D} \)
Appendix B: Unlevering Formula for a Constant Debt Level D

- Consider a firm with perpetual expected cash-flows, $X$.
- Capital structure: Debt worth $D$ and equity worth $E$

\[
E + D = V_{\text{all-equity}} + PVTS
\]

- Since the firm's $D$ is constant over time, $PVTS = tD$

\[
E + D = \frac{(1-t)X}{k_A} + tD \quad \text{or} \quad k_A = \frac{(1-t)X}{E + D(1-t)}
\]
Appendix B: Unlevering Formula for a Constant Debt Level D (cont.)

- Debt- and equity-holders share each year’s (expected) cash-flows

  \[
  \frac{(1-t)X}{(1-t)X} + \frac{tk_D D}{tk_D D} = \frac{k_D D}{k_D D} + \frac{k_E E}{k_E E}
  \]

- Dividing both sides by (D+E), we get (see formula for \( k_A \) above):

  \[
  k_A = k_D \frac{D(1-t)}{E + D(1-t)} + k_E \frac{E}{E + D(1-t)}
  \]

- Translating into betas yields:

  \[
  \beta_A = \beta_D \frac{D(1-t)}{E + D(1-t)} + \beta_E \frac{E}{E + D(1-t)}
  \]

  and so if \( \beta_D \approx 0 \) we have \( \beta_A = \beta_E \frac{E}{E + D(1-t)} \)
Appendix C: WACC vs. APV: Example

Objective of the example:

- See APV and WACC in action.
- Show that, when correctly implemented, APV and WACC give identical results.
- Correctly implementing WACC in an environment of changing leverage.
- Convince you that APV is the way to go.
WACC vs. APV: Example (cont.)

Anttoz Inc., a Fortune 500 widget company, is planning to set up a new factory in New Orleans with cash flows as presented on the next slide:

- The new plant will require an initial investment in PPE of $75 million, plus an infusion of $10 million of working capital (equal to 8% of first-year sales).
- Sales are projected to be $125 million in the first year of operation. Sales are projected to rise a whopping 10% over the next two years, with growth stabilizing at a 5% rate indefinitely thereafter.
- Anttoz’s army of financial analysts estimate that cash costs (COGS, GS&A expenses, etc.) will constitute 50% of revenues.
- New investment in PPE will match depreciation each year, starting at 10% of the initial $75 million investment and growing in tandem with sales thereafter.
- The firm plans to maintain working capital at 8% of the following year’s projected sales.
WACC vs. APV: Example (cont.)

- With Anttoz Widgets Inc. in the 35% tax bracket, FCF would approach $45 million in three years, and grow 5% per year thereafter.

- The required rate of return on the project’s assets, $k_A$, is 20%.

- The project supports a bank loan of $80 million initially with $5 million principal repayments at the end of the first three years of operation, bringing debt outstanding at the end of the third year to $65 million.

- From that point on, the project’s debt capacity will increase by 5% per year, in line with the expected growth of operating cash flows. Because of the firm’s highly leveraged position in the early years, the borrowing rate is 10% initially, falling to 8% once it achieves a stable capital structure (after year 3).
## WACC vs. APV: Example (cont.)

<table>
<thead>
<tr>
<th></th>
<th>Year 0</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>125,000</td>
<td>137,500</td>
<td>151,250</td>
<td>158,813</td>
<td></td>
</tr>
<tr>
<td>Cash Costs</td>
<td>62,500</td>
<td>68,750</td>
<td>75,625</td>
<td>79,406</td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>7,500</td>
<td>8,250</td>
<td>9,075</td>
<td>9,529</td>
<td></td>
</tr>
<tr>
<td>EBIT</td>
<td>55,000</td>
<td>60,500</td>
<td>66,550</td>
<td>69,878</td>
<td></td>
</tr>
<tr>
<td>Corporate Tax</td>
<td>19,250</td>
<td>21,175</td>
<td>23,293</td>
<td>24,457</td>
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<tr>
<td>Earnings Before Interest After Taxes</td>
<td>35,750</td>
<td>39,325</td>
<td>43,258</td>
<td>45,420</td>
<td></td>
</tr>
<tr>
<td>+ Depreciation</td>
<td>7,500</td>
<td>8,250</td>
<td>9,075</td>
<td>9,529</td>
<td></td>
</tr>
<tr>
<td>Gross Cash Flow</td>
<td>43,250</td>
<td>47,575</td>
<td>52,333</td>
<td>54,949</td>
<td></td>
</tr>
<tr>
<td>Investments into</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed Assets</td>
<td>75,000</td>
<td>7,500</td>
<td>8,250</td>
<td>9,075</td>
<td>9,529</td>
</tr>
<tr>
<td>Net Working Capital</td>
<td>10,000</td>
<td>1,000</td>
<td>1,100</td>
<td>605</td>
<td>635</td>
</tr>
<tr>
<td>Unlevered Free Cash Flow</td>
<td>(85,000)</td>
<td>34,750</td>
<td>38,225</td>
<td>42,653</td>
<td>44,785</td>
</tr>
<tr>
<td>Debt Level</td>
<td>80,000</td>
<td>75,000</td>
<td>70,000</td>
<td>65,000</td>
<td>68,250</td>
</tr>
</tbody>
</table>
### WACC vs. APV: Example (cont.)

<table>
<thead>
<tr>
<th></th>
<th>Year 0</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>APV</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unlevered FCF</td>
<td>(85,000)</td>
<td>34,750</td>
<td>38,225</td>
<td>42,653</td>
<td>44,785</td>
</tr>
<tr>
<td>Unlevered Value</td>
<td>252,969</td>
<td>268,813</td>
<td>284,350</td>
<td>298,568</td>
<td>313,496</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Interest Tax Shield</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,800</td>
<td>2,625</td>
<td>2,450</td>
<td>1,820</td>
<td></td>
</tr>
<tr>
<td><strong>Discounted Value of TS</strong></td>
<td>52,135</td>
<td>54,549</td>
<td>57,379</td>
<td>60,667</td>
<td>63,700</td>
</tr>
<tr>
<td><strong>Levered Value</strong></td>
<td>305,104</td>
<td>323,361</td>
<td>341,729</td>
<td>359,234</td>
<td>377,196</td>
</tr>
</tbody>
</table>
### WACC vs. APV: Example (cont.)

<table>
<thead>
<tr>
<th></th>
<th>Year 0</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>APV</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unlevered Value</td>
<td>252,969</td>
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<td>284,350</td>
<td>298,568</td>
<td>313,496</td>
</tr>
<tr>
<td>Discounted Value of Tax Shields</td>
<td>52,135</td>
<td>54,549</td>
<td>57,379</td>
<td>60,667</td>
<td>63,700</td>
</tr>
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<td>323,361</td>
<td>341,729</td>
<td>359,234</td>
<td>377,196</td>
</tr>
<tr>
<td><strong>WACC</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of Debt</td>
<td>80,000</td>
<td>75,000</td>
<td>70,000</td>
<td>65,000</td>
<td>68,250</td>
</tr>
<tr>
<td>Value of Equity</td>
<td>225,104</td>
<td>248,361</td>
<td>271,729</td>
<td>294,234</td>
<td>308,946</td>
</tr>
<tr>
<td>Required Equity Return</td>
<td>21.2%</td>
<td>20.8%</td>
<td>20.5%</td>
<td>20.2%</td>
<td>20.2%</td>
</tr>
<tr>
<td>WACC</td>
<td>17.4%</td>
<td>17.5%</td>
<td>17.6%</td>
<td>17.5%</td>
<td>17.5%</td>
</tr>
<tr>
<td><strong>WACC Discounted FCF</strong></td>
<td>305,104</td>
<td>323,361</td>
<td>341,729</td>
<td>359,234</td>
<td>377,196</td>
</tr>
</tbody>
</table>
The Big Picture: Part II - Valuation

A. Valuation: Free Cash Flow and Risk
- April 1 Lecture: Valuation of Free Cash Flows
- April 3 Case: Ameritrade

B. Valuation: WACC and APV
- April 8 Lecture: WACC and APV 1
- April 10 Lecture: WACC and APV 2
- April 15 Case: Dixon Corporation 1
- April 17 Case: Dixon Corporation 2
- April 24 Case: Diamond Chemicals

C. Project and Company Valuation
- April 29 Lecture: Real Options
- May 1 Case: MW Petroleum Corporation
- May 6 Lecture: Valuing a Company
- May 8 Case: Cooper Industries, Inc.
- May 13 Case: The Southland Corporation
Real Options: Valuing Flexibility

- The “Real Options Approach” assess the value of managerial flexibility in responding to new information.

- Managers have many options to adapt and revise decisions in response to new and unexpected developments.

- Such flexibility is clearly valuable and should be accounted for in the valuation of a project or firm.

Example:
- Often, managers can expand or contract production in response to changes in demand.
- The firm would be less valuable if they had to choose a fixed production level before knowing the level of demand.

Two Steps in Real Options Analysis:

Identification
- Are there real options imbedded in a given project?
- What type of options?
- Are they important?

Valuation
- How do we value the (important) options?
- How do we value different types of options?
- Why can’t we just use NPV?
Step 1: Identifying Real Options

Identifying Real Options

- It is important to identify the options imbedded in a project.

- There are options imbedded in all but the most trivial projects.

- The most crucial skill consists of:
  - Identifying those options that are "significant", if any.
  - Ignoring those that are not.

- Identifying real options takes practice, and sometimes "vision".
Example: Oz Toys’ Expansion Program

- Oz Toys’ management is considering building a new plant to exploit innovations in process technology.
- About three years out, the plant’s capacity may be expanded to allow Oz Toys’ entry into a new market.

<table>
<thead>
<tr>
<th>Oz Toys’ Initial Calculations for Phased Expansion Program</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBIT * (1 - t)</td>
<td>2.2</td>
<td>4.0</td>
<td>-10.0</td>
<td>11.5</td>
<td>13.7</td>
<td>17.4</td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>19.0</td>
<td>21.0</td>
<td>21.0</td>
<td>46.3</td>
<td>48.1</td>
<td>50.0</td>
<td></td>
</tr>
<tr>
<td>CAPX</td>
<td>120.0</td>
<td>8.1</td>
<td>9.5</td>
<td>307.0</td>
<td>16.0</td>
<td>16.3</td>
<td>17.0</td>
</tr>
<tr>
<td>∆NWC</td>
<td>25.0</td>
<td>4.1</td>
<td>5.5</td>
<td>75.0</td>
<td>7.1</td>
<td>8.0</td>
<td>9.7</td>
</tr>
<tr>
<td>FCF</td>
<td>-145.0</td>
<td>9.0</td>
<td>10.0</td>
<td>-371.0</td>
<td>34.7</td>
<td>37.5</td>
<td>43.7</td>
</tr>
<tr>
<td>TV (5% growing perpetuity)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPV (at 12% WACC)</td>
<td>-19.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Is There An Option?

- Two conditions:
  1. News will probably arrive in the future.
  2. When it arrives, the news may affect decisions.

- Identify the uncertainty that managers face:
  - What is the main thing that managers will learn over time?
  - How will they exploit the new information?
  - What decisions will change as a function of the new information?
Oz Toys: Is There An Option?

(1) Oz Toys might learn (or not) about:
• The demand for the current and/or new products.
• The possibility of rivals entering the market.
• Etc.

(2) The information might affect (or not) Oz Toys’ decision:
• Whether or not to undertake expansion phase 1 at all.
• Whether to undertake phase 2 (or subsequent phases…).
• Whether to push one new product or the other.
• Etc.

Identifying Real Options (cont.)

• Look for clues in the project's description: “Phases”, “Strategic investment”, “Scenarios”, …

• Examine the pattern of cash flows and expenditures over time. For instance, large expenditures are likely to be discretionary.

• Taxonomy of frequently encountered options:
  → Growth option
  → Abandonment option
  → Option to expand or contract scale
  → Timing option
  → Option to switch (inputs, outputs, processes, etc.)
Growth Options

- An investment includes a growth option if it allows to undertake a follow on investment, and the decision whether to undertake the follow-on investment will be made later on the basis of new information.

- When valuing such an investment, one should (also) take the value of the growth option into account.

- Such projects are often presented as having “strategic value”.

- Examples:
  - R&D → Developing applications if R&D is successful.
  - Movie Production → Sequel.

Growth Options (cont.)

- Growth options are akin to Call options: You have the option, not the obligation, to get something by incurring a cost.

- Growth options can be “nested”, i.e., series of related choices:
  - Rocky 1 → Rocky 2 → Rocky 3 → …

- Growth options can be very valuable and account for over half of the market value of some industries.
  - Industries with heavy R&D.
  - Industries with multiple project generations (e.g. computers, pharmaceuticals).
  - Industries with multinational operations.
Abandonment Options: The Option to Shut-down

- An investment includes an abandonment option if, under certain circumstances, it may be preferable to shut down current operations permanently and realize the resale value of capital equipment and other assets in secondhand markets.

- Sometimes, abandonment options are hidden in aggregated forecasts: While it may be preferable to continue operations on average, shutting down may be better under some scenarios.

- Abandonment options are akin to Put options: You have the option (but no obligation) to get rid of something and receive a payment (the liquidation value).

Option to Expand or Contract Scale

- If conditions are more favorable than expected, the firm can expand the scale of production or accelerate resource utilization.

- If conditions are less favorable than expected, the firm can contract the scale of operations. In extreme cases, production can temporarily halt and start again.

- Similar to growth and abandonment options.

- Examples:
  - Ability to slow the rate of mineral extraction from a mine.
  - Ability to add a temporary third shift at a factory.
Timing Options: Option to accelerate or decelerate projects

- Retaining some flexibility about the timing of an investment (possibly including "never") can be very valuable.

- Example: A patent's value should account for the timing option, i.e., when buying the patent, you are buying the right to use it whenever you want (during the patent's lifetime).

- Akin to an American call option: You have the option (but not the obligation) to get something at any time by paying a cost.

- Note: Only those investment timing problems for which relevant information is likely to arrive involve "option value".

Time to Build Options (Staged Investment)

- Staging investment as a series of outlays creates the option to abandon the enterprise in midstream if new information is unfavorable.

- Each stage can be viewed as a call option on the value of subsequent stages, and valued as a compound option.

- Important in:
  → all R&D intensive industries, especially pharmaceuticals;
  → long-development capital-intensive projects, e.g., large-scale construction or energy-generating plants;
  → start-up ventures.
Summary of Real Option Examples

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Important in:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option to Defer</td>
<td>Management has opportunity to wait to invest, and can see if markets warrant further investment.</td>
<td>Natural resources extraction, real estate, farming, technology.</td>
</tr>
<tr>
<td>Staged Investment</td>
<td>Staging investment creates the option to revaluate and/or abandon at each stage.</td>
<td>R&amp;D intensive industries, energy generation, start-up ventures.</td>
</tr>
<tr>
<td>Option to alter operating scale</td>
<td>If market conditions change, the firm can expand/contract or temporarily shut down.</td>
<td>Natural resources, fashion, real estate, consumer goods.</td>
</tr>
<tr>
<td>Option to abandon</td>
<td>If market conditions decline, management sells off assets</td>
<td>Capital-intensive industries, new product introductions in uncertain markets.</td>
</tr>
<tr>
<td>Option to switch</td>
<td>If prices or demand change, management can change product mix (product flexibility) or switch inputs (process flexibility)</td>
<td>Companies in volatile markets with shifting preferences, energy companies</td>
</tr>
<tr>
<td>Growth options</td>
<td>An early investment opens up future growth opportunities in the form of new products or processes, access to markets, or strengthening of core capabilities</td>
<td>High tech; industries with multiple product generations (drug companies, computers, strategic acquisitions).</td>
</tr>
<tr>
<td>Multiple Interacting Options</td>
<td>Projects involve a collection of various options—both put and call types. Values can differ from the sum of separate option values because they interact.</td>
<td>Many of the industries discussed above.</td>
</tr>
</tbody>
</table>

Oz Toys: Identifying the Option

- Project’s description refers to two distinct phases
  - Phase 1: New plant
  - Phase 2: Expansion
- Spike in spending: Probably discretionary
  ⇒ Most likely an imbedded growth option!
Practical Issue: Need for Simplifications

- Real projects, especially long-horizon ones, are complex:
  - They often combine assets-in-place and options.
  - Options are often nested.

- Simplifying assumptions are needed:
  - To allow the technical valuation analysis.
  - To keep the model flexible.
  - To keep the model understandable to you and others (especially others involved in the decision process).

Practical issue: Simplifications (cont.)

What should you do?

- Cut the project into pieces corresponding to simple options.
- Search for the primary uncertainty that managers face.
- A simplified model that dominates (is dominated by) the project gives an upper (a lower) bound for the project's value.
  - Examples:
    - Using European rather than American options.
    - Ignoring some of the options.
    - Ignoring some adverse effects of waiting (e.g. possible entry).
Oz Toys: Possible simplifications

- Value phase 1 and phase 2 separately.

- Focus on the option to undertake expansion phase 2 or not.
  → Assume all other options are "negligible".

- Assume that phase 2 is to be undertaken in 2003 or never.
  → Value as a European Call option.
  → Make simplifying assumptions about the distribution of the project's value.

Step 2: Valuing Real Options
Valuation of Real Options

- The tools developed to value financial options (i.e. calls and puts on stocks and other financial assets) can be useful to estimate the value of real options embedded in some projects. → Black-Scholes is often used to value real options.

- **PROBLEM:** Real options are much more complex than financial options.
  → Need to simplify them to fit them into the valuation models for financial options.

- Similar to DCF analysis, the aim is to develop numerical techniques to “keep score” and assist in the decision-making process, not to replace sound business sense.

Start with DCF Analysis:

- Begin by valuing the project as if there was no option involved, i.e., as if all decisions had to be taken immediately.

- This benchmark constitute a lower bound for the project’s value.

- Then introduce flexibility / optionality into the decision making process:
  → NPV<0 does not mean that you will never want to undertake the investment.
  → NPV>0 does not mean that you should go ahead immediately with the invest (nor that you will definitely invest in the future).
Oz Toys: DCF Analysis

- We need to disentangle the cash flows from the two phases.

- This requires making judgments about:
  - Which expenses are discretionary vs. non-discretionary, i.e. which decisions need to be made today and which can be made in the future, after new information has arrived.
  - Which cash inflows/outflows are associated with each phase

- Note: Sometimes it is possible to simply retrieve the disaggregated data used to construct the summary DCF analysis.

Separating Phases 1 and 2

<table>
<thead>
<tr>
<th></th>
<th>DCF Analysis of Phases 1 and 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2000</td>
</tr>
<tr>
<td><strong>Phase 1</strong></td>
<td></td>
</tr>
<tr>
<td>Cash flow</td>
<td>9.0</td>
</tr>
<tr>
<td>Investment</td>
<td>145.0</td>
</tr>
<tr>
<td>TV (5% growing perpetuity)</td>
<td>191.0</td>
</tr>
<tr>
<td>NPV (at 12% WACC)</td>
<td>-3.7</td>
</tr>
<tr>
<td><strong>Phase 2</strong></td>
<td></td>
</tr>
<tr>
<td>Cash flow</td>
<td>23.2</td>
</tr>
<tr>
<td>Investment</td>
<td>382.0</td>
</tr>
<tr>
<td>TV (5% growing perpetuity)</td>
<td>419.5</td>
</tr>
<tr>
<td>NPV (at 12% WACC)</td>
<td>-16.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
</tr>
<tr>
<td>Cash flow</td>
<td>9.0</td>
</tr>
<tr>
<td>Investment</td>
<td>145.0</td>
</tr>
<tr>
<td>TV</td>
<td></td>
</tr>
<tr>
<td>NPV (at 12% WACC)</td>
<td>-19.8</td>
</tr>
</tbody>
</table>
Oz Toys: DCF Analysis (cont.)

- Both phases have negative NPV.
- Phase 2’s NPV is probably largely overstated:
  - Investment ($382M) is likely to be less risky than cash flows.
  - Should probably be using the three-year risk-free rate of 5.5%?

<table>
<thead>
<tr>
<th>DCF Analysis of Phase 2 Discounting the Investment at 5.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 2</td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>Cash flow</td>
</tr>
<tr>
<td>Investment</td>
</tr>
<tr>
<td>TV (5% growing perpetually)</td>
</tr>
<tr>
<td>NPV</td>
</tr>
</tbody>
</table>

Valuing the Option:

- First we recognize the option:
  - **Phase 2 will only be undertaken if it is positive NPV at the time the decision will be made.**
- The strategy is to map the embedded option in our project into a simple financial option and use financial valuation tools to price the option: Black-Scholes formula.
- Oftentimes, this involves making somewhat heroic assumptions about the project!
Black-Scholes formula:

- The Black-Scholes formula

\[\text{Option value} = N(d_1) \times S - N(d_2) \times PV(X)\]

- \(N(d):\) Cumulative normal probability density function
- \(d_1 = \frac{\ln(S/PV(X)) + (\sigma T^{1/2})^2}{(1/2)(\sigma T^{1/2})^2}\)
- \(d_2 = d_1 - (\sigma T^{1/2})\)
- \(S:\) Current stock price
- \(X:\) Exercise price
- \(r:\) Risk-free interest rate
- \(\sigma:\) Standard deviation of stock return
- \(T:\) Time to expiration in years.

Question: What inputs do we need?

Mapping: Project \(\rightarrow\) Call Option

<table>
<thead>
<tr>
<th>Project</th>
<th>Call Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenditure required to acquire the assets</td>
<td>(X) Exercise price</td>
</tr>
<tr>
<td>Value of the operating assets to be acquired</td>
<td>(S) Stock price (price of the underlying asset)</td>
</tr>
<tr>
<td>Length of time the decision may be deferred</td>
<td>(T) Time to expiration</td>
</tr>
<tr>
<td>Riskiness of the operating assets</td>
<td>(\sigma^2) Variance of stock return</td>
</tr>
<tr>
<td>Time value of money</td>
<td>(r) Risk-free rate of return</td>
</tr>
</tbody>
</table>
Oz Toys: The 5 Variables

<table>
<thead>
<tr>
<th></th>
<th>Investment needed in 2003 to obtain the phase 2 assets.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>$382M</td>
</tr>
<tr>
<td>S</td>
<td>PV of phase 2's cash flows.</td>
</tr>
<tr>
<td>T</td>
<td>$255.8</td>
</tr>
<tr>
<td>r</td>
<td>3-year risk-free rate (Check yield curve).</td>
</tr>
<tr>
<td>σ²</td>
<td>Variance per year on phase 2 assets. Can’t get it from DCF spreadsheet.</td>
</tr>
</tbody>
</table>

It seems that phase 2 can be deferred for 3 years (Check with managers).

3 years

r
3-year risk-free rate (Check yield curve).
5.5%

σ²
Variance per year on phase 2 assets. Can’t get it from DCF spreadsheet.
Say 40%

3 years

Phas e 2

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
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<th>2006</th>
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<tr>
<td>Cash flow</td>
<td>23.2</td>
<td>26.0</td>
<td>26.0</td>
<td>26.0</td>
<td>26.0</td>
<td>26.0</td>
<td>26.0</td>
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<tr>
<td>TV</td>
<td></td>
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<tr>
<td>PV (WACC=12%)</td>
<td>255.8</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Practical Issue: What Volatility?

Volatility (σ) cannot be looked up in a table or newspaper.

Note: Even a rough estimate of σ can be useful, e.g., to decide whether to even bother considering the option value.

1. Take an informed guess:
   • Systematic and total risks are correlated: High β projects tend to have a higher σ.
   • The volatility of a diversified portfolio within that class of assets is a lower bound.
   • 20-30% per year is not remarkably high for a single project.
Practical Issue: What Volatility? (cont.)

2. Data:
   • For some industries, historical data on investment returns.
   • Implied volatilities can be computed from quoted option prices for many traded stocks.
   Note: These data need adjustment because equity returns being levered, they are more volatile than the underlying assets.

3. Simulation:
   • Step 1: Build a spreadsheet based (simplified) model of the project’s future cash flows and how they depend on specific items (e.g. commodity prices, interest and exchange rates, etc.)
   • Step 2: Use Monte Carlo simulation to simulate a probability distribution for the project’s returns and infer \( \sigma \).

Black-Scholes Formula

Two numbers suffice:

\[
A = \frac{S \times (1 + r)^T}{X} \quad \text{and} \quad B = \sigma \times \sqrt{T}
\]

- A table that gives the Black-Scholes’ call option value as a fraction of the stock price \( S \) (see table in handout):
Black-Scholes Formula (cont.)

- The number $A$ captures phase 2’s value if the decision could not be delayed (but investment and cash flows still began in 2003).

- Indeed, in that case, $A$ would be phase 2’s Profitability Index:

$$\text{PI} = \frac{\text{PV(cf)}}{\text{PV(inv.)}} = \frac{S}{(1 + r)^T} = A$$

and $A > 1 \iff \text{NPV} > 0$

- The option’s value increases with $A$ (as shown in the table).

Black-Scholes Formula (cont.)

- The number $B$, a.k.a. Cumulative Volatility, is a measure of “how much $S$ can change” between now and the decision time $T$.

- Intuitively, $S$ can change more:
  - $\rightarrow$ when $S$ has more variance per year, i.e., $\sigma$ is large
  - $\rightarrow$ when there is more time for $S$ to change, i.e., $T$ is large

- $B$ captures the value of being able to delay the decision.

Note: When $B=0$, only the project’s NPV matters (whether $A>1$) because either the decision has to be taken now ($T=0$) or it might just as well be taken now as no news will arrive ($\sigma=0$).
Oz Toys: Valuation

\[ A = \frac{S \times (1+r)^T}{X} = \frac{255.8 \times (1.055)^{255.8}}{382} = 0.786 \quad \text{and} \quad B = \sigma \times \sqrt{T} = 0.4 \times \sqrt{3} = 0.693 \]

<table>
<thead>
<tr>
<th>Black-Scholes Formula</th>
<th>0.60</th>
<th>0.65</th>
<th>0.70</th>
<th>0.75</th>
<th>0.80</th>
<th>0.85</th>
<th>0.90</th>
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<tr>
<td>0.50</td>
<td>5.1</td>
<td>6.1</td>
<td>8.2</td>
<td>10.0</td>
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<td>14.2</td>
<td>15.7</td>
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<tr>
<td>0.55</td>
<td>6.6</td>
<td>8.3</td>
<td>10.0</td>
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<tr>
<td>0.60</td>
<td>8.3</td>
<td>10.1</td>
<td>11.9</td>
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<td>18.1</td>
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<tr>
<td>0.65</td>
<td>10.0</td>
<td>11.9</td>
<td>13.8</td>
<td>15.8</td>
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<tr>
<td>0.70</td>
<td>11.9</td>
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<td>19.8</td>
<td>22.1</td>
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<td>0.75</td>
<td>13.7</td>
<td>15.8</td>
<td>17.8</td>
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<td>25.6</td>
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<tr>
<td>0.80</td>
<td>15.7</td>
<td>17.7</td>
<td>19.8</td>
<td>21.8</td>
<td>23.7</td>
<td>26.0</td>
<td>27.5</td>
</tr>
</tbody>
</table>

• The value of phase 2 is (roughly)
  \[ V_2 = 19\% \times S \times 0.19 \times 255.8 = 48.6 \text{M} \]

• The value of the expansion program is
  \[ V_1 + V_2 = -3.7 + 48.6 = 44.9 \text{M} \]

**Interpretation:**

- Since we use simplified models, the results need to be taken with a grain of salt and interpreted.

- Put complexity back into the model with:
  → Sensitivity analysis
  → Conditioning and qualifying of inferences

- Iterative process.

- Helps you identify the main levers of the project, and where you need to gather more data or fine tune the analysis.
Real Options

Katharina Lewellen
Finance Theory II
April 28, 2003
Real options

- Managers have many options to adapt and revise decisions in response to unexpected developments.

- Such flexibility is clearly valuable and should be accounted for in the valuation of a project or firm.
Real options, cont.

Imbedded options
- Follow-up investments
- Option to abandon the project
- Option to wait before investing
- Option to expand / change production methods

Key elements
- Information will arrive in the future
- Decisions can be made after receiving this information
Our plan

Last class
- Real options: basic intuition
- Simple DCF analysis of real options (decision trees)

Today
- Review of option pricing
  - Why doesn’t simple DCF work quite well?
- Identifying real options
- Valuing real options using Black Scholes
1. Review of option pricing
Real options and financial options

**Option Definition**  The *right* (but not the obligation), to buy/sell an underlying asset at a price (the exercise price) that **may be** different than the market price.

Financial Options          Vs.          Real Options:

Options on stocks, stock indices, foreign exchange, gold, silver, wheat, etc.  Not traded on exchange.  Underlying asset is something other than a security
Pricing of a call option on stock

The challenge is to find the value of the call option today
Pricing of a call option on stock

- Consider the following strategy:
  - Borrow money (or sell a bond with face value of B)
  - Buy a N shares of stock

- Choose N and B so that the payoffs from the portfolio = option payoffs

\[ 10 = -B + N \times 120 \]

\[ 0 = -B + N \times 80 \]

\[ B = 20 \]
\[ N = 0.25 \]
Pricing of a call option on stock

- Our stock / bond portfolio has exactly the *same payoff* as the option
  - So, the option and the portfolio must have the *same value today*
  - Otherwise: arbitrage opportunity

- What is the value of the portfolio today (assume risk-free rate = 4%)?

\[-B / (1+r) + N * S_0 = -20 / 1.04 + 0.25 * 100 = 5.77\]

- We just priced the option. *Option value = $5.77.*
Why standard DCF doesn’t work very well?

- Let’s value our option using standard DCF
  - What discount rate should we use?
  - Let’s try the required return on stock $E[R_S]$

\[
\begin{align*}
S_0 &= 100 \\
p &= 0.8 \\
S_1 &= 120 \\
p &= 0.2 \\
S_1 &= 80 \\
E[S_1] &= 112 \implies E[R_S] &= 12\%
\end{align*}
\]
Why standard DCF doesn’t work very well?

- DCF gives us the following option value:

\[
\frac{(0.8 \times 10 + 0.2 \times 0)}{1.12} = \$7.14 \neq \$5.77
\]

What’s wrong?

- Discount rate of 12% is too low => the option is riskier than the underlying stock

Why?

- Option is a levered position in a stock.
  - Recall the analogy with firms’ financial leverage: Higher financial leverage => higher equity betas and equity returns.
**Option is a levered position in a stock**

- Recall our replicating portfolio: Borrow $B/(1+r)$ and buy $N$ shares of stock
  - Suppose that stock beta = 1 and market premium = 8%
    - Note that this works. CAPM: $12\% = 4\% + 1 \times 8\%$

- What is option beta?

\[
\beta_{\text{option}} = w_{\text{bond}} \times \beta_{\text{bond}} + w_{\text{stock}} \times \beta_{\text{stock}} = 4.33
\]

\[
0 \quad 25/5.77 \times 1
\]

- So, the required return on the option is $38\% = 4\% + 4.33 \times 8\%$
- And the option value is again: $\$5.77 = 8 / 1.38$
How about multiple periods?

- In principle, we can value the option the same way as before
  - Start at time T=2 and move backwards

- But several things change at each node:
  - Replicating portfolio, option beta, discount rate

- This can become quite tedious
- That’s where option pricing models such as **Black-Scholes** come in.
Options valuation techniques

- "Dynamic" DCF (decision trees)
  - Recall our "Handheld PC" and "Copper Mine" examples
  - *Approximation* used for real-options problems
  - Not an exact answer because of *problems with discounting*

- Binomial model
  - Similar to our one-period example from today’s class
  - Requires more computations than Black-Scholes
  - Can be useful when Black-Scholes doesn’t work very well

- Black-Scholes
  - We will focus on this model from now on
Black-Scholes formula

- Black-Scholes formula relies on the same valuation principles as the binomial model (replicating portfolios, no arbitrage)

\[
\text{Option value} = N(d_1) \times S - N(d_2) \times PV(X)
\]

- Note the similarities to the one-period binomial model

\[
\text{Option value} = N \times S - PV(B)
\]

- **N(d):** Cumulative normal probability density function

  \[
  d_1 = \ln\left[\frac{S}{PV(X)}\right] + \left(\sigma T^{1/2}\right)/2 \quad d_2 = d_1 - \left(\sigma T^{1/2}\right)
  \]

- **S** = Current stock price
- **X** = Exercise price
- **r** = Risk-free interest rate
- **T** = Time to maturity in years.
- **\sigma** = Standard deviation of stock return
Recall “Handheld PC” example

Model A turns out well =>
good news for Model B

Model A turns out badly =>
bad news for Model B

Model B NPV (t=3) = 16,557
⇒ go for it

Model B NPV (t=3) = -21,148
⇒ drop it

<table>
<thead>
<tr>
<th>Model B value at t=0</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Static&quot; NPV</td>
</tr>
<tr>
<td>[(16,557 - 21,148)/2]/1.12³</td>
</tr>
<tr>
<td>&quot;Dynamic&quot; NPV</td>
</tr>
<tr>
<td>[(16,557 + 0)/2]/1.12³</td>
</tr>
<tr>
<td>Option pricing</td>
</tr>
<tr>
<td>[(16,557 + 0)/2]/???³</td>
</tr>
</tbody>
</table>
2. Identifying Real Options
Two Issues with Real Options

Identification
- Are there real options imbedded in this project?
- What type of options?

Valuation
- How do we value options?
- How do we value different types of options?
- Can’t we just use NPV?
Identifying Real Options

- It is important to identify the options imbedded in a project.

- There are options imbedded in all but the most trivial projects.

- All the art consists in:
  - Identifying those that are “significant”, if any
  - Ignoring those that are not

- Identifying real options takes practice, and sometimes “vision”.
Identifying Real Options (cont.)

- Look for clues in the project’s description: “Phases”, “Strategic investment”, “Scenarios”, …

- Examine the pattern of cash flows and expenditures over time. For instance, large expenditures are likely to be discretionary.

- Taxonomy of frequently encountered options:
  - Growth option
  - Abandonment option
  - Option to expand or contract scale
  - Timing
  - Option to switch (inputs, outputs, processes, etc.)
Is There An Option?

- Two conditions:
  1. News will possibly arrive in the future;
  2. When it arrives, the news may affect decisions.

- Search for the uncertainty that managers face:
  - What is the main thing that managers will learn over time?
  - How will they exploit that information?
Oz Toys’ Expansion Program

- Oz Toys’ management is considering building a new plant to exploit innovations in process technology.

- About three years out, the plant’s capacity may be expanded to allow Oz Toys’ entry into two new markets.

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
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<td>EBIT * (1-t)</td>
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<td>17.4</td>
<td></td>
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<td>Depreciation</td>
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<td>21.0</td>
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<td>48.1</td>
<td>50.0</td>
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<td>307.0</td>
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<td>16.3</td>
<td>17.0</td>
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<td></td>
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<td>610.5</td>
</tr>
<tr>
<td>NPV (WACC=12%)</td>
<td>-19.8</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Oz Toys: Is There An Option?

(1) Oz Toys might learn (or not) about:
- The demand for the current and/or new products
- The possibility of rivals entering the market
- Etc.

(2) The information might affect (or not) Oz Toys’ decision:
- Whether or not to undertake expansion phase 1 at all
- Whether to undertake phase 2 (or even phase 3, …)
- Whether to push one new product or the other
- Etc.
Oz Toys: Identifying the Option

- Project’s description refers to two distinct phases
  - Phase 1: New plant
  - Phase 2: Expansion

- Spike in spending: Probably discretionary

- Possibly, an imbedded growth option
Practical Issue #1: Simplifications

- Real projects, especially long-horizon ones, are complex:
  - They often combine assets-in-place and options.
  - Options are nested.

- Simplifying assumptions are needed:
  - To allow the technical valuation analysis
  - To keep the model flexible
  - To keep the model understandable to you and others (especially others involved in the decision process)
Practical Issue #1: Simplifications (cont.)

- Cut the project into pieces corresponding to simple options.

- Search for the primary uncertainty that managers face

- A simplified model that dominates (is dominated) by the project gives an upper (a lower) bound for the project’s value, e.g.:
  - Using European rather than American options
  - Ignoring some of the options
  - Ignoring some adverse effects of waiting (e.g. possible entry)
Oz Toys: Simplifications

- Value phase 1 and phase 2 separately.

- Focus on the option to undertake expansion phase 2 or not.
  - Assume all other options are “negligible”

- Assume that phase 2 is to be undertaken in 2003 or never.

- European Call option
3. Valuing Real Options
Valuation of Real Options

- Tools developed to value financial options can be useful to estimate the value of real options embedded in some projects.

- Real options are much more complex than financial options.

- The aim here is to develop numerical techniques to “keep score” and assist in the decision-making process, not provide a recipe to replace sound business sense.
Options vs. DCF

- The real options approach is often presented as an alternative to DCF.

- In fact, the real options’ approach does not contradict DCF: It is a particular form that DCF takes for certain types of investments.

- Recall that option valuation techniques were developed because discounting is difficult

  - I.e., due to the option, one should not use the same discount rate (e.g. WACC) for all cash flows.
Options vs. DCF (cont.)

- **DCF method:**
  - “expected scenario” of cash flows,
  - discount the expected cash flows

- This is perfectly fine as long as:
  - expected cash flows are estimated properly
  - discount rates are estimated properly

- Precisely, it is complex to account for options in estimating:
  - expected cash flow
  - discount rates
Start with the “static” DCF Analysis

- Begin by valuing the project as if there was no option involved
  - Pretend that the investment decision must be taken *immediately*.

- This benchmark constitute a *lower bound* for the project’s value.
  - NPV<0 does not mean that you will never want to undertake the investment.
  - NPV>0 does not mean that you should go ahead immediately with the invest (nor that you will definitely invest in the future).
Oz Toys: DCF Analysis

- Disentangling the two phases.

- Requires making judgments about:
  - Which expenses are discretionary vs. non-discretionary
  - Which cash inflows/outflows are associated with each phase

- Note: Sometimes, simply retrieve disaggregated data used to construct the summary DCF analysis.
### Oz Toys: Valuing Phases 1 and 2

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
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<tbody>
<tr>
<td><strong>Phase 1</strong></td>
<td></td>
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<tr>
<td>Cash flow</td>
<td>9.0</td>
<td>10.0</td>
<td>11.0</td>
<td>11.6</td>
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<tr>
<td>TV (5% growing perpetuity)</td>
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<tr>
<td><strong>Phase 2</strong></td>
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<td>419.5</td>
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<td>TV</td>
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<td>610.5</td>
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</tr>
</tbody>
</table>
Oz Toys: DCF Analysis (cont.)

- Both phases have negative NPV

- Phase 2’s NPV is probably largely overstated:
  - Investment ($382M) is likely to be less risky than cash flows.
  - Using the three-year risk-free rate of 5.5%

<table>
<thead>
<tr>
<th>DCF Analysis of Phase 2 Discounting the Investment at 5.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Phase 2</td>
</tr>
<tr>
<td>Cash flow</td>
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<td>TV (5% growing perpetuity)</td>
</tr>
<tr>
<td>NPV (WACC=12%)</td>
</tr>
</tbody>
</table>
Valuing the Option

- The strategy is to map the project into a simple option and use financial valuation tools to price the option: Black-Scholes formula.

- Oftentimes, this involves making somewhat heroic assumptions about the project.
Mapping: Project $\rightarrow$ Call Option

<table>
<thead>
<tr>
<th>Project</th>
<th>Call Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenditure required to acquire the assets</td>
<td>$X$</td>
</tr>
<tr>
<td></td>
<td>Exercise price</td>
</tr>
<tr>
<td>Value of the operating assets to be acquired</td>
<td>$S$</td>
</tr>
<tr>
<td></td>
<td>Stock price (price of the underlying asset)</td>
</tr>
<tr>
<td>Length of time the decision may be deferred</td>
<td>$T$</td>
</tr>
<tr>
<td></td>
<td>Time to expiration</td>
</tr>
<tr>
<td>Riskiness of the operating assets</td>
<td>$\sigma^2$</td>
</tr>
<tr>
<td></td>
<td>Variance of stock return</td>
</tr>
<tr>
<td>Time value of money</td>
<td>$r$</td>
</tr>
<tr>
<td></td>
<td>Risk-free rate of return</td>
</tr>
</tbody>
</table>
## Oz Toys: The 5 Variables

<table>
<thead>
<tr>
<th>$\chi$</th>
<th>Investment needed in 2003 to obtain the phase 2 assets.</th>
<th>$382M$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S$</td>
<td>PV of phase 2’s cash flows.</td>
<td>$255.8$</td>
</tr>
<tr>
<td>$T$</td>
<td>It seems that phase 2 can be deferred for 3 years (Check with managers).</td>
<td>$3$ years</td>
</tr>
<tr>
<td>$r$</td>
<td>3-year risk-free rate (Check yield curve).</td>
<td>$5.5%$</td>
</tr>
<tr>
<td>$\sigma^2$</td>
<td>Variance per year on phase 2 assets. Can’t get it from DCF spreadsheet.</td>
<td>Say $40%$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase 2</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
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<tbody>
<tr>
<td>Cash flow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PV (WACC=12%)</td>
<td>255.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Practical Issue #2: What Volatility?

- Volatility ($\sigma$) cannot be looked up in a table or newspaper.
  - Note: Even a rough estimate of $\sigma$ can be useful, e.g., to decide whether to even bother considering the option value.

1. Take an informed guess:

- Systematic and total risks are correlated: High $\beta$ projects tend to have a higher $\sigma$.

- The volatility of a diversified portfolio within that class of assets is a lower bound.

- 20-30% per year is not remarkably high for a single project.
Practical Issue #2: What Volatility? (cont.)

2. Data:

- For some industries, historical data on investment returns.
- Implied volatilities can be computed from quoted option prices for many traded stocks.
  
  Note: These data need adjustment because equity returns being levered, they are more volatile than the underlying assets.
Practical Issue #2: What Volatility? (cont.)

3. Simulation:

- Step 1: Build a spread-sheet based (simplified) model of the project’s future cash flows
  - Model how CFs depend on specific items (e.g. commodity prices, interest and exchange rates, etc.)

- Step 2: Use Monte Carlo simulation to simulate a probability distribution for the project’s returns and infer \( \sigma \).
Black-Scholes Formula

- Two numbers suffice:

\[
A = \frac{S \times (1+r)^T}{X} \quad \text{and} \quad B = \sigma \times \sqrt{T}
\]

- A table that gives the Black-Scholes’ call option value as a fraction of the stock price S (see handout)

<table>
<thead>
<tr>
<th>Black-Scholes Formula: Columns: A</th>
<th>Lines: B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.60</td>
<td>0.65</td>
</tr>
<tr>
<td>0.50</td>
<td>5.1</td>
</tr>
<tr>
<td>0.55</td>
<td>6.6</td>
</tr>
<tr>
<td>0.60</td>
<td>8.3</td>
</tr>
<tr>
<td>0.65</td>
<td>10.0</td>
</tr>
<tr>
<td>0.70</td>
<td>11.9</td>
</tr>
<tr>
<td>0.75</td>
<td>13.7</td>
</tr>
</tbody>
</table>
Black-Scholes Formula (cont.)

- The number $A$ captures phase 2’s value if the decision could not be delayed (but investment and cash flows still began in 2003).

- Indeed, in that case, $A$ would be phase 2’s *Profitability Index*:

\[
PI = \frac{PV(cf)}{PV(inv.)} = \frac{S}{\frac{X}{(1+r)^T}} = A
\]

and $A > 1 \iff NPV > 0$

- The option’s value increases with $A$ (as shown in the table).
Black-Scholes Formula (cont.)

- The number $B$, *Cumulative Volatility*, is a measure of “how much $S$ can change” between now and the decision time $T$.

- Intuitively, $S$ can change more:
  - when $S$ has more variance per year, i.e., $\sigma$ is large
  - when there is more time for $S$ to change, i.e., $T$ is large

- $B$ captures the value of being able to delay the decision.

**Note:** When $B=0$, only the project’s NPV matters (whether $A>1$) because either the decision has to be taken now ($T=0$) or it might just as well be taken now as no news will arrive ($\sigma =0$).
Oz Toys: Valuation

\[ A = \frac{S \cdot (1+r)^T}{X} = \frac{255.8 \cdot (1.055)^3}{382} = 0.786 \quad \text{and} \quad B = \sigma \cdot \sqrt{T} = 0.4 \cdot \sqrt{3} = 0.693 \]

<table>
<thead>
<tr>
<th>Black-Scholes Formula:</th>
<th>Columns: A</th>
<th>Lines: B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.60</td>
<td>0.65</td>
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<td>11.9</td>
<td>13.8</td>
</tr>
<tr>
<td>0.75</td>
<td>13.7</td>
<td>15.8</td>
</tr>
</tbody>
</table>

- The value of phase 2 is (roughly):  \( V_2 = 19\% \times S = 0.19 \times 255.8 = $48.6M \)
- The value of the expansion program is:  \( V_1 + V_2 = -3.7 + 48.6 = $44.9M \)
Practical Issue #3: Checking the Model

- Formal option pricing models make distributional assumptions.

- Approach 1: Try and find a model that is close to your idea of the real distribution (More and more are available).

- Approach 2: Determine the direction in which the model biases the analysis, and use the result as an upper or lower bound.

- Approach 3: Simulate the project as a complex decision tree and solve by brute force with a computer (i.e., not analytically).
Practical Issue #4: Interpretation

- Since we use simplified models, the results need to be taken with a grain of salt and interpreted.

- Put complexity back into the model with:
  - Sensitivity analysis
  - Conditioning and qualifying of inferences

- Iterative process.

- Helps you identify the main levers of the project, and where you need to gather more data or fine tune the analysis.
Valuing Companies

The Big Picture: Part II - Valuation

A. Valuation: Free Cash Flow and Risk
   • April 1        Lecture: Valuation of Free Cash Flows
   • April 3        Case: Ameritrade

B. Valuation: WACC and APV
   • April 8        Lecture: WACC and APV 1
   • April 10       Lecture: WACC and APV 2
   • April 15       Case: Dixon Corporation 1
   • April 17       Case: Dixon Corporation 2
   • April 24       Case: Diamond Chemicals

C. Project and Company Valuation
   • April 29       Lecture: Real Options
   • May 1          Case: MW Petroleum Corporation
   • May 6          Lecture: Valuing a Company
   • May 8          Case: Cooper Industries, Inc.
   • May 13         Case: The Southland Corporation
Two Complementary Valuation Methods:

1) Discounted Cash Flow Analysis
   → WACC
   → APV

2) Comparables
   → Cash flow based Value Multiples
   → Cash flow based Price Multiples
   → Asset-based Multiples

Discounted Cash Flow Analysis

• WACC method:
  → Forecast expected FCF
  → Estimate WACC
  → Compute PV

• APV method:
  → Forecast expected FCF
  → Estimate $k_a$
  → Compute PV
  → Add PV(Tax Shield)
Terminal Values

- In valuing long-lived projects or ongoing businesses, we cannot forecast every year of cash flow forever.

- Forecast FCF until it is reasonable to think that the project or company is in “steady state.”

- Typically, assume:
  → either the company is liquidated;
  → or FCF is a growing, flat, or declining perpetuity;

- Note: The forecast horizon will depend on firm and industry.

Terminal Value in Liquidation:

1) Salvage value (SV):
   - CF that the firm receives from liquidating its assets

   \[ SV = \text{Liquidation price} - \text{Liquidation costs} \]

   - The firm is taxed on (SV – PPE) so that overall it gets

   \[ SV(1 - t) + t \times \text{PPE} \]

2) Net Working Capital
   - Recouped NWC at project end (i.e., last \( \Delta \text{NWC} = \text{last NWC} \)
Remarks on Liquidation Values:

- In principle, you would like NWC’s actual value, not book value.
- These might differ for several reasons:
  - cannot recoup the A/R fully
  - Inventory may sell above or below book value
  - etc.
- Note that differences between actual and book value of NWC will have tax implications.
- Liquidation value tends to underestimate TV unless liquidation is likely. Useful as a lower bound.

Terminal Value as Perpetuity:

- No-growth perpetuity: PV in year t of a flat perpetuity starting in year (t+1) with first payment C, and discount rate k is C/k.

\[ TV = \frac{FCF_{t+1}}{k} \]

- For a no-growth firm, we often assume (for simplicity)

\[ FCF = EBIT(1-t) + \text{Depreciation} - \text{CAPX} - \Delta NWC \]

\[ TV = \frac{(1-t)EBIT_{t+1}}{k} \]
Terminal Value as Growing Perpetuity:

- PV in year t of a perpetuity starting in year (t + 1) with first payment C, growth rate g, and discount rate k is $C/(k - g)$

$$TV = \frac{FCF_{t+1}}{k - g}$$

- For a growing perpetuity, we often assume (for simplicity)

$$FCF = EBIT(1-t) + \text{Depreciation} - \text{CAPX} - \Delta NWC$$

$$\Delta N = -g*NA \text{ prior year}$$

$$TV = \frac{[(1-t)EBIT_{t+1} - g*NA_t]}{(k - g)}$$

Remarks

- Growing perpetuity – assumptions:
  - Net assets grow at the same rate as profits.
  - $\Delta NA$ is a good measure of replacement costs.

- Don’t forget to discount TV further to get PVTV.

- In WACC method, $k=WACC$.

- IN APV method, $k=k_d$ for FCF and appropriate rate for TS.
When is Growth Valuable?

Need to compare the terminal value with growth to the value without growth:

$$TV\ (\text{with growth}) > TV\ (\text{w/o growth})$$

$$\frac{(1+g)\cdot EBIT(1-t) - g\cdot NA}{k-g} > \frac{EBIT(1-t)}{k}$$

$$EBIT^*(1-t) - k^*NA > 0$$

Economic Value Added (EVA):

$$EVA = EBIT^*(1-t) - k^*NA$$

**Intuition:** Growth is good when the cost of increasing NA is more than compensated by the capitalized increase in $EBIT^*(1-t)$. 
EVA: Some remarks

- EVA is a snapshot measure, disregards future cash flow implications.

Use EVA as...
- ... a simple measure to determine whether the business is generating value and whether growth is enhancing value.
- ... as a way of setting goals to enhance value.

Beware of EVA for...
- ... young companies.
- ... companies in rapidly changing business environments.
- ... companies where book values are not accurate measures of replacement costs.

DCF Analysis: Pros and Cons

Strengths
- CF comes from specific forecasts and assumptions.
- Can see impact of changes in strategies.
- Valuation tied to underlying fundamentals.

Weaknesses
- CF only as good as your forecasts/assumptions.
- Might "forget something".
- Need to forecast managerial behavior (unless you’re in control).
- Need to estimate the discount rate using a theory (e.g. CAPM) that may be incorrect or imprecise in this particular case.
Valuation by Multiples:

- Assess the firm’s value based on that of publicly traded comparables.

- **Cash-flow-based Value multiples:**
  - MV of firm/Earnings, MV of firm /EBITDA, MV of firm /FCF

- **Cash-flow-based Price multiples:**
  - Price/Earnings (P/E), Price/EBITDA, Price/FCF

- **Asset-based multiples:**
  - MV of firm/BV of assets, MV of equity/BV of equity

Procedure

- **Hope:** Firms in the same business should have similar multiples (e.g. P/E).

- **STEP 1:** Identify firms in same business as the firm you want to value.

- **STEP 2:** Calculate P/E ratio for comps and come up with an estimate of P/E for the firm you want to value (e.g. take the average of comps’ P/E).

- **STEP 3:** Multiply the estimated P/E by the actual Net Income of the firm you want to value.
Remarks

• For firms with no earnings or limited asset base (e.g. hi-tech),
  → price-to-patents multiples,
  → price-to-subscribers multiples,
  → or even price-to-PhD. multiples!

• For transactions, can also use multiples for comparable transactions (e.g. similar takeovers).

• Multiples based on equity value (or stock price, e.g., P/E) as opposed to total firm value ignore effect of leverage on the cost of equity (or assume the firms have similar leverage) => Beware if comps have very different leverage.

Motivation for Multiples?

• If the firm’s actual FCF are a perpetuity:
  • MV firm = FCF/(WACC-g) => MV firm/FCF = 1/(WACC-g)

  ⇒ Comps will have a similar MV firm/FCF provided:
  → their FCFs are also a perpetuity
  → they have the same WACC (requires similar D/(D+E))
  → they are growing at a similar rate

• Since these are rough approximations (at best), you may want to check if using different multiples give you similar answers. If not, find out why not.
## Comparables: Pros and Cons

### Pros:
- Incorporates a lot of information from other valuations in a simple way.
- Embodies market consensus about discount rate and growth rate.
- Free-ride on market’s information.
- Can provide discipline in valuation process by ensuring that your valuation is in line with other valuations.

### Cons:
- Implicitly assumes all companies are alike in growth rates, cost of capital, and business composition. Hard to find true comps.
- Hard time incorporating firm specific information. Particularly problematic if operating changes are going to be implemented.
- Accounting differences, particularly with earnings and equity-based measures. Multiples of FCF and EBITDA preferable for this reason.
- Book values can vary across firms depending on age of PPE.
- If everyone uses comps, who actually does fundamental analysis?

## APPENDIX
Example

- You are considering the acquisition of XYZ Enterprises. XYZ’s balance sheet looks like this as of today (year 0).

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current assets</td>
<td>50</td>
</tr>
<tr>
<td>Plant</td>
<td>30</td>
</tr>
<tr>
<td>Net worth</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

- Projections:

<table>
<thead>
<tr>
<th>Year</th>
<th>Sales</th>
<th>EBIT</th>
<th>NWC</th>
<th>Depreciation</th>
<th>CAPX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>200</td>
<td>20</td>
<td>33</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Year 2</td>
<td>217</td>
<td>22</td>
<td>37</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Year 3</td>
<td>239</td>
<td>25</td>
<td>41</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Year 4</td>
<td>270</td>
<td>26</td>
<td>44</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>Year 5</td>
<td>293</td>
<td>30</td>
<td>48</td>
<td>8</td>
<td>30</td>
</tr>
</tbody>
</table>

Example (cont.)

- Assuming tax rate \( t = 34\% \) and WACC = 13%, what is the value of XYZ’s stock under the following assumptions past year 5:

1) XYZ is liquidated after year 5 (assuming zero salvage value).

2) Sales growth slows to \( g = 5\% \) and EBIT/Sales remains about 10%.

3) Sales stop growing (\( g = 0 \)), and EBIT/Sales remains around 10%.

4) Sales growth slows to \( g = 5\% \), and EBIT/Sales drop to 5%.

5) Sales stop growing (\( g = 0 \)), and EBIT/Sales drop to 5%.
Example (cont.)

Start by estimating FCF over 5 years:
- NWC(year 0) = Current assets - current liabs = 50-20=30

\[
FCF = EBIT(1 - t) + \text{Dep} - \text{CAPX} - \Delta\text{NWC}
\]

<table>
<thead>
<tr>
<th>Year 0</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBIT</td>
<td>20</td>
<td>22</td>
<td>25</td>
<td>26</td>
<td>30</td>
</tr>
<tr>
<td>EBIT(1-t)</td>
<td>13.2</td>
<td>14.52</td>
<td>16.5</td>
<td>17.16</td>
<td>19.8</td>
</tr>
<tr>
<td>NWC</td>
<td>30</td>
<td>33</td>
<td>37</td>
<td>41</td>
<td>44</td>
</tr>
<tr>
<td>\Delta\text{NWC}</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Depreciation</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>CAPX</td>
<td>10</td>
<td>10</td>
<td>15</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>FCF</td>
<td>5.2</td>
<td>5.52</td>
<td>3.5</td>
<td>15.16</td>
<td>3.8</td>
</tr>
<tr>
<td>PV @ 13%</td>
<td>22.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Finance Theory II (15.402) – Spring 2003 – Dirk Jenter

Example (cont.)

1) Liquidation value (LV)
\[ t^*\text{PPE(year 5)} + \text{NWC(year 5)} \]

\[
\text{PPE(year 5)} = \text{PPE(year 0)} + \text{all CAPX} - \text{all Dep from year 0 to 5}
\]

\[
\Rightarrow \text{PPE} = 50 + (10+10+15+6+20)-(5+5+6+7+8) = 80
\]

\[
\Rightarrow \text{PPE} * t = 80 * 34\% = 27.2
\]

\[
\text{LV} = 27.2 + 48 = 75.2 \Rightarrow \text{PVLV} = 75.2/(1.13)^5 = 40.8
\]

Firm value = 22.7 + 40.8 = 63.5
Equity value = Firm value - MV of Debt = 63.5 - 30 = 33.5
Example (cont.)

For 2) to 5), we need EBIT (year 6) and NA (year 5) to apply

$$\text{EBIT(year 6)} = \frac{\text{fraction } \alpha \text{ of Sales(year 6)}}{\text{EBIT(year 6)(1 - t) - g*NA(year 5))}}[/k - g]$$

$$\text{EBIT(year 6)} = \frac{\alpha *(1 + g) * \text{Sales(year 5)}}{\alpha *(1 + g) * 293}$$

$$\text{NA(year 5)} = \text{NA(year 0) + all CAPX - all Dep + all } \Delta \text{NWC from 0 to 5}$$

$$= (100-20) + (10+10+15+6+20) - (5+5+6+7+8) + (3+4+4+3+4)$$

$$= 128$$

$$\text{TV} = [\alpha *(1 + g) * 293 * (1-34\%) - g * 128] / (13\%-g) \text{ and } \text{PVTV} = \frac{\text{TV}}{1.13}$$

<table>
<thead>
<tr>
<th>Firm</th>
<th>Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2)</td>
<td>87.0</td>
</tr>
<tr>
<td>3)</td>
<td>73.4</td>
</tr>
<tr>
<td>4)</td>
<td>18.2</td>
</tr>
<tr>
<td>5)</td>
<td>33.1</td>
</tr>
</tbody>
</table>

Example (cont.)

<table>
<thead>
<tr>
<th></th>
<th>α</th>
<th>g</th>
<th>TV</th>
<th>PVTV</th>
<th>Firm</th>
<th>Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2)</td>
<td>10%</td>
<td>5%</td>
<td>173.8</td>
<td>94.3</td>
<td>117.0</td>
<td>87.0</td>
</tr>
<tr>
<td>3)</td>
<td>10%</td>
<td>0%</td>
<td>148.8</td>
<td>80.7</td>
<td>103.4</td>
<td>73.4</td>
</tr>
<tr>
<td>4)</td>
<td>5%</td>
<td>5%</td>
<td>46.9</td>
<td>25.5</td>
<td>48.2</td>
<td>18.2</td>
</tr>
<tr>
<td>5)</td>
<td>5%</td>
<td>0%</td>
<td>74.4</td>
<td>40.4</td>
<td>63.1</td>
<td>33.1</td>
</tr>
</tbody>
</table>
Valuing companies

- Familiar valuation methods
  - Discounted Cash Flow Analysis
  - Comparables
  - Real Options

- Some new issues
  - Do we value assets or equity?
  - Terminal values (liquidation, going concern)
  - Minority interests, controlling interests
DCF Analysis

- **WACC method:**
  - Forecast expected FCF
  - Estimate WACC
  - Compute PV

- **APV method:**
  - Forecast expected FCF
  - Estimate $k_A$
  - Compute PV
  - Add PV(Tax Shield)
Value Assets or Equity?

- DCF methods give you the value of the whole firm (D + E) or *Enterprise Value*.
  - E.g., you are founding a new firm: you will receive D from creditors and E from shareholders.

- Often, you need to value the *Equity Value* in an existing firm
  - E.g., M&A, IPOs
  - You need to subtract the value of its existing debt D

- Also, need to add the value of control when valuing a controlling equity position (more on this later).
Terminal Values

- In valuing long-lived projects or ongoing businesses, we don’t typically forecast every year of cash flow forever.

- Forecast FCF until it is reasonable (or best guess) to think that the project or company is in “steady state.”

- Typically, assume:
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1) Salvage value (SV):
   - CF that the firm receives from liquidating its assets

   \[ SV = \text{Liquidation price} - \text{Liquidation costs} \]

   - The firm is taxed on (SV – PPE) so that overall it gets

   \[ SV*(1- t) + t*PPE \]

2) Net Working Capital
   - Recouped NWC at project end (i.e., last \( \Delta \text{NWC} = \text{last WC} \)
Remarks

- In principle, you would like NWC’s actual value, not book value.

- These might differ for instance:
  - cannot recoup full A/R,
  - Inventory sells over or below book value
  - etc.

- Liquidation value tends to underestimate TV unless liquidation is likely. Useful as a lower bound.
Terminal Value as Perpetuity

- No-growth perpetuity

\[ TV = \frac{FCF_{T+1}}{k} \]

- For a no-growth firm, we can assume (for simplicity)

\[ FCF = EBIT(1-t) + \text{Depreciation} - \text{CAPX} - \Delta NWC \]

\[ TV = \frac{EBIT(1-t)_{T+1}}{k} \]
Terminal Value as Growing Perpetuity

- PV in year t of a perpetuity growing at a rate g

\[ TV = \frac{FCF_{T+1}}{(k - g)} \]

- For a growing perpetuity, we can assume (for simplicity)

\[ FCF = EBIT(1-t) + \text{Depreciation} - \text{CAPX} - \Delta NWC \]

\[ -\Delta NA = -g*NA_{\text{prior year}} \]

\[ TV = \frac{[EBIT(1-t)_{T+1} - g*NA_{T}]}{(1+g)EBIT(1-t)_{T}} / (k - g) \]
Terminal Value as Perpetuity (Summary)

\[
\begin{align*}
&T \\
&T+1 \quad \ldots \\
TV \\
\downarrow \\
\frac{FCF_{T+1}}{k} & \quad \frac{EBIT(t-1)}{k - g} \\
\downarrow \\
\frac{FCF_{T+1}}{(k - g)} & \quad EBIT(t-1) - \Delta NA \\
\downarrow \\
& \quad g*NA_T
\end{align*}
\]

No growth

Growth @ g
Remarks

- Growing perpetuity - assumptions
  - Net assets grow at the same rate as profits
  - $\Delta NA$ is a good measure of replacement costs
- Don’t forget to discount TV further to get PVTV
- In WACC method, $k=WACC$
- In APV method, $k=k_A$ for FCF and appropriate rate for TS
Example

- You are considering the acquisition of XYZ Enterprises. XYZ’s balance sheet looks like this as of today (year 0).

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current assets</td>
<td>50</td>
</tr>
<tr>
<td>Plant</td>
<td>50</td>
</tr>
<tr>
<td>Current liabilities</td>
<td>20</td>
</tr>
<tr>
<td>Debt</td>
<td>30</td>
</tr>
<tr>
<td>Net worth</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

- Projections:

<table>
<thead>
<tr>
<th></th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>200</td>
<td>217</td>
<td>239</td>
<td>270</td>
<td>293</td>
</tr>
<tr>
<td>EBIT</td>
<td>20</td>
<td>22</td>
<td>25</td>
<td>26</td>
<td>30</td>
</tr>
<tr>
<td>NWC</td>
<td>33</td>
<td>37</td>
<td>41</td>
<td>44</td>
<td>48</td>
</tr>
<tr>
<td>Depreciation</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>CAPX</td>
<td>10</td>
<td>10</td>
<td>15</td>
<td>6</td>
<td>20</td>
</tr>
</tbody>
</table>
Example (cont.)

What is the value of XYZ’s stock under the following assumptions:

1) XYZ is liquidated after year 5 (assuming zero salvage value).

2) Sales growth and EBIT/Sales ratios are (past year 5):

<table>
<thead>
<tr>
<th>Sales growth</th>
<th>EBIT/Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>0%</td>
<td>10%</td>
</tr>
<tr>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>0%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Tax rate = 34%, and WACC = 13%.
Example (cont.)

Start by estimating FCF over 5 years:
- NWC(year 0) = Current assets - current liabs = 50-20=30

FCF = EBIT(1 - t) + Dep - CAPX - \(\Delta NWC\)

<table>
<thead>
<tr>
<th></th>
<th>Year 0</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBIT</td>
<td>20</td>
<td>22</td>
<td>25</td>
<td>26</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>EBIT(1-t)</td>
<td>13.2</td>
<td>14.52</td>
<td>16.5</td>
<td>17.16</td>
<td>19.8</td>
<td></td>
</tr>
<tr>
<td>NWC</td>
<td>30</td>
<td>33</td>
<td>37</td>
<td>41</td>
<td>44</td>
<td>48</td>
</tr>
<tr>
<td>(\Delta NWC)</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>CAPX</td>
<td>10</td>
<td>10</td>
<td>15</td>
<td>6</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>FCF</td>
<td>5.2</td>
<td>5.52</td>
<td>3.5</td>
<td>15.16</td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td>PV @ 13%</td>
<td>22.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Example – Liquidation Value (LV)

1) Liquidation value (LV)
\[ t \times \text{PPE(year 5)} + \text{NWC(year 5)} \]

\[ \text{PPE(year 5)} = \text{PPE(year 0)} + \text{all CAPX} - \text{all Dep from year 0 to 5} \]

\[ \text{PPE} = 80 \]
\[ \text{PPE} \times t = 80 \times 34\% = 27.2 \]

\[ \text{LV} = 27.2 + 48 = 75.2 \quad \Rightarrow \quad \text{PVLV} = 75.2/(1.13)^5 = 40.8 \]

\[ \text{Firm value} = 22.7 + 40.8 = 63.5 \]
\[ \text{Equity value} = \text{Firm value} - \text{MV of Debt} = 63.5 - 30 = \boxed{33.5} \]
Example (cont.)

For 2) to 5), we need EBIT (year 6) and NA (year 5) to apply

\[ TV = \frac{[EBIT(\text{year 6})(1 - t) - g \times NA(\text{year 5})]}{[k - g]} \]

**EBIT(\text{year 6})**  
= fraction \( \alpha \) of Sales(\text{year 6})  
= \( \alpha(1 + g) \times \text{Sales(\text{year 5})} = \alpha(1 + g) \times 293 \)

**NA(\text{year 5})**  
= NA(\text{year 0}) + all \ CAPX - all \ Dep + all \ \Delta\text{NWC} \text{ from 0 to 5}  
= 128

**PVTV**  
= \( TV/(1.13)^5 \)
Example (cont.)

<table>
<thead>
<tr>
<th></th>
<th>$\alpha$</th>
<th>g</th>
<th>TV</th>
<th>PVTV</th>
<th>Firm</th>
<th>Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2)</td>
<td>10%</td>
<td>5%</td>
<td>173.8</td>
<td>94.3</td>
<td>117.0</td>
<td>87.0</td>
</tr>
<tr>
<td>3)</td>
<td>10%</td>
<td>0%</td>
<td>148.8</td>
<td>80.7</td>
<td>103.4</td>
<td>73.4</td>
</tr>
<tr>
<td>4)</td>
<td>5%</td>
<td>5%</td>
<td>46.9</td>
<td>25.5</td>
<td>48.2</td>
<td>18.2</td>
</tr>
<tr>
<td>5)</td>
<td>5%</td>
<td>0%</td>
<td>74.4</td>
<td>40.4</td>
<td>63.1</td>
<td>33.1</td>
</tr>
</tbody>
</table>
When is Growth Valuable?

TV (with growth) > TV (w/o growth)

\[
\frac{(1+g) \cdot EBIT(1-t) - g \cdot NA}{k-g} > \frac{EBIT(1-t)}{k}
\]

EBIT*(1 - t) - k*NA > 0
Economic Value Added (EVA)

EVA = EBIT*(1 - t) - k*NA

**Intuition:** Growth is good when the cost of increasing NA is more than compensated by the capitalized increase in EBIT*(1 - t).
Remarks

- EVA is a particular incarnation of NPV (+ some assumptions)

- Appeal of EVA coherent measure for Capital budgeting, Performance evaluation and Managerial compensation.

- Assumes linear relationship between NA and EBIT*(1 - t)

- **EVA has nothing to do with sustainable growth:**
  - Sustainable growth rate answers “How fast can I grow without increasing my leverage ratio or issuing equity?”
  - It has nothing to say about whether growing is good or not.
EVA: Bottom Line

Use EVA as...
- a simple measure to determine whether the business is generating value and whether growth is enhancing value
- as a way of setting goals to enhance value

Beware of EVA for...
- young companies
- companies in rapidly changing business environments
- companies where book values are not accurate measures of replacement costs
DCF Analysis: Pros and Cons

Strengths
- CF comes from specific forecasts and assumptions
- Can see impact of changes in strategies
- Valuation tied to underlying fundamentals

Weaknesses
- CF only as good as your forecasts/assumptions
- Might “forget something”
- Need to forecast managerial behavior (unless you’re in control)
- Need to estimate the discount rate using a theory (e.g., CAPM) that may be incorrect or imprecise in this particular case
Multiples

- Assess the firm’s value based on that of publicly traded comps.

- **Cash-flow-based Value multiples:**
  - MV of firm/Earnings, MV of firm /EBITDA, MV of firm /FCF

- **Cash-flow-based Price multiples:**
  - Price/Earnings (P/E), Price/EBITDA, Price/FCF

- **Asset-based multiples:**
  - MV of firm/BV of assets, MV of equity/BV of equity
Procedure

- **Hope:** Firms in the same business should have similar multiples (e.g., P/E).

- **STEP 1:** Identify firms in same business as the firm you want to value.

- **STEP 2:** Calculate P/E ratio for comps and come up with an estimate of P/E for the firm you want to value (e.g. take the average of comps’ P/E).

- **STEP 3:** Multiply the estimated P/E by the actual Net Income of the firm you want to value.
Motivation for Multiples?

- **Assumption 1:** Comps’ actual FCF are a perpetuity

\[
MV = \frac{FCF}{WACC - g} \quad \Rightarrow \quad \frac{MV}{FCF} = \frac{1}{WACC - g}
\]

- **Assumption 2:**
  - Comps have the same WACC (requires similar D/(D+E))
  - Comps are growing at a similar rate g
Motivation for Multiples?

- **Assumption 1:**
  - E = CF to shareholders
  - E is a perpetuity

\[
P = \frac{E}{k_E - g} \implies \frac{P}{E} = \frac{1}{k_E - g}
\]

- **Assumption 2:**
  - Comps have the same \( k_E \) => *This requires similar leverage!*
  - Comps are growing at a similar rate g
Remarks

- For firms with no earnings or limited asset base (e.g. hi-tech),
  - price-to-patents multiples,
  - price-to-subscribers multiples,
  - or even price-to-Ph.D. multiples!

- Since these are rough approximations (at best)
  - One may want to check different multiples
  - See if some multiples are quite constant across firms
## Example: Valuing ADI

<table>
<thead>
<tr>
<th>ADI (Dec. 1995)</th>
<th>EBIT</th>
<th>tax rate</th>
<th>Net income</th>
<th>BV equity</th>
<th>BV liabs</th>
<th># shares</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADI</td>
<td>163.6</td>
<td>25%</td>
<td>119.3</td>
<td>656.0</td>
<td>345.7</td>
<td>114.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>ADI</th>
<th>Burr-Brown</th>
<th>Linear Techno.</th>
<th>Maxim Integrated Products</th>
<th>Siliconix</th>
<th>Motorola</th>
<th>Mean w/o ADI</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROE</td>
<td>18.2%</td>
<td>16.3%</td>
<td>25.5%</td>
<td>23.4%</td>
<td>26.8%</td>
<td>16.1%</td>
<td>21.6%</td>
</tr>
<tr>
<td>Liabs/Assets</td>
<td>34.5%</td>
<td>29.0%</td>
<td>16.9%</td>
<td>22.1%</td>
<td>56.6%</td>
<td>51.5%</td>
<td>35.2%</td>
</tr>
<tr>
<td>5-year growth in sales</td>
<td>14.3%</td>
<td>9.9%</td>
<td>32.2%</td>
<td>43.1%</td>
<td>14.0%</td>
<td>20.3%</td>
<td>23.9%</td>
</tr>
<tr>
<td>P/E</td>
<td>14.2</td>
<td>25.8</td>
<td>30.3</td>
<td>15.2</td>
<td>18.9</td>
<td></td>
<td>20.9</td>
</tr>
<tr>
<td>(D+E)/EBIT(1-t)</td>
<td>16.3</td>
<td>26.6</td>
<td>30.3</td>
<td>18.3</td>
<td>24.2</td>
<td></td>
<td>23.1</td>
</tr>
<tr>
<td>Market-to-Book equity</td>
<td>2.3</td>
<td>6.6</td>
<td>7.1</td>
<td>4.1</td>
<td>3.0</td>
<td></td>
<td>4.6</td>
</tr>
<tr>
<td>Market-to-Book firm</td>
<td>1.9</td>
<td>5.6</td>
<td>5.7</td>
<td>2.3</td>
<td>2.0</td>
<td></td>
<td>3.5</td>
</tr>
</tbody>
</table>
Example (cont.)

- There is no exact science to come up with appropriate multiples. The following is only an example. Need experience and guts.

- ADI’s 5-year sales growth is less than average
  - Shade down estimate of P/E and (D+E)/EBIT*(1 - t) w.r.t. mean
    - P/E = 20.9*(1 - 15%) = 17.8
    - (D+E)/EBIT*(1 - t) = 23.1*(1 - 15%) = 19.6

- ADI’s ROE is less than average
  - Shade down estimate of M/B equity and M/B firm w.r.t. mean
    - M/B equity = 4.6*(1 - 15%) = 3.9
    - M/B firm = 3.5*(1 - 15%) = 3.0
## Example (cont.)

<table>
<thead>
<tr>
<th></th>
<th>Comps ratio (X / Y)</th>
<th>P/E</th>
<th>(D+E) / EBIT(1-t)</th>
<th>M/B Equity</th>
<th>M/B Firm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>17.8</td>
<td>19.6</td>
<td>3.9</td>
<td>3.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Actual (Y)</th>
<th>NI</th>
<th>EBIT(1-t)</th>
<th>BV Equity</th>
<th>BV Firm</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>119.3</td>
<td>122.7</td>
<td>656</td>
<td>1001.7</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>MV Firm (Ratio * Y)</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2409.2</td>
<td></td>
<td></td>
<td></td>
<td>2980.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>MV Equity (Ratio * Y or MV Firm - Debt)</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2119.4</td>
<td></td>
<td></td>
<td></td>
<td>2634.4</td>
</tr>
</tbody>
</table>

|   | Price (MV Equity / #shares) | 18.5 | 18.0 | 22.4 | 23.0 |

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
<td>18.0</td>
</tr>
</tbody>
</table>
Comparables: Pros and Cons

Pros:
- Simple + lots of information
- Market consensus about discount rate and growth rate.
- Free-ride on market’s information.

Cons:
- Assumes that companies are alike in growth, costs of capital, business composition, leverage
- Hard to find true comps
- Hard to incorporate firm specific information
- Accounting differences
- If everyone uses comps, who actually does fundamental analysis?
Comps & the Conglomerate Discount

- Is the value of a conglomerate equal to the sum of its parts?
  - Calculate Firm Value / Assets for the conglomerate
  - For each of its business segments (in annual report), calculate median Firm Value / Assets for single segment firms in that industry
  - Add up these comps, weighting by the share of the conglomerate’s assets in that industry

- Result: On average, conglomerates are worth 12% less than the sum of their parts.
Possible Interpretations

- Conglomerates are an inefficient form of organization
- The stock market doesn’t get it
- The comparables method doesn’t work
Distribution of Price / Sales ratios for Internet stocks (March 2000)
Distribution of Price / Sales ratios for all stocks (March 2000)
## Internet stocks and selected high-tech stocks
(March 2000, in $billions)

<table>
<thead>
<tr>
<th></th>
<th>Internet</th>
<th>Cisco</th>
<th>Intel</th>
<th>IBM</th>
<th>Microsoft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity MV</td>
<td>651.6</td>
<td>445.5</td>
<td>408</td>
<td>194.1</td>
<td>505.7</td>
</tr>
<tr>
<td>Equity BV</td>
<td>34.7</td>
<td>11.7</td>
<td>35.8</td>
<td>21.6</td>
<td>27.5</td>
</tr>
<tr>
<td>Sales</td>
<td>12.1</td>
<td>12.2</td>
<td>29.4</td>
<td>87.5</td>
<td>19.7</td>
</tr>
<tr>
<td>Gross Profits</td>
<td>4.8</td>
<td>8.4</td>
<td>20.3</td>
<td>38.1</td>
<td>17.4</td>
</tr>
<tr>
<td>NI</td>
<td>-7.2</td>
<td>2.1</td>
<td>7.3</td>
<td>7.7</td>
<td>7.8</td>
</tr>
<tr>
<td>M/B Equity</td>
<td>18.8</td>
<td>38.1</td>
<td>11.4</td>
<td>9.0</td>
<td>18.4</td>
</tr>
<tr>
<td>MV Equity / Sales</td>
<td>53.9</td>
<td>36.5</td>
<td>13.9</td>
<td>2.2</td>
<td>25.7</td>
</tr>
<tr>
<td>MV Equity / Profits</td>
<td>135.8</td>
<td>53.0</td>
<td>20.1</td>
<td>5.1</td>
<td>29.1</td>
</tr>
</tbody>
</table>
What growth and margin assumptions would have justified Internet valuation in March 2000?

<table>
<thead>
<tr>
<th>Short-run growth rate</th>
<th>Years of high growth</th>
<th>Value ($billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel A: Profit margin = 5%</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20%</td>
<td>10</td>
<td>7.7</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>30.4</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>58.6</td>
</tr>
<tr>
<td>30%</td>
<td>10</td>
<td>50.0</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>150.2</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>368.0</td>
</tr>
<tr>
<td><strong>Panel B: Profit margin = 10%</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20%</td>
<td>10</td>
<td>37.4</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>74.6</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>125.7</td>
</tr>
<tr>
<td>30%</td>
<td>10</td>
<td>122.0</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>314.1</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td><strong>744.5</strong></td>
</tr>
</tbody>
</table>

Assumptions: Discount rate = 10%, long-term growth = 6%
Wrap-up of 15.402

The Big Picture: Part II - Valuation

A. Valuation: Free Cash Flow and Risk
   • April 1     Lecture: Valuation of Free Cash Flows
   • April 3     Case: Ameritrade

B. Valuation: WACC and APV
   • April 8     Lecture: WACC and APV 1
   • April 10    Lecture: WACC and APV 2
   • April 15    Case: Dixon Corporation 1
   • April 17    Case: Dixon Corporation 2
   • April 24    Case: Diamond Chemicals

C. Project and Company Valuation
   • April 29    Lecture: Real Options
   • May 1       Case: MW Petroleum Corporation
   • May 6       Lecture: Valuing a Company
   • May 8       Case: Cooper Industries, Inc.
   • May 13      Case: The Southland Corporation
Final Exam

- Rules of the game:
  - No laptops
  - Closed books
  - Two (2) letter-sized cheat sheets
  - Bring a calculator

Aside: Incentives

Whenever structuring a deal, be it on the RHS or the LHS of the balance sheet, make sure that all players have the right incentives.

- Example:
  1. You want to see a decent review of the course material.
  2. The professor is motivated by his teaching ratings (because he doesn’t want the Dean to beat him up).
  
  ⇒ It is a bad idea to fill out the teaching rates before the professor has delivered the review! You are inviting moral hazard.
  
  ⇒ Similar to the Southland case – don’t let crucial players cash out too early!
Valuation by Multiples:

- Assess the firm’s value based on that of publicly traded comparables.

- **Cash-flow-based Value multiples:**
  - \( \text{MV of firm/Earnings, MV of firm }/\text{EBITDA, MV of firm }/\text{FCF} \)

- **Cash-flow-based Price multiples:**
  - \( \text{Price/Earnings (P/E), Price/EBITDA, Price/FCF} \)

- **(Book) Asset-based multiples:**
  - \( \text{MV of firm/BV of assets, MV of equity/BV of equity} \)

Procedure

- **Hope:** Firms in the same business should have similar multiples (e.g. P/E).
  - Requires similar levels of risk.
  - Requires similar expected growth rates.

- **STEP 1:** Identify firms in same business as the firm you want to value.

- **STEP 2:** Calculate P/E ratio for comps and come up with an estimate of P/E for the firm you want to value (e.g. take the average of comps' P/E).

- **STEP 3:** Multiply the estimated P/E by the actual Net Income of the firm you want to value.
Remarks

- For firms with no earnings or limited asset base (e.g. hi-tech),
  - price-to-patents multiples,
  - price-to-subscribers multiples,
  - or even price-to-PhD. multiples!

- For transactions, can also use multiples for comparable transactions (e.g. similar takeovers).

- Multiples based on equity value (or stock price, e.g. P/E) as opposed to total firm value ignore effect of leverage on the cost of equity (or assume the firms have similar leverage) => Beware if comps have very different leverage.

Comparables: Pros and Cons

Pros:
- Incorporates a lot of information from other valuations in a simple way.
- Embodies market consensus about (comp’s) discount rate and growth rate.
- Free-ride on market’s information.
- Can provide discipline in valuation process by ensuring that your valuation is in line with other valuations.

Cons:
- Implicitly assumes that comps are alike in growth rates, cost of capital, and business composition. Hard to find true comps.
- Hard time incorporating firm specific information. Particularly problematic if operating changes are going to be implemented.
- Accounting differences, particularly with earnings and equity-based measures. Multiples of FCF and EBITDA preferable for this reason.
- Book values can vary across firms depending on age of PPE.
- If everyone uses comps, who actually does fundamental analysis?
Valuation

Valuation tools:
- Free cash flows
- Cost of capital: WACC and APV
- Real options

Valuing companies
- DCF analysis:
  - Forecast horizon and terminal values
  - EVA: When is growth good?
- Comparables, Multiples.
Estimating the FCF

- Free cash flows (FCF) are the expected after-tax cash flows that the firm would generate if it were 100% equity financed.

\[
\text{FCF} = \text{EBIT}*(1-t) + \text{Depreciation} - \text{CAPX} - \Delta\text{NWC}
\]

\[
\text{FCF} = \text{EBITD}*(1-t) + t * \text{Depreciation} - \text{CAPX} - \Delta\text{NWC}
\]

\[
\text{FCF} = \text{EBIT}*(1-t) - \Delta\text{NA}
\]

Recall:
- \(\text{NWC} = \) Current assets – Current liabilities
- \(\text{NA} = \) Assets – Current liabilities.

Some Things to Keep In Mind:
- Formulas need to be adapted to particular situations:
  - Need to understand the economics (e.g. Southland’s asset sales).
  - Use all incremental cash flows:
    - Ignore sunk costs, count opportunity costs, avoid “accounting illusions”...
  - Don’t forget FCF at the end of the project’s life:
    - If liquidated: \(SV^*(1-t) + t * \text{PPE}\), recoup NWC.
    - If not liquidated: Terminal values.
  - FCF ignores the tax shield provided by the firm’s debt.
  - We deal with it separately in APV or WACC. Do not include the effects of financing at this stage: You would count them twice!
**APV – Adjusted Present Value**

- **Step 1:** Value if 100% equity, i.e. use $k_A$ to discount the project’s FCF
  \[ k_A = r_f + \beta_A \cdot \text{Market Risk Premium} \]

- **Step 2:** Add PV(Tax Shield)
  - Count only tax savings actually attributable to the project.
  - Use the marginal (as opposed to the average) tax rate.
  - Use expected (as opposed to maximal) interest payments.

- **Caveat:** For high D/V, should count expected costs of financial distress.

**Weighted Average Cost of Capital (WACC)**

- **Approach:** Adjust the discount rate to account for the tax shield.
  \[ \text{WACC} = \frac{D}{D+E}k_D(1-t) + \frac{E}{D+E}k_E \]

- Most widely used DCF analysis method.
- The aim is to avoid 1st order mistakes:
  - Everything in WACC is project-specific (except for tax rate $t$).
  - Firm-wide WACC is OK only if project comparable to the firm
  - WACC can be used only if D/V is reasonably stable
Embedded Real Options:

Real Options = Managerial flexibility to react to new information.

- Sometimes, much of a project's value is in embedded options.

- Conditions for there to be an option:
  1. New information will possibly arrive in the future.
  2. When it arrives, the new information may affect decisions.

- Frequently encountered options: Options to grow, abandon, expand/contract, time, switch (inputs, outputs, processes, etc.)

- Valuation:
  - Black-Scholes
  - Scenario analysis and decision trees

Take-Aways:

- Main merit of DCF analysis: Forces to argue where value comes from. Most important step is a reasonable forecast of FCF.

- Sales forecasts: Reasonable given the firm's resources, the industry, and competition? What market share is needed?

- Margin forecasts: Reasonable given potential competition/entry barriers and bargaining position with suppliers and customers?

- CAPX and other investment forecasts: Consistent with the sales and margin forecasts?

- Terminal value: Does it make sense?

- Sensitivity analysis: What variables and assumptions are crucial to the value? Get more information about these levers.
Take-Aways cont.:

• Valuation by multiples and DCF valuation methods are complements, not substitutes!

• Comparables and multiples are important but:
  → don’t tell you where value comes from;
  → whether comparables are really comparable.

• DCF analysis (+ real options) forces to justify valuation but:
  → only as good as the data input;
  → relies on imperfect models.

• Go back and forth between the two approaches.
Financing

- The bulk of the value is created on the LHS by making good investment decisions.

- You can destroy much value by mismanaging your RHS: Financial policy should be supporting your business strategy.

- You cannot make sound financial decisions without knowing the implications for the business.

- Avoid one-size-fit-all approaches.

- Finance is too important to leave it to finance people.

Valuation

- Making sound business decisions requires valuing them.

- This involves mostly knowing the business (to make appropriate cash-flow forecasts and scenario analyses)

- But also some finance:
  - What discount rate?
  - Valuation exercises help to identify the key value drivers and often inform the business strategy.

- Avoid one-size-fit-all approaches.

- Business is too important to leave it to business people.
Wrap-up of Valuation

Katharina Lewellen
Finance Theory I
May 14, 2003
Final Exam

- Rules of the game:
  - No laptops
  - Closed books
  - Cheat sheet
Valuation

Valuation tools:
- Free cash flows
- Cost of capital: WACC and APV
- Real options

Valuing companies
- DCF analysis:
  - Forecast horizon and terminal values
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- Comparables, Multiples
Estimating the FCF

- Free cash flows (FCF) are the *expected* after-tax cash flows that the firm would generate if it were 100% equity financed.

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\]

\[
\text{FCF} = \text{EBIT} \times (1 - t) - \Delta \text{NA}
\]

Recall:
- NWC = Current assets - Current liabilities
- NA = Assets – Current liabilities.
FCF = EBIT*(1-t) + Dep. - CAPX - ∆WC

- This expression amends EBIT(1-t) which is an accounting measure of cash flow into an economic measure.

- CAPX not reported as cash outflow but is one \(\Rightarrow\) - CAPX

- Depreciation
  - is reported as cash outflow but is not one \(\Rightarrow\) Add \((1-t)\)*Dep
  - however, depreciation does imply a cash inflow of \(t\)*Dep.
  - Altogether \(\Rightarrow\) + Dep

- Working capital has an opportunity cost \(\Rightarrow\) - ∆NWC
Other Things to Keep In Mind

- Formulas need to be adapted in particular situations
  - Need to understand the economics (e.g., Southland’s asset sales)

- Use *all incremental* cash flows:
  - Ignore sunk costs, Count opportunity costs, Avoid “accounting illusions”…

- Don’t forget FCF at the end of the project’s life:
  - If liquidated: $SV*(1-t) + t * PPE$
  - Even if not liquidated, recoup WC

- FCF ignores the tax shield provided by the firm’s debt.
- We deal with it separately in APV or WACC. Do not include the effects of financing at this stage: You would count them twice!
APV Step 1: Value if 100% equity

1. **Identify comps**, i.e., publicly traded pure plays in same business.

2. **Unlever each comp’s** $\beta_E$ **to estimate its** $\beta_A$ **using**

\[
\beta_A = \beta_E \frac{E}{E+D}
\]

(OK if the comp’s D not too high (+ can assume their D/V is stable))

3. Use the comps’ $\beta_A$ to estimate the **project’s** $\beta_A$ (e.g., as average).

4. Use estimated $\beta_A$ to calculate the **all-equity cost of capital** $k_A$

\[
k_A = r_f + \beta_A \cdot \text{Market Risk Premium}
\]

5. Use $k_A$ to **discount the project’s FCF**
Why We Need to Unlever

- Comps may have different leverage

- Equity in a firm with debt is more risky than equity in a firm without debt because debt receives some of the safe cashflows.

Note: Business Risk and Financial Risk

- Financial risk has nothing to do with costs of financial distress!

- Similar firms have similar business risk ($\beta_A$) but can have different financial risk ($\beta_{E} - \beta_A$) if they have different leverage.

- As leverage increases, equity becomes riskier (i.e. $\beta_E$).
APV Step 2: Add PV (Tax Shield)

- If the project’s D is constant over time, then

\[ PV(TS) = \frac{t \cdot D \cdot k_D}{k_D} = t \cdot D \]

- If the project’s D/V is constant, then

\[ PV(TS) = \frac{t \cdot D \cdot k_D}{k_A} \]

- If there is a known debt policy or repayment schedule
  - you can simply forecast actual debt levels and discount by a rate between \( k_D \) and \( k_A \)
APV Step 2: Add PV (Tax Shield), Remarks

- Count only *debt attributed to the project*
  - Recall: If a project is 100% debt finance, some of the debt is probably issued against firm’s other assets

- Make sure to discount *expected* not maximum tax shields
  - This is particularly important for high D/V

- For high D/V, should count costs of financial distress

- Recall: Use the marginal (as opposed to the average) tax rate
Weighted Average Cost of Capital (WACC)

- Approach: Adjust the discount rate to account for the tax shield.

\[
WACC = \frac{D}{D+E} k_D (1 - t) + \frac{E}{D+E} k_E
\]

- Most widely used DCF analysis method.
- The aim is to avoid 1st order mistakes:
  - A priori, WACC is project-specific (except for tax rate t)
  - Firm-wide WACC is OK only if project comparable to the firm
Leverage ratio: \( D/(D+E) \)

- **What we want:** The debt that is incremental to the project, i.e., that could not be raised w/o the project.

- **1st-order mistakes we want to avoid:**
  - Use the deal’s leverage ratio;
  - Use the “acquirer”’s leverage ratio.

- **Imperfect approach to what we want:**
  - Target leverage ratio if project/firm were a stand-alone

- **How we get there:**
  - Get \( D/V \) from comps, business plan, checklist, etc.
Cost of debt capital: \( k_D \)

- What we want: Expected return for creditors if project were a stand-alone with leverage ratio \( D/(D+E) \) estimated above.

- Imperfect approach to what we want: \( k_D \) close the interest rate charged to project as stand-alone (unless debt is very risky).

- How we get there:
  - Find comps with similar leverage + recent interest rate.
  - Estimate the debt rating and examine corporate yield curve.

- 1st-order mistakes we want to avoid:
  - Use the interest rate in the deal or of the “acquirer”;
Effective Marginal Tax Rate $t$

- Marginal tax rate of firm undertaking the project: $t$
Using CAPM to Estimate $k_E$

1. **Find comps** for the project under consideration.

2. **Unlever** each comp’s $\beta^E$ (using its $D/(D+E)$):

   $$\beta^A = \beta^E \frac{E}{E + D}$$

3. Use the comps’ $\beta^A$ to estimate the project’s $\beta^A$ (e.g. average).

4. **Relever** the project’s estimated $\beta^A$ (using its own $D/(D+E)$):

   $$\beta^E = \frac{E + D}{E} \beta^A = \left[1 + \frac{D}{E}\right] \beta^A$$

5. Use the estimated $\beta^E$ to calculate the project’s cost of equity $k_E$:

   $$k_E = r_f + \beta^E \cdot \text{Market Risk Premium}$$

**Note:** These (un-) levering formulas are OK only if the (comp) firm’s debt is not too risky and its $D/V$ is reasonably stable.
Remarks

- WACC can be used only if D/V is reasonably stable

- Use APV when debt is very risky and/or when D/V is unstable (recall the Southland LBO case)

- WACC is an attribute of the project, not the firm (except tax rate)

- OK to use the firm’s WACC when project is very much like the firm (because the firm happens to be a comp for the project).

- Few companies have WACC that they can use for all projects (recall our discussion of GE).
Real options

Embedded options
- Follow-up investments
- Option to abandon the project
- Option to wait before investing
- Option to expand / change production methods

Key issues
- Identification
- Valuation
Identify **significant** options

- Look for clues in project’s description and cash flow pattern
  - “Phases”, “Strategic investment”, “Scenarios”…
  - Large expenditures are likely discretionary

- Is there an option? Verify two conditions:
  1. News will possibly arrive in the future;
  2. When it arrives, the news may affect decisions.

- Search for the uncertainty that managers face:
  - What is the main thing that managers will learn over time?
  - How will they exploit that information?
Practical Issue: Simplifications

- Search for *significant* options
  - E.g., option to shut down the plant may not be very valuable (why?)
  - Look for primary sources of uncertainty

- Cut the projects into *simple* options
  - You might want to ignore nested options (difficult to value)

- Use *European* rather than American option

- Ignoring some adverse effects of waiting (e.g. possible entry)

A simplified model that is dominated by the project gives a *lower bound* for the project’s value (and vice versa).
Value the options

Step 1:
- Start with the simple DCF analysis
  - Pretend that there is no option embedded in the project
  - This benchmark constitute a \textit{lower bound} for the project’s value

Step 2:
- Value the option
  - Decision trees (dynamic DCF)
  - Option pricing models (Black-Scholes)
Mapping: Project → Call Option

<table>
<thead>
<tr>
<th>Project</th>
<th>Call Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenditure required to acquire the assets</td>
<td>Exercise price</td>
</tr>
<tr>
<td>Value of the operating assets to be acquired</td>
<td>Stock price (price of the underlying asset)</td>
</tr>
<tr>
<td>Length of time the decision may be deferred</td>
<td>Time to expiration</td>
</tr>
<tr>
<td>Riskiness of the operating assets</td>
<td>Variance of stock return</td>
</tr>
<tr>
<td>Time value of money</td>
<td>Risk-free rate of return</td>
</tr>
</tbody>
</table>
Practical Issue: What Volatility?

What do we want?
- Standard deviation of returns for the underlying asset
- In case of real options, the underlying is the PV of the project’s CFs

Imperfect ways to get it?
- Informed guess
  - 20-30% per year is not remarkably high for a single project.
- Data
  - Historical return volatilities on comparable traded assets
  - Implied volatilities can be computed from quoted option prices
- Simulations
Valuing Companies

- Terminal values:
  - Liquidation
  - Flat, growing, or decreasing perpetuity

- EVA: When is growth good?

- Comparables, Multiples.
Terminal Values

- **Liquidation:** Should be adjusted (e.g. if cannot recoup all A/R, etc.)

  \[ SV \times (1-t) + t \times PPE + WC \]

- **Growing perpetuity:** Take EBIT and NA in last year of forecast

  \[ TV = \frac{[(1+g) \times EBIT \times (1-t) - g \times NA]}{(k-g)} \]

- **Flat perpetuity:**

  \[ TV = \frac{EBIT \times (1-t)}{k} \]
Terminal Values, Remarks

- Growing perpetuity formula assumes a linear relationship between EBIT and NA

- Don’t forget to take PVTV

- Forecast horizon: Company is reasonably stable afterwards
EVA

- Growth is valuable when (very roughly!):

\[
EVA = EBIT*(1-t) - k*NA > 0 \quad \text{or} \quad EBIT*(1-t) / NA > k
\]

- Growth is good if the cost of scaling up NA is offset by the value of increased revenues.

Remarks:
- Assumes linearity between EBIT and NA and that NA is a good measure of marginal “replacement cost”, now and in the future.
- EVA has nothing to do with sustainable growth.
EVA: Bottom Line

Use EVA as…
- … a simple measure of whether a business is generating value and whether growth is enhancing value
- … as a way of setting goals to enhance value

Beware of EVA for…
- … young companies
- … companies in rapidly changing business environment
- … companies in which book values are not accurate measures of marginal replacement cost.
Multiples

- Assess the value based on that of publicly traded comps

- Cash-flow based Value multiples
  - MV(firm)/Earnings, MV(firm)/EBITDA, MV(firm)/FCF,

- Cash-flow based Price multiples:
  - Price/Earnings, Price/EBITDA, Price/FCF,

- Asset-based multiples:
  - MV(firm)/BV(assets), MV(equity)/BV(equity),
Motivation for Multiples?

- **Assumption 1:**
  - E = CF to shareholders
  - E is a perpetuity

  \[ P = \frac{E}{k_E - g} \Rightarrow \frac{P}{E} = \frac{1}{k_E - g} \]

- **Assumption 2:**
  - Comps have the same \( k_E \) => *This requires similar leverage!*
  - Comps are growing at a similar rate \( g \)
Multiples: Pros and Cons

Pros:
- Incorporates simply a lot of information from other valuations
- Embodies market consensus
- Can provide discipline for DCF valuation: Ask yourself “How do I explain the difference?”
- Sometimes, what you care about is what the market will pay, not the fundamental value (e.g., Venture firm will want out).

Cons:
- Hard to incorporate firm specific information.
- Relies on accounting measures being comparable too.
Other Things to Think About

Control:
- With a controlling stake, influence operations, implement synergies and capture (part of) their value
- Also, entrepreneur might care about “the vision”

Large individual shareholder (e.g., entrepreneur):
- Maybe very undiversified, at least for a while

Liquidity:
- Especially for private companies
- Note: Need to account for IPO plans
Valuation: Conclusion

- Main merit of DCF analysis: Forces to argue where value comes from ⇒ Most important step is a **reasonable** forecast of FCF.

- Sales forecasts: Reasonable given the firm’s resources, the industry, and competition? What market share is needed?
- Margin forecasts: Reasonable given potential competition/entry barriers and bargaining position with suppliers and customers?
- CAPX and other investment forecasts: Consistent with the sales and margin forecasts?
- Terminal value: Does it make sense?
- Sensitivity analysis: What variables and assumptions are crucial to the value? Get more information about these levers.
Valuation: Conclusion

- The different methods are not mutually exclusive.

- Comparables and multiples are important but:
  - don’t tell you where value comes from;
  - whether comparables are really comparable.

- DCF analysis (+ Real options) forces to justify valuation but:
  - only as good as the data input;
  - relies on imperfect models.

- Go back and forth between the two approaches.
Course: Conclusion
What We Have Been About

- Acquire a few general tools:
  - Capital structure
  - DCF analysis
  - Comparables and multiples

- Avoiding 1st order misconceptions (list your own below if any):
  - etc.

- Developing a healthy skepticism.
Financing

- The bulk of the value is created on the LHS by making good investment decisions.

- You can destroy much value by mismanaging your RHS: Financial policy should be supporting your business strategy.

- You cannot make sound financial decisions without knowing the implications for the business.

- Avoid one-size-fit-all approaches.

- Finance is too serious to leave it to finance people.
Valuation

- Making sound business decisions requires valuing them.

- This involves mostly knowing the business (to make appropriate cash-flow forecasts and scenario analysis, etc.)

- But also some finance:
  - What discount rate?
  - Valuation exercises can indicate key value levers, ...

- Avoid one-size-fit-all approaches.

- Business is too serious to leave it to business people.
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Valuation Tools

- A key task of managers is to undertake valuation exercises in order to allocate capital between mutually exclusive projects:
  - Is project A better than doing nothing?
  - Is project A better than project B?
  - Is the project's version A better than its modified version A’?

- The process of valuation and ultimately of capital budgeting generally involves many factors, some formal, some not (experience, hard-to-formalize information, politics, etc.).

- We will focus on financial tools for valuation.

Valuation Tools (cont.)

- These tools provide managers with numerical techniques to “keep score” and assist in the decision-making process.

- They build on modern finance theory and deal with cash flows, time and risk.

- All rely on (often highly) simplified models of the business:
  - Technical limitations (less now with computers)
  - Versatility
  - Understandability and “communicatibility”
How to Value a Project or a Firm?

- Look up the price of a comparable project
  - Arbitrage pricing
  - More on using comps soon
- Calculate NPV:
  - Estimate the expected cash flows
  - Estimate the appropriate discount rate for each cash flow
  - Calculate NPV
- Caveat: Many companies do not use NPV but IRR, payback period, etc. You need to be an educated avoider of these.

The Free Cash Flow (FCF) Approach

- FCF: The expected after tax cash flows of an all equity firm.
- These cash flows ignore the tax savings the firm gets from debt financing (the deductibility of interest expense).

Plan of Attack:

- Step 1: Estimate the Free Cash Flows.
- Step 2: Assess the risk of the free cash flows.
- Step 3: Account for the effect of financing on value.

Preview of Step 3: Two ways to account for tax shield:

- Adjust the discount rate (WACC method).
- Adjust the cash flow estimate (APV method).
Step 1: Calculating Cash Flows

Count all incremental, after-tax cash flows allowing for reasonable inflation.

- All:
  - Don’t just look at operating profits in the out years.
  - If project requires follow-on CAPX or additional working capital, take these into account.

- **After-tax:** The rest goes to the IRS.

- **Be consistent in your treatment of inflation:**
  - Discount nominal cash flows at nominal discount rates.
  - Note:
    - Nominal rates reflect inflation in overall economy, but inflation in cash flows may be different.
    - In fact, some items in cash flows, e.g., depreciation, may have no inflation.
Equivalent Expressions for Free Cash Flows (see Finance Theory I)

FCF = (1 - t) × EBIT + Depreciation - CAPX - Change in NWC

FCF = (1 - t) × EBITD + t × Depreciation - CAPX - Change in NWC

FCF = (1 - t) × EBIT - Change in Net Assets

Note:
EBIT = Earnings before interest and taxes
EBITD = Earnings before interest and taxes and depreciation = EBIT + Depreciation
Change in NWC is sometimes called Investment in NWC.

Example of Free Cash Flow Calculation

| Year | Sales  | Cost of Goods Sold | Depreciation | Interest Expense | Taxes (38%) | Profit After taxes | Capital Expenditures | Accounts Receivable | Inventories | Accounts Payable |
|------|--------|--------------------|--------------|------------------|-------------|-------------------|---------------------|------------------|-------------|----------------|----------------|
| 1998 | 1,000  | 700                | 30           | 40               | 80          | 150               | 40                  | 50               | 50          | 20           | 25            |
| 1999 | 1,200  | 850                | 35           | 50               | 90          | 175               | 40                  | 60               | 60          | 25           | 25            |

In 1999: FCF = EBIT*(1-t) + Depreciation - CAPX - Change in NWC

→ EBIT = 1,200 - 850 - 35 = 315
→ t=38%
→ Ch. NWC = (60+60-25) - (50+50-20) = 15
→ FCF = 315 * (1-0.38) + 35 - 40 - 15 = 175.3
Beware!

- Note:
  - We ignored interest payments
  - We computed taxes on EBIT

- Do not take the effect of financing (e.g., interest) into account at this stage!

- Remember our plan:
  - First, determine the expected cash flows as if the project were 100% equity financed.
  - Later, we will adjust for financing.

- If you count financing costs in cash flow, you count them twice.

Turbo Widget Example

- XYZ, a profitable widget producer ($100M annual after-tax profit) contemplates introducing new Turbo Widgets (TWs), developed in its labs at an R&D cost of $1M over the past 3 years.

- New plant to produce TW would
  - cost $20M today
  - last 10 years with salvage value of $5M
  - be depreciated to $0 over 5 years using straight-line depreciation

- TWs need painting: Use 40% of the capacity of a painting machine
  - currently owned and used by XYZ at 30% capacity
  - with maintenance costs of $100,000 (regardless of capacity used)

- Annual
  - operating costs: $400,000
  - operating income generated: $42M
  - operating income from sales of regular widgets would decrease by $2M

- Working capital (WC): $2M needed over the life of the project

- Corporate tax rate 36%
Calculate Incremental Cash Flows:

- We want to compare firm value with and without the project:
  \[ V(\text{project}) = V(\text{firm w/ project}) - V(\text{firm w/o project}) \]

- Use only cash flows (in and out) attributable to the project.
  - **Sunk costs should be ignored**
    - They are spent w/ or w/o the project (bygones are bygones).
  - **Opportunity costs should be accounted for**
    - A project might exclude good alternatives (e.g., use of land).
  - **Accounting illusions should be avoided**
    - e.g. the project might be “charged” for a fraction of expenses that would be incurred anyway.

TW Example (cont.)

Which of the following items are relevant to evaluate the project?

- $100M after-tax profit
- R&D cost of $1M over the past three years
- The plant’s $20M cost
- Machine’s $100K maintenance cost
- Operating income from regular widgets decreases by $2M
TW Example (cont.)

- Ignore the $100M after-tax profit and focus on incremental cash flows
- R&D cost of $1M over the past three years: Sunk cost ==> Ignore it
- The plant’s $20M cost: It’s a CAPX ==> Count it
- Machine’s $100K maintenance cost: Not incremental ==> Ignore it
  → Incurred with or without TW production
  → True even if accounting charges TW production a fraction of these
- Operating income from widgets decreases by $2M due to cannibalization
  → Would not occur without TW production
  → It is an opportunity cost ==> Count it

<table>
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<tr>
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<td>0</td>
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</table>

Use After-tax Cash Flows

- These are what you have left after paying for your costs (COGS and other costs), and after paying the IRS.

- Make sure to count the tax benefits of expensing, depreciation, etc.

- CAPX and Depreciation:
  → Tax treatment of CAPX depends on depreciation
  → CAPX is not directly subtracted from taxable income
  → Instead, each year’s depreciation “expense” is subtracted from that year’s taxable income
  → As far as taxes are concerned, everything is as if there was no CAPX and a cost equal to depreciation was incurred each year.
TW Example (cont.)

- **Depreciation:**
  - Straight line depreciation: Flat annual depreciation
  - Accelerated depreciation: Decreasing

- $20M CAPX is depreciated linearly over 5 years, down to zero.
  \[ D = \frac{(20 - 0)}{5} = $4M \]

- Salvage value of $5M is fully taxable since book value is zero.

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<td>5</td>
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</table>

**Note:** We do as if entire EBIT is taxable ==> We ignore (for now) the fact that interest payments are not taxable.
So far (but we’re not done yet):

\[
\text{CF} = \text{Incr. Profit} - \text{Taxes} - \text{CAPX}
\]
\[
= \text{Incr. Profit} - t \times (\text{Incr. Profit} - \text{Depr.}) - \text{CAPX}
\]
\[
= (1 - t) \times \text{Incr. Profit} + t \times \text{Depr.} - \text{CAPX}
\]

Example: We could have computed the CF in year 1 as

\[
(1 - 36\%) \times 39.6 + 36\% \times 4 - 0 = $26.8M
\]

Changes in (Net) Working Capital:

Working Capital = Inventory + A/R - A/P

Remark 1:
- Many projects need some capital to be tied up (working capital) which constitutes an opportunity cost.
  \( \Rightarrow \) We need the Change in Working Capital implied by the project.

Remark 2:
- Accounting measure of earnings are based on:
  Sales - Cost of Goods Sold
- But: Income and expense are reported when a sale is declared.
  \( \Rightarrow \) \text{COGS in 2000 includes the costs of items sold in 2000 even if the cost was incurred in 1999 or hasn’t been incurred yet.}
  \( \Rightarrow \) Sales in 2000 include the income from items sold in 2000 even if the payment has not been received yet.
### TW Example (cont.)

<table>
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<tr>
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<td>2.0</td>
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</tr>
<tr>
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<tr>
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<td>26.8</td>
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<td>25.3</td>
<td>25.3</td>
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<td>30.5</td>
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### Putting It All Together

FCF = \((1 - t) \times \text{Incr. Profit} + t \times \text{Depr.} - \text{CAPX} - \Delta \text{NWC}\)

This can also be rewritten as:

FCF = \((1 - t) \times \text{EBIT} + \text{Depr.} - \text{CAPX} - \Delta \text{NWC}\)
Finding the Value of the Cash Flows

- What now?
  - We know how to find the expected Free Cash Flows

We want to calculate the present value of the cash flows:

- We need to account for the tax benefit of interest payments
  - Adjust the discount rate (WACC method).
  - Adjust the cash flow estimate (APV method).

- We need to account for the risk of the project
  - Calculate a risk-adjusted discount rate:
    - What expected rate of return do outside investors require to invest into the project?

Calculating a risk-adjusted discount rate:

Ignore the tax benefits of debt for now, i.e. assume the project is 100% equity financed.

- Then the firm’s or project’s value is the present value of the future free cash flows:

\[
V = \text{Cash} + \frac{E[C_1]}{1+r_{\text{Assets}}} + \frac{E[C_2]}{(1+r_{\text{Assets}})^2} + \frac{E[C_3]}{(1+r_{\text{Assets}})^3} + \ldots
\]

- Expected Return = Cost of Capital = \( r_{\text{Assets}} = r_f + \text{Risk Premium} \)

- The risk premium for an investment is the required rate of return of the investment minus the risk free rate.
Risk Premium

- How do we find the Risk Premium?
- CAPM is one method:

\[ r_A = E[r_{\text{assets}}] = r_f + \beta_a (E[r_m] - r_f) \]

→ Get risk premium from beta & market premium

- How do you estimate asset betas?
  → For an all-equity firm (project), simply regress past stock returns on the market return to get the asset beta.
  → For levered firms, regress past stock returns on the market return to get equity betas, then unlever the estimated equity betas to arrive at asset betas.
  → Find comparable firms with similar risk, estimate their asset betas, and average across comparables.

Appendix
Computing the CAPM asset beta:

- Definition: Measure of the systematic risk of the cash flows of the firm or project.

- Note: The expected return on the assets must equal the expected return on all of the financial claims on the assets:

\[ E(r_{\text{asset}}) = \frac{D}{D+E} E(r_{\text{Debt}}) + \frac{E}{D+E} E(r_{\text{Equity}}) \]

- The CAPM is a general asset-pricing model that can price any type of asset. Hence the CAPM specifies the expected returns for both the debt and equity claims:

\[
E(r_{\text{Debt}}) = r_f + \beta_{\text{Debt}} \left[ E(r_{\text{Market}}) - r_f \right]
\]

\[
E(r_{\text{Equity}}) = r_f + \beta_{\text{Equity}} \left[ E(r_{\text{Market}}) - r_f \right]
\]

Cont.:

- Substituting the CAPM equations above into the formula for the expected return on the assets, we see that the asset beta is just a weighted average of the debt and equity betas:

\[
\beta_{\text{asset}} = \frac{D}{D+E} \beta_{\text{Debt}} + \frac{E}{D+E} \beta_{\text{Equity}}
\]

- Hence we need an estimate of each term on the right-hand side of this equation. Typically, we start by estimating equity betas from a regression of equity returns on stock market returns.

- Problem: Sometimes we need to use the betas on “comparable” firms, either because there is insufficient data on the project available, or because we try to improve the precision of the estimate in that way. This “comparable firms” procedure for the estimation of asset betas is explained on the next slide.
An approach for estimating the asset beta:

1) Recognize that all firms that generate cash flow streams with the same risk will have the same asset beta.
2) Identify firms that are likely to have cash flow streams that have similar risk. These are the “comparable” firms.
3) Estimate asset betas for the comparable firms using the formula above:
   i. Estimate equity betas for each comparable firm by regressing stock returns on market returns.
   ii. Estimate debt betas for each comparable firm in the same manner. Usually, you won’t have data to do this. In practice, it is common to assume that debt is risk free (debt beta of zero), or to assume debt betas between 0.1 and 0.3, which come from empirical studies of corporate debt returns. We need to be more careful if leverage is high.
   iii. Estimate the market value (D+E) of the firm as the sum of the market values of the debt and equity of the firm. If market value of debt (D) is not available, proxy with book value of debt.
4) Calculate the asset beta for our firm as the average of the asset betas of the comparable firms.
Wrap-Up of the Financing Module

The Big Picture: Part I - Financing

A. Identifying Funding Needs
   Feb 6       Case: Wilson Lumber 1
   Feb 11      Case: Wilson Lumber 2

B. Optimal Capital Structure: The Basics
   Feb 13      Lecture: Capital Structure 1
   Feb 20      Lecture: Capital Structure 2
   Feb 25      Case: UST Inc.
   Feb 27      Case: Massey Ferguson

C. Optimal Capital Structure: Information and Agency
   Mar 4       Lecture: Capital Structure 3
   Mar 6       Case: MCI Communications
   Mar 11      Financing Review
   Mar 13      Case: Intel Corporation
Overview of Financing

Financial forecasting
- Short-term and medium-term forecasting.
- General dynamics: Sustainable growth.

Capital structure
- Describing a firm’s capital structure.
- Benchmark: MM irrelevance.
- Theory 1: Static Trade-Off Theory.
- Theory 2: Pecking Order Theory.
- Agency issues related to capital structure.

→ Pulling it all together.

Forecasting a Firm’s Funding Needs

Question: Given a firm’s operations and the forecast thereof, how much funding will be required, and when?

- Requires short-run and long-run forecasting.
- Requires an assessment of a firm’s general dynamics:
  → The concept of sustainable growth.
  → Distinguish “cash cows” from “finance junkies”.
General Dynamics

- **Sustainable Growth Rate**: \( g^* = (1-d) \times \text{ROE} \)

- Give a (very rough) measure of how fast you can grow assets without increasing your leverage ratio or issuing equity.

- Sustainable growth rate increases when
  - Dividends \((d)\) decreases
  - Profit margins \((\text{NI/Sales})\) increases
  - Asset turnover \((\text{Sales/Assets})\) increases
  - Leverage \((\text{Assets/NW})\) increases

Key Points

- **Key Point 0**: The concept of sustainable growth does not tell you whether growing is good or not.

- **Key Point 1**: Sustainable growth is relevant only if you cannot or will not raise equity, and you cannot let D/E ratio increase.

- **Key Point 2**: Sustainable growth gives a quick idea of general dynamics: Cash cows \((g << g^*)\) or Finance junkies \((g >> g^*)\).

- **Key Point 3**: Financial and business strategies cannot be set independently.
Capital Structure: Theory and Practice

- Modigliani-Miller Theorem
  → Capital structure choices are irrelevant.

- Theory 1: Static Trade-off Theory
  → Tax shield vs. Expected distress costs

- Theory 2: Pecking Order Theory
  → Costs of asymmetric information.

- Agency Issues related to capital structure.

Modigliani-Miller Theorem

**MM**: In frictionless markets, financial policy is irrelevant.

→ “Proof”: Financial transactions are NPV=0. QED

- **Corollary**: All the following are irrelevant:
  → Capital structure
  → Long- vs. short-term debt
  → Dividend policy
  → Risk management
  → Etc.
Using MM Sensibly:

**MM gives us a framework to understand why capital structure matters -> Changing the size of the pie.**

When evaluating an argument in favor of a financial move:

- Ask yourself: Why is a financing argument wrong under MM?
  - Avoid fallacies such as mechanical effects on accounting measures (e.g., WACC fallacy, EPS fallacy)

- Ask yourself, what frictions does the argument rely on?
  - Taxes, Costs of financial distress, Information asymmetry, Agency problems.

- If none, dubious argument. If some, evaluate magnitude.

---

Theory 1: Static Trade-Off Theory

- The optimal target capital structure is determined by balancing
  
  **Tax Shield of Debt vs. Expected Costs of Financial Distress**

- Debt increases firm value by reducing the corporate tax bill.
  - This is because interest payments are tax deductible.
  - Personal taxes tend to reduce but not offset this effect.

- This is counterbalanced by the expected costs of financial distress:

```plaintext
Expected costs of financial distress = (Probability of Distress) \times (Costs if actually in distress)
```
Checklist for Target Capital Structure

**Tax Shield:**
- Would the firm benefit from debt tax shield? Is it profitable?
  - Does it have tax credits?

**Expected distress costs:**
- Are cash flows volatile?
- Need for external funds for investment?
- Competitive threat if pinched for cash?
- Customers and suppliers care about distress?
- Are assets easy to re-deploy?

**Note:** Hard to renegotiate debt structure increases distress costs (Recall Massey’s complex debt structure).

---

**Theory 2: Pecking Order**

- The Pecking Order Theory states that firms make financing choices with the goal to minimize the losses from raising funds under asymmetric information.
  - With information asymmetries between firms and markets:
    - External finance is more costly than internal funds.
    - Debt is less costly than equity (because less info-sensitive).
  - This implies that firms:
    - Preferably use retained earnings,
    - Then borrow from debt market,
    - As a last resort, issue equity.
Implications for Investment

- The value of a project depends on how it is financed.
  \[ \text{Value} = \text{NPV of project} - \text{loss from financing} \]

- Some projects will be undertaken only if funded internally or with relatively safe debt but not if financed with risky debt or equity.

- Companies with less cash and more leverage will be more prone to under-invest.

- Rationale for hoarding cash.

Agency Problems and Capital Structure

- Modigliani-Miller assumes that the real investment policy of a firm does not change as a function of capital structure.

- But: Managers’ incentives and hence their behavior may change with the capital structure of the firm.

- Managers and stockholders incentives do not always coincide. These conflicts are called agency problems.

- Agency problems in the firm:
  - We have Principals = Shareholders
  - We have Agents = Managers
Conflicts between managers and investors: Principal-Agent Problems

• Potential problems include:
  → Reduced Effort
  → Perks
  → Empire Building

• There are also conflicts between Bondholders and Shareholders

• Question:
  → Can Leverage help to avoid agency costs?
  → Can Leverage give managers incentives to make value-maximizing decisions?

Some classic principal-agent problem:

The Free Cash Flow Problem:
• Managers in firms with lots of free cash flow (cash cows) and bad investment opportunities may be reluctant to simply give the excess cash back to shareholders.
  ⇒ Having debt puts free cash flows to use, and reduces managers ability to squander funds on pet projects and empire building.

The Lazy Managers Problem:
• Managers in stable firms with lots of free cash flow and without much product market competition may become lazy and complacent.
  ⇒ Raising leverage (a lot) puts pressure on managers to perform and to make operations more efficient.
Can leverage create agency costs?

(Excessive) Leverage can create agency conflicts between equity holders (managers) and creditors (bond holders):

- **Looting the firm in financial distress**
  - Firms have incentives to loot the company prior to bankruptcy
  - Drexel paid $350M in bonuses three weeks before it filed Chapter 11

- **Delayed liquidation**
  - Firms have incentives to delay liquidation even if immediate liquidation is efficient.
  - Liquidation usually only helps creditors, not shareholders or managers.

- **Claim Dilution**
  - Firms have incentives to surprise existing creditors by borrowing more.

- **Risk shifting (asset substitution)**:
  - Managers may decide to increase the risk of the firm after they have borrowed.

All these costs are anticipated by creditors and hence raise the cost of borrowing.

---

Take Away: Agency Problems and Capital Structure

- **Leverage can help to overcome certain agency problems:**
  - The free cash flow problem.
  - Complacent, lazy managers.
  - ....

- **Excessive leverage can create other agency problems:**
  - These tend to kick in in actual financial distress, hence can be regarded as additional costs of distress.
  - Clever usage of covenants can eliminate many of these problems.
Thinking about Capital Structure: An Extended Checklist

- **Taxes**
  - Does the company benefit from debt tax shield?

- **Information Problems**
  - Do outside investors understand the funding needs of the firm?
  - Would an equity issue be perceived as bad news by the market?

- **Agency Problems**
  - Does the firm have a free cash flow problem?
  - Do the managers need additional motivation and monitoring?

- **Expected Distress Costs**
  - What is the probability of distress? (Cash flow volatility)
  - What are the costs of distress?
  - Need for external funds for investment, competitive threat if pinched for cash, customers care about distress, assets difficult to redeploy?
  - Managerial misbehavior in distress?

Conclusion

- The bulk of the value is created on the LHS by making good investment decisions.

- You can destroy much value by mismanaging your RHS: Financial policy should be supporting your business strategy.

- You cannot make sound financial decisions without knowing the implications for the business.

- Finance is too serious to leave it to finance people.
Wrap-up of Financing

Katharina Lewellen
Finance Theory II
March 11, 2003
Overview of Financing

Financial forecasting
- Short-run forecasting
- General dynamics: Sustainable growth.

Capital structure
- Describing a firm’s capital structure
- Benchmark: MM irrelevance
- Theory 1: Static Trade-Off Theory
- Theory 2: Pecking Order Theory
- An integrated approach

Note: Throughout we take “operations” as given.
Forecasting a Firm’s Funding Needs

- **Question:** Given our operations (and the forecast thereof), will we need funding, and how much?

- Short-run forecasting

- General dynamics:
  - The concept of sustainable growth
  - Cash Cows and Finance junkies
Financial Forecasting: General Approach

- Need (a model of) the firm’s production function
  - Use available data
  - Common sense
  - Specific knowledge of firm and industry

- Given this model forecast all items in the balance sheet except “funding needs”

- Infer the funding need from identity of Assets and Liabilities + Net Worth
Forecasting: Our approach

- Forecast Assets
- Forecast non-bank liabilities, excluding Net Worth
- Forecast Net Income
  - Assume some starting value for Bank Loan = “Bank Plug”
  - Forecast interest using Bank Plug
- Forecast Net Worth
- Consistency check: Assets = Liabilities + Net Worth?
  - If yes, stop
  - If not, adjust Bank Plug
- Recall: All we want are rough approximations
General Dynamics

- **Sustainable Growth Rate**: \( g^* = (1-d) \times \text{ROE} \)

- Gives a (very rough) measure of how fast you can grow Assets without increasing your leverage ratio or issuing equity

- Sustainable growth rate increases when
  - Dividends \((d)\) decreases
  - Profit margins \((\text{NI/Sales})\) increases
  - Asset turnover \((\text{Sales/Assets})\) increases
  - Leverage \((\text{Assets/NW})\) increases
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Capital Structure

- Describing a firm’s capital structure
- MM theorem
- Theory 1: Static Trade-off Theory
  - Tax shield vs. Expected distress costs
- Theory 2: Pecking Order Theory
  - Implications for investment
  - Implications for capital structure
- Pulling it all together
MM Theorem

- **MM: In frictionless markets, financial policy is irrelevant.**
  - Finance Theory 1: Financial transactions are NPV=0. QED

- **Corollary: All the following are irrelevant:**
  - Capital structure
  - Long- vs. short-term debt
  - Dividend policy
  - Risk management
  - Etc.
Evaluate the following statements

- Issuing equity dilutes earnings-per-share and thus hurts current shareholders.

- Equity in a levered firm is riskier than equity in an unlevered (but otherwise identical) firm.

- Currently, interest rates are high, so it is better to issue equity than debt.

- Currently, short-term interest rates are lower than long-term interest rates, so it is better to issue long-term than short-term debt.
Using MM Sensibly

When evaluating an argument in favor of a financial move:

- **Ask yourself: Why is financing argument wrong under MM?**
  - Avoid fallacies such as mechanical effects on accounting measures (e.g., WACC, EPS, Win-win)

- **Ask yourself, what frictions does the argument rely on?**
  - Taxes, Costs of financial distress, Information asymmetry, Agency problems

- If none, dubious argument. If some, evaluate magnitude.
Financing Choices

Debt vs. Equity
Theory 1: Static Trade-Off Theory

- Talks about costs and benefits of Debt relative to Equity
- The optimal target capital structure is determined by balancing

![Diagram](Tax Shield of Debt vs. Expected Costs of Fin. Distress)

**Note:** The theory does not give you a precise target but rather a range, an order of magnitude.
Tax Shield of Debt

- Debt increases firm value by reducing corporate tax bill.
  - This is because interest payments are tax deductible.
  - Personal taxes tend to reduce but not offset this effect.

\[ V(\text{w/ debt}) = V(\text{all equity}) + PV(\text{tax shield}) \]

- Order of magnitude for PV tax shield
  - Constant debt level : \( t \times D \)
  - \( t \) = marginal tax rate depends on country, tax credits, etc.

**Note:** A move that increases firm value will increase equity value!
Expected Costs of Distress: Two Terms

Expected costs of financial distress

= 

(Probability of Distress) * (Costs if actually in distress)
Probability of Distress

- Cashflow volatility
  - Is industry risky? Is firm’s strategy risky?
  - Are there uncertainties induced by competition?
  - Is there a risk of technological change?
  - Sensitive to macroeconomic shocks, seasonal fluctuations?
  - Etc.

- Use past data but also knowledge of industry.

- Beware of changes of environment.
Indirect costs of financial distress:

- **Debt overhang**: Inability to raise funds to undertake investments.
  - Pass up valuable projects ⇒ **Do I need to invest?**
  - Rivals become aggressive ⇒ **Do I have aggressive rivals?**

- **Scare off customers and suppliers** (e.g., implicit warranty or specific investment) ⇒ **Do other parties care?**

- **Asset fire sales** ⇒ **Are assets easily re-deployable?**
  - Are my assets valuable to other firms? (e.g. R&D)
  - Who are potential buyers? How many? Will they be cash constrained when I want to sell my assets?
Checklist for Target Capital Structure

Tax Shield:
- Would the firm benefit from debt tax shield? Is it profitable? Does it have tax credits?

Expected distress costs:
- Are cashflows volatile?
- Need for external funds for investment?
- Competitive threat if pinched for cash?
- Customers and suppliers care about distress?
- Are assets easy to re-deploy?

Note: Hard to renegotiate debt structure increases distress costs (Recall Massey’s complex debt structure).
Theory 2: Pecking Order

- Firms general financing choices:
  - Preferably use retained earnings
  - Then borrow from debt market
  - As a last resort, issue equity

- Theory: Info. asymmetry between firm and market makes:
  - External finance more costly than internal funds
  - Debt less costly than equity (because less info-sensitive)
Implications for Investment

- The value of a project depends on how it is financed.
- Some projects will be undertaken only if funded internally or with relatively safe debt but not if financed with risky debt or equity.
- Companies with less cash and more leverage will be more prone to under-invest.
- Rationale for hoarding cash.
Implications for Capital Structure

- If a firm follows the Pecking Order, its leverage ratio results from a series of incremental decisions, not attempt to reach a target.
  - High cash flow ==> Leverage ratio decreases
  - Low cash flow ==> Leverage ratio increases

- There may be good and bad times to issue equity depending on the degree of information asymmetry.

- Rationale for hybrid instruments.
What Do We Do With Two Theories?

- Sometimes, both theories will give the same recommendation
- But sometimes, they will differ
- Consider Massey Ferguson:
  - Static Trade-off theory ==> Equity issue
  - Pecking Order Theory ==> Debt issue
- Two questions:
  - Is one theory better at describing what firms do?
  - Is one theory better at telling what they should be doing?
But As a Prescriptive Theory?

If firms use Pecking order blindly and ignore static trade-off:

- **Cash cows will end up with too little leverage (UST).**
  - Good news: Never too late to lever-up

- **Finance junkies will end up with too much leverage (Massey)**
  - Bad news: It can be too late to unlever (debt-overhang).
  - ST debt is temporary relief but worsens things in fine.
DON'T TALK TO DEERE & COMPANY ABOUT MARKET SIGNALING (from Higgins)

(Please see “Don’t Talk to Deere & Company About Market Signaling” from the course textbook by Higgins.)
An Integrative Approach

- Each theory makes a statement about what is first order issue:
  - STO: Tax shield and Distress costs
  - PO: Information (Price of claims you issue)

- Both theories need not be incompatible:
  - Use each when you think they emphasize the right issues

- When getting far away from target, STO type issues dominate

- When reasonably close to target, PO type issues dominate
An Integrative Approach (cont.)

- Establish long-run “target” capital structure

- Evaluate the true economic costs of issuing equity
  - What is real cost of price hit vs. foregone investment or increase in expected cost of distress.

- If still reluctant to issue equity:
  - Are there ways to reduce the cost? (e.g., give information)
  - Will the cost be lower if you issue later?
  - Can you use hybrids and packages to get there? But be careful. (Recall MCI might get stuck with too much debt)
An Integrative Approach (cont.)

- Straying from target may be warranted. But, be as systematic and precise as possible about justification -- Are benefits from straying plausibly large relative to costs?

- Remember: Lion’s share of value is created on LHS. Don’t want to endanger operations. Beware excessive leverage. Ultimately, business strategy should drive financial strategy, not the other way around.

- Avoid rules of thumb like: "Never issue in a down market"; or "Don't knock props out from under stock." These may make sense in some, but certainly not all circumstances.
Conclusion

- The bulk of the value is created on the LHS by making good investment decisions.

- You can destroy much value by mismanaging your RHS: Financial policy should be supporting your business strategy.

- You cannot make sound financial decisions without knowing the implications for the business.

- Finance is too serious to leave it to finance people.
## Apex Drugs and Products

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</thead>
<tbody>
<tr>
<td>Sales</td>
<td>2,471.7</td>
<td>2,685.1</td>
<td>3,062.6</td>
<td>3,406.3</td>
<td>3,798.5</td>
</tr>
<tr>
<td>Net income</td>
<td>277.9</td>
<td>306.2</td>
<td>348.4</td>
<td>396.0</td>
<td>445.9</td>
</tr>
<tr>
<td>EPS</td>
<td>1.75</td>
<td>1.94</td>
<td>2.21</td>
<td>2.51</td>
<td>2.84</td>
</tr>
<tr>
<td>DPS</td>
<td>1.00</td>
<td>1.15</td>
<td>1.33</td>
<td>1.50</td>
<td>1.70</td>
</tr>
<tr>
<td>Cash</td>
<td>358.8</td>
<td>322.9</td>
<td>436.6</td>
<td>493.8</td>
<td>593.3</td>
</tr>
<tr>
<td>Total assets</td>
<td>1,510.9</td>
<td>1,611.3</td>
<td>1,862.2</td>
<td>2,090.7</td>
<td>2,370.3</td>
</tr>
<tr>
<td>A/P and other non-interest bearing liabilities</td>
<td>511.60</td>
<td>565.70</td>
<td>670.50</td>
<td>758.40</td>
<td>883.60</td>
</tr>
<tr>
<td>Long-term + short-term debt</td>
<td>7.8</td>
<td>10.3</td>
<td>13.7</td>
<td>10.3</td>
<td>13.9</td>
</tr>
<tr>
<td>Net worth</td>
<td>991.5</td>
<td>1,035.3</td>
<td>1,178.0</td>
<td>1,322.0</td>
<td>1,472.8</td>
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</table>
Describe Apex’s capital structure.
What are the likely factors that led to this capital structure.

Different measures of leverage should give you a similar picture:

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<td>1,178.0</td>
<td>1,322.0</td>
<td>1,472.8</td>
</tr>
<tr>
<td>D/(D+NW)</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>D/(Total Assets)</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td>(D-Cash)/(Total Assets)</td>
<td>-23%</td>
<td>-19%</td>
<td>-23%</td>
<td>-23%</td>
<td>-24%</td>
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</table>
What are likely factors that led to this capital structure?

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<td>2,370.3</td>
</tr>
<tr>
<td>Growth in assets</td>
<td>0.07</td>
<td>0.16</td>
<td>0.12</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
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<td>1,322.0</td>
<td>1,472.8</td>
</tr>
<tr>
<td>ROE</td>
<td>0.31</td>
<td>0.34</td>
<td>0.34</td>
<td>0.34</td>
<td></td>
</tr>
<tr>
<td>Dividend payout ratio</td>
<td>0.59</td>
<td>0.60</td>
<td>0.60</td>
<td>0.60</td>
<td></td>
</tr>
<tr>
<td>Plowback ratio</td>
<td>0.41</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td>Sustainable growth rate</td>
<td>0.13</td>
<td>0.13</td>
<td>0.14</td>
<td>0.14</td>
<td></td>
</tr>
</tbody>
</table>
What are likely factors that led to this capital structure?

- In most years, assets grew slower than the sustainable rate
  - Retained earnings more than covered the investment needs
  - Apex never had to raise outside funds
  - A classic “cash cow”

- What explains the high sustainable rate?
  - High profit margins and asset turnover offset the mechanical effect of low leverage and the high payout ratios

- Apex management has not attempt to voluntarily increase leverage
What explains the high sustainable rate?
(Focus on year 1992)

\[ g^* = (1-d) \times \text{ROE} = (1-d) \times \frac{\text{NI}}{\text{NW}} = (1-d) \times \frac{\text{NI}}{\text{Assets}} \times \frac{\text{Assets}}{\text{NW}} \]

\[ g^* = 0.4 \times 0.34 = 0.4 \times 0.21 \times 1.58 \]
What explains the high sustainable rate?
(Focus on year 1992)

\[ g^* = (1-d) \times \text{ROE} = (1-d) \times \frac{\text{NI}}{\text{NW}} = (1-d) \times \frac{\text{NI}}{\text{Assets}} \times \frac{\text{Assets}}{\text{NW}} \]

\[ g^* = 0.4 \times 0.34 = 0.4 \times 0.21 \times 1.58 \]

\[ \text{ROA} = \frac{\text{NI}}{\text{Assets}} = \frac{\text{NI}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Assets}} = \text{Profit Margin} \times \text{Asset Turnover} \]

\[ \text{ROA} = 0.12 \times 1.82 \]
Is this capital structure optimal?

USE THE CHECKLIST!

Tax shield:
- Would APEX benefit from tax shields?
  - Is APEX profitable? Yes
  - Does it have tax deductions? Not likely

Expected distress costs:
- Are cashflows volatile? No
- Need for external funds for investment? Not much
- Competitive threat if pinched for cash? Yes
- Customers and suppliers care about distress? Not much
- Are assets hard to re-deploy? Not really
Apex’s capital structure in 1993?
Sales will grow at 11%. Profit margin will fall to 7%.

<table>
<thead>
<tr>
<th></th>
<th>1992</th>
<th>1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>3,799</td>
<td>4,216</td>
</tr>
<tr>
<td>Net income</td>
<td>446</td>
<td>295</td>
</tr>
<tr>
<td>Profit margin</td>
<td>0</td>
<td>0.07</td>
</tr>
<tr>
<td>Retained earnings</td>
<td>178</td>
<td>118</td>
</tr>
<tr>
<td>NW (NW 1993 + Retained earnings 1994)</td>
<td>1,473</td>
<td>1,591</td>
</tr>
<tr>
<td>Cash (remains constant)</td>
<td>593</td>
<td>593</td>
</tr>
<tr>
<td>Total assets (all other assets grow at 11%)</td>
<td>2,370</td>
<td>2,566</td>
</tr>
<tr>
<td>A/P and other non-interest bearing liabilities (grow at 11%)</td>
<td>884</td>
<td>981</td>
</tr>
<tr>
<td>Bank plug (Total assets - NW - A/P)</td>
<td>14</td>
<td>(6)</td>
</tr>
</tbody>
</table>

External funding needs = -6 – 14 = -20

=> Apex has excess internal funds of 20.
Apex’s target capital structure in the long run?

- **More uncertainty**
  - Potential regulation
  - Technological change

- **More competitive pressure**
  - Regulation may favor competition in generic drugs

- **Apex needs to invest more**
  - Advances in biotechnology => more R&D required

- **Less internally generated funds**
  - Patents expire

- **Bottom line:** Lower target leverage.
Corporate Finance 15.402
Assignment 1: Wilson Lumber 1 (REQUIRED)

Your job is to evaluate Mr. Wilson’s loan application for the Northup Bank, and ultimately, to decide whether or not to grant a loan. To start with (in session 1), Mr. Dodge needs a memo from you describing Wilson’s business, the likely reason(s) for his funding need, and the possible ways in which it can be financed. Ideally, your memo should be typed, short, precise and to the point.

1. Briefly describe the lumber business and the key factors for success in this business.
2. From an operational standpoint (not financial) – how well is the Wilson Lumber Company doing?
3. Describe the company’s financial policy over the previous few years.
4. Why does Mr. Wilson have to borrow money to support his business despite a record of profitable operations?
5. What are Wilson’s alternatives to borrowing money from Northrup?

For question 4, you may want to do the following:

a. Prepare a statement showing the sources of funds and the uses of funds for the period from 1982 through the first quarter of 1985. This will help you realize where the money is coming from and where it is going. What are the main sources and uses of funds?
   i. Compare Wilson’s balance sheet in 1982 and 1985-Q1
   ii. Classify Assets that have increased as a use of funds, and those that have decreased as a source of funds.
   iii. Classify Liabilities that have increased as a source of funds and those that have decreased as a use of funds.

b. You may also want to calculate and analyze those financial ratios that you feel explain Wilson’s need for funds.
Corporate Finance 15.402
Assignment 2: Wilson Lumber 2 (REQUIRED)

Now that you have a better understanding of Wilson’s business so far, you need to look at the future and forecast his funding needs.

1. Do you agree with Mr. Wilson’s conclusion that a $325,000 line of credit will be sufficient to meet his foreseeable funding needs? How much will he need to borrow to finance his expected sales over the next few years?
2. As Mr. Wilson’s financial advisor, would you recommend further expansion of his business and more debt financing? Why or why not?
3. As his banker, would you be willing to lend to Mr. Wilson? If so, what conditions might you attach to the loan? If not, explain your reasons.

To answer question 1, assume that sales reach $2.5MM in 1985 and construct a *pro forma* income statement and balance sheet projections for 1985-1988. Do this for each of the following three scenarios:

1. Sales grow at 25% per year in 1986-1988 and accounts payable remains at 55 days.
2. Sales grow at 25% per year in 1986-1988 and accounts are paid by the tenth day in order to get the 2% discount.
3. Sales grow at 14% per year in 1986-1988 and accounts are paid by the tenth day in order to get the 2% discount.

You will need to estimate the size of the bank loan under each scenario. To do this, you should first forecast the value of assets using the appropriate assumptions. Next, forecast non-bank liabilities – including a guess as to the value of the Net Income. The difference gives you an estimate of the amount that Wilson needs to borrow from the bank. Plug in an estimate of the bank loan. Recalculate net Income using the interest of the estimated bank loan. Iterate until the balance sheet balances.
Corporate Finance 15.402
Assignment 3: Debt Policy at UST Inc.

Prepare a memo addressing the following questions:

1. Suppose that you are considering purchasing UST’s bonds. Briefly describe the attributes and business risks associated with UST that you would find of interest.

2. UST Inc. has a long history of conservative debt policy. Briefly describe why they are considering a recapitalization that involves issuing debt and repurchasing equity?

3. Should UST Inc. undertake the $1 Billion recapitalization? Calculate the effect on stock price assuming that the entire recapitalization is done immediately (January 1, 1999).
   a. In this calculation, assume the following:
      i. Corporate tax rate is 38%
      ii. All equity is bought back at a price that reflects the added value of the tax shield.
   b. Prepare a Pro Forma Statement to analyze whether UST will be able to make the interest payments.
      i. Use Exhibit 8 to determine UST’s credit rating and interest rate.
      ii. State your assumptions clearly.
Your group has been brought in to sort out the crisis Massey is in. Your first task is to understand how and why Massey got into trouble. Then, you will need to advise Massey’s management on a refinancing plan. Your memo is most eagerly awaited.

1. Assess the product market strategy Massey pursued through 1976. Where possible, compare their strategy with those of its leading competitors. Did Massey’s strategy make sense (at the time)?

2. Describe briefly Massey’s capital structure in 1976. In your view, is this a good capital structure for Massey? If yes, explain what are its main benefits. If not, what might explain why Massey has such a capital structure? Where possible, compare Massey’s strategy with those of its leading competitors.

3. What went wrong after 1976? How did Massey respond? How did its competitors respond? What were the consequences for Massey?

4. Assess the various alternatives at the current stage (as of the case date) of Massey’s difficulties. What options are available for alleviating their financial problems?

5. As a financial advisor to Massey’s management, what refinancing plan would you propose? Give particular attention to the various interested parties: shareholders, lenders, employees, governments and management.
Prepare a memo addressing the following questions:

1. What is the likely level of MCI’s external financing needs over the next several years? How much might you expect them to vary? Why?

2. Discuss MCI’s past financial strategy, paying attention to the types of securities issued. Why did MCI finance itself in this manner?

3. Based on your analysis of the outlook for MCI (given the competitive and regulatory nature of the industry) recommend a capital structure policy, and defend your decision against plausible alternatives.

4. Assume that Mr. English (MCI’s CFO) has the following financing alternatives available to him in April 1983. Which – if any – of these alternatives would you suggest he take? Why?
   a. $500 million of 12-1/2%, 20-year subordinated debentures.
   b. $400 million of common stock.
   c. $1 billion of 7-1/2%, 10-year convertible subordinated debentures with a conversion price of $55 per share (i.e., each $1000 face value bond would be converted into 18.18 common shares). The company can call the bonds any time after three years.

   In a broad outline, what financing steps would you suggest he follows over the next several years?

Additional Case Facts: The allocation of long distance market share after 1983

The FCC has dictated a series of “elections”, city by city, starting in 1984 and concluding in 1987. In each election, every customer will be sent a ballot and asked to return it with a selection of a long-distance carrier. Despite heavy advertising by long-distance companies, only 15%-30% of customers are expected to return their ballots. The nonvoting market share will be allocated in the proportions determined by those voting. MCI’s future will be determined by its success in this electoral process.
Corporate Finance 15.402
Assignment 6: Intel Corporation, 1992

Prepare a memo addressing the following questions:

1. Why has Intel been so successful in recent years? What are the pros and cons of being an innovator vs. a second mover in this industry? What steps should Intel take to strengthen its competitive position?

2. Describe briefly Intel’s current capital structure. Discuss whether in your view this capital structure is optimal for Intel, with particular emphasis on the pros and cons of Intel’s substantial cash holdings. Articulate and defend a “target” capital structure for Intel.

3. What are the primary differences between dividends and repurchases as a means of disbursing cash to investors?

4. What are the pros and cons of the three different methods of repurchases
   a. Open Market
   b. Fixed Price Tender Offer
   c. Dutch Auction Tender Offer

5. Evaluate the Put-Warrant/Convertible Bond proposal. Does it solve Intel’s capital structure dilemma? What arguments might be made in favor of it?

6. What should Intel do?
Prepare a memo addressing the following questions:

1. What factors should Ameritrade management consider when evaluating the proposal? Why?

2. How can the Capital Asset Pricing Model (CAPM) be used to estimate the cost of capital for a real investment (as opposed to a financial investment)?

3. Using the CAPM:
   a. What is your estimate of the risk-free rate to use for the cost of capital for Ameritrade? Why?
   b. What is your estimate for the market risk premium? Why?
   c. In principal, how would you compute the asset beta of a project?

4. Ameritrade has a short history of trading, so the beta cannot be computed from historical data. Exhibit 4 provides some choices for comparable firms. Which of these firms do you think are appropriate to use as comparables to determine the beta of Ameritrade’s planned advertising and technology investments? Why?

5. Using the stock price and returns presented in Exhibit 5 and Exhibit 6, and the capital structure from Exhibit 4, calculate the asset betas for the comparable firms. What beta should Ameritrade use? Why?
Corporate Finance 15.402  
Case 8: Dixon Corporation

Your job is to help Dixon's management decide whether to acquire the Collinsville plant at the proposed price. Some of the managers in charge of the decision are familiar with the simple WACC valuation method (i.e., using a single WACC to discount all cash flows) and so you have been asked to perform the valuation in this way. However, because you are aware of certain pitfalls of this method, you are also performing an APV-based valuation exercise.

1) Estimate the weighted average cost of capital that is appropriate for discounting the Collinsville plant’s incremental cash flows. You should estimate and present each component of the WACC separately, explaining briefly but clearly what assumptions you are making for each of them. In the same spirit, estimate the appropriate all-equity cost of capital for the APV-based valuation.

2) Project the incremental cash flows associated with the acquisition of the Collinsville plant without the laminate technology. Use projections from Exhibit 8 through 1984. After 1984 assume: EBIT is flat; capital expenditures are $600,000 per year; and that net working capital increases 8% per year. Assume that the plant is shut down at the end of 1989 and that its salvage value is zero.

3) Estimate the value of the Collinsville plant without the laminate technology using the simple WACC method.

4) Project the incremental cash flows associated with the 1980 investment in laminate technology. Using the simple WACC method, estimate the investment’s net present value.

5) Compare the WACC-based valuation to the APV-based valuation. Do they differ and how much? If the difference is important, explain why. If the difference is small or zero, explain why.

6) As CEO of Dixon Corporation, would you approve the acquisition of the Collinsville plant at the price and on the terms proposed? Why, or why not?
Your task is to evaluate the proposed plan to modernize Diamond’s production line. Please answer the following questions:

1) What changes, if any, should Lucy Morris ask Frank Greystock to make in his discounted-cash-flow (DCF) analysis? Why? What should Morris be prepared to say to:
   a. the Transport Division?
   b. the Director of Sales?
   c. her assistant plant manager?
   d. the analyst from the Treasury staff?

2) How does Diamond Chemicals evaluate its capital-expenditure proposals? What is your assessment of this scheme?

3) After incorporating all changes that you identified in part (1) into Greystock’s DCF analysis, do you think that Morris should continue to promote the project for funding?
Corporate Finance 15.402  
Case 10: MW Petroleum

You have to present Apache's board of directors with a formal evaluation of the MW properties that Apache is considering acquiring. You will pay particular attention to identifying and valuing the several options that are imbedded in MW's assets.

1) Estimate the value of all the MW reserves using APV. Is your APV estimate more likely to be biased high or low? What is the main source of the bias?

2) How would you structure a simplified analysis of MW as a portfolio of assets-in-place and a number of significant options imbedded in MW's assets? Which parts of the business will you regard as assets-in-place and which as options?

3) Conduct the analysis you structured above, beginning with the assets-in-place. For each of the options you have decided to value:
   a) Estimate S, X, r, T, σ, and discuss your estimates.
   b) Compute option values and compare them to APV values.

4) Decision Time: What is your estimate of the MW properties under consideration?
Corporate Finance 15.402  
Case 11: Cooper Industries, Inc.

Your team is to advise Cooper’s top management on the possible acquisition of Nicholson File. In order to make your recommendation, you need to assess the value of Nicholson following the acquisition, as well as the implied stock price, under a number of scenarios.

1) Why is Cooper Industries interested in acquiring Nicholson File?

2) What is the maximum price Cooper should be willing to pay for all of Nicholson's common stock assuming an 11% cost of capital, 6% per year growth in future sales, no improvements in managing working capital, and

   a. no margin improvements.

   b. if the forecasted margin improvements are realized by 1973 only in cost of goods sold such that cost of goods sold is 67% of sales in 1972 and 65% thereafter.

   c. if the forecasted margin improvements are realized from both cost of goods sold as indicated in (b) above, and SG&A is reduced to 21% of sales in 1973, 20% in 1974, and 19% thereafter.

3) Consider the most optimistic scenario of question 2(c) above. How much of an improvement in the net working capital/sales ratio must Cooper achieve at Nicholson to justify paying $50/share for Nicholson? In your view, is such a ratio a reasonable target for Cooper? Explain briefly.

4) Time to make your recommendation. What should Mr. Cizik do? Should he acquire Nicholson File? If yes, how and on what terms? If not, explain why.
Corporate Finance 15.402
Case 12: The Southland Corporation
(optional)

As representatives of Southland’s shareholders (not the Thomsons), your mission, if you accept it, is to analyze the proposed LBO plan, and to give recommendation in favor or against it.

1) What are the possible motives for a LBO of Southland?

2) Estimate the value of Southland’s shares under the proposed LBO plan, using the Adjusted Present Value approach and taking the 1988-1997 projections in Exhibit 4 as given. (You will have to work out a post-1997 "terminal value" yourself.) Use the following additional assumptions:

   - A tax rate of 36%
   - A pre-transaction equity beta for Southland of 1.0 (this is the 1986 value from Exhibit 1)

3) Do you think the projections are plausible? If not, what do you think is a more reasonable estimate of Southland's value?

4) It's decision time again! What is your recommendation to Southland’s shareholders? Why?
Finance Theory II (15.402)
Practice Exam
Exam courtesy of Prof. David Scharfstein. Used with permission.

Bradley W. Bushengore sat back in his extremely comfortable chair in his extremely comfortable office looking out over the New Jersey Turnpike. He could see the smoke billowing out of the oil refineries on the other side of the Turnpike and, if he opened his window, he could smell them too. Mr. Bushengore thought back on his last few years as Chief Financial Officer of Apex Drugs and Products. By 1992, Apex had become a major player in prescription drugs with sizable market share in quite a few of them, and several "blockbuster" drugs. Apex also had numerous brand name home products such as Clean detergent and Chef Girardee canned food.

The three pillars of Apex's strategy were conservatism, marketing and cost control. Apex consistently avoided much of the risk of product development and introduction in the volatile drug industry. Most of its new products were acquired or licensed after their development by other firms. Others were copies and clever extensions of products introduced by competitors. Apex's success was built on its expertise in marketing, which eroded its competitors’ headstart, and on cost control, which ensured substantial margins. The results were impressive. Selected financial data for Apex (in $ millions):

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<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>2,471.7</td>
<td>2,685.1</td>
<td>3,062.6</td>
<td>3,406.3</td>
<td>3,798.5</td>
</tr>
<tr>
<td>Net income</td>
<td>277.9</td>
<td>306.2</td>
<td>348.4</td>
<td>396.0</td>
<td>445.9</td>
</tr>
<tr>
<td>EPS</td>
<td>1.75</td>
<td>1.94</td>
<td>2.21</td>
<td>2.51</td>
<td>2.84</td>
</tr>
<tr>
<td>DPS</td>
<td>1.00</td>
<td>1.15</td>
<td>1.33</td>
<td>1.50</td>
<td>1.70</td>
</tr>
<tr>
<td>Cash</td>
<td>358.8</td>
<td>322.9</td>
<td>436.6</td>
<td>493.8</td>
<td>593.3</td>
</tr>
<tr>
<td>Total assets</td>
<td>1,510.9</td>
<td>1,611.3</td>
<td>1,862.2</td>
<td>2,090.7</td>
<td>2,370.3</td>
</tr>
<tr>
<td>A/P and other non-interest bearing liabilities</td>
<td>511.60</td>
<td>565.70</td>
<td>670.50</td>
<td>758.40</td>
<td>883.60</td>
</tr>
<tr>
<td>Long-term + short-term debt</td>
<td>7.8</td>
<td>10.3</td>
<td>13.7</td>
<td>10.3</td>
<td>13.9</td>
</tr>
<tr>
<td>Net worth</td>
<td>991.5</td>
<td>1,035.3</td>
<td>1,178.0</td>
<td>1,322.0</td>
<td>1,472.8</td>
</tr>
</tbody>
</table>

Balance Sheet 1992

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash and equivalent</td>
<td>A/P and other non-interest bearing liabilities</td>
</tr>
<tr>
<td>A/R</td>
<td>Long-term + short-term debt</td>
</tr>
<tr>
<td>Inventory</td>
<td>Total liabilities</td>
</tr>
<tr>
<td>PPE</td>
<td>Net Worth</td>
</tr>
<tr>
<td>Other</td>
<td>Total liabilities + Net worth</td>
</tr>
<tr>
<td>Total assets</td>
<td></td>
</tr>
</tbody>
</table>

As he thought more about Apex's past performance, and sat further back in his extremely comfortable chair in his extremely comfortable office, Mr. Bushengore fell asleep.
Please answer the following 4 questions on the attached blank sheets. Each question is worth 25 points. If you make assumptions, mention them explicitly. Answers to each question should more or less fit in one page (No need to write a novel).

1) Before Mr. Bushengore wakes up, describe Apex's capital structure over the period 1988-92. What are the likely factors that explain this capital structure? (Your discussion should be based on simple statistics computed from the available data).

2) Based on the information given above, is this capital structure likely to be optimal? If yes, explain its merits relative to alternative capital structures. If not, discuss this capital structure’s main drawbacks, as well as the relative merits of the different possible paths to a more suitable capital structure. (No calculations needed).

After several hours of snoozing, Mr. Bushengore woke up with a start and a stiff neck. He realized that all industries undergo change at some point and the pharmaceutical industry was no different. The Clinton administration was threatening the industry with tighter regulation with measures increasing the control of prices, and favoring the development and diffusion of generic drugs. At the same time, some of Apex's most profitable patents were about to expire. Also, many industry analysts believed that advances in bio-technologies would lead, in the longer run, to a new generation of drugs replacing more traditional ones. Developing these new drugs, as well as building up expertise in the new industry, was bound to require a considerable R&D effort.

3) Mr. Bushengore’s quick forecast was that Apex’s sales were likely to grow 11% the following year, but that its margins (net income/sales) were likely to fall to 7%. He wondered what his capital structure would look like the following year given that he did not want to cut the dividend ratio, or issue equity. Please help Mr. Bushengore out with these calculations, as he is not very good with numbers. (Calculations needed).

4) Given these changes in the industry and assuming that they persist, what do you think Apex's target capital structure should be in the long run? What impediments, if any, might Mr. Bushengore face in maintaining this target?
Answer question 1:

Since Zizanic is a project of Asteroid Films, one reasonable assumption is that the corporation is profitable and can benefit from debt tax shields, the investment in Zizanic should theoretically be financed in the same fashion as the rest of the company. In practice, since Asteroid’s debt/equity ratio is already ½, and since the investment in this movie is not backed by hard assets, Zizanic’s share of debt should be smaller than for the rest of the corporation – i.e. Asteroid’s debt capacity increases proportionally less than the amount invested in the movie. The exact amount is hard to estimate – in the following WACC calculations all assumption ranging between 0 additional debt and the same share of debt as the rest of the company would be acceptable, as long as this issue concerning debt capacity is carefully spelled out.

Answer Question 2:

In order to estimate WACC, we have to estimate the cost of equity and cost of debt for the project. We also assume that Asteroid finances Zizanic with the same share of debt as the rest of the company.

- Since both Asteroid pictures and Pixar derive most of their profits from movies, they should have similar returns on assets. We decide to use Pixar as a comparable. We start by using Pixar’s equity beta estimated with monthly return since there will be less noise. Since Debt = 0, $\beta_A = \beta_E = 1.30$. Using CAPM, if we assume that the market risk premium is 7.5%, $r_A = 2\% + 1.3 \times (7.5\%) = 11.75\%$.

- Asteroid Pictures has a credit rating of BBB (same as Harras’ Casinos). Comparable debt in the market has a 5.8% YTM. Also, Asteroid’s market value of debt is $935M, given its current market price ($93.5/$100).

In this question full credit was given only to people who explained WHY they chose a certain beta, a certain RD or a certain Rf rate.

The two data points above allow us to write:

\[
\begin{align*}
    r_A &= r_D \times \frac{D}{D+E} + r_E \times \frac{E}{E+D} \\
    11.75\% &= 5.8\% \times \left[ \frac{0.935}{2+0.935} \right] + r_E \times \left[ \frac{2}{2+0.935} \right] \\
    \text{Therefore} \quad r_E &= 14.5316\%
\end{align*}
\]

\[
\begin{align*}
    \text{WACC} &= r_D \times (1-t) \times \frac{0.935/2.935}{2.935} + r_E \times \frac{2}{2.935} = \\
    &= 5.8\% \times (1-40\%) \times \frac{0.935/2.935}{2.935} + 14.5315\% \times \frac{2}{2.935} = 11.0109\%
\end{align*}
\]

1 The best answer would acknowledge the fact that Pixar is a much smaller company and might not be completely meaningful as a comparable. As a cross check, MGM and Harrahs’ (companies of comparable size) asset betas can be used to estimate the asset beta of a company invested 100% in movies.
**Answer Question 3:**
In the APV calculations the discount rate should be that of an all-equity firm: \( r_A \). We found above that \( r_A \) for Asteroid is 11.75%.

**Answer Question 4:**

### a)

<table>
<thead>
<tr>
<th></th>
<th>Today 2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>+ Revenues from Operations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First year (theatres)</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Following (videotapes @ $20 each)+B7</td>
<td>10</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased Profits from other movies</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td><strong>- COGS</strong></td>
<td></td>
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<tr>
<td>Videotapes production @ $4 each</td>
<td>-2</td>
<td>-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>- Depreciation (3 years)</strong></td>
<td>-16.6</td>
<td>-16.6</td>
<td>-16.6</td>
<td></td>
</tr>
<tr>
<td><strong>EBIT</strong></td>
<td>29.9</td>
<td>-7.1</td>
<td>-11.1</td>
<td></td>
</tr>
<tr>
<td><strong>- Taxes @ 40%</strong></td>
<td>-12.0</td>
<td>2.8</td>
<td>4.4</td>
<td></td>
</tr>
<tr>
<td><strong>Earnigs B1 after Taxes</strong></td>
<td>17.9</td>
<td>4.3</td>
<td>-6.7</td>
<td></td>
</tr>
<tr>
<td><strong>+ Depreciation</strong></td>
<td>16.6</td>
<td>16.6</td>
<td>16.6</td>
<td></td>
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</tbody>
</table>

### Capex

<p>| | | | | |</p>
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<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Purchase of rights</td>
<td>-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production costs</td>
<td>-46.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costs sale delayed</td>
<td>-0.3</td>
<td>0.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sale of production items</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NWC</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase in NWC</td>
<td>-0.1</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decrease of NWC</td>
<td></td>
<td></td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td><strong>FREE CASH FLOWS</strong></td>
<td>-50.1</td>
<td>34.74</td>
<td>12.34</td>
<td>11.04</td>
</tr>
</tbody>
</table>

**b)**
Asteroid would depreciate straight line because the total amount of depreciation it could benefit from for tax purposes would increase. Although when Asteroid sells its assets in year three it would have to pay taxes on the surplus, the capital gains tax rate is lower than the corporate tax rate (40% in this case).
Answer Question 5:

1) Assuming that the Zizanic project is contributes nothing to the firm’s debt capacity, APV = NPV.

Valuation:
Discount rate = 11.75%

\[ \text{NPV} = \text{APV} = (1.22 \text{M}) \]

2) If instead we assume that the project adds to the debt capacity so as to keep the overall D/E ratio constant, results are different.
- NPV is calculated with the same cash flows but using the firm WACC = 11.0109%. NPV turns out to be (0.722M)
- APV is calculated using the same cash flows and Asteroid's cost of equity: 11.75%. The all-equity value of the firm is, as above, (1.22M). On top of it we need to add the PV of the interest tax shield. The additional debt issued because of Zizanic is $15.9M (amount that keeps the firm capital structure constant). Yearly interest payments would be $15.9 \times 5.8\% = $0.922M. Yearly tax savings would be: $0.922 \times 40\% = $0.3688. The PV of the tax shield is \[ 0.3688/(1.02) + 0.3688/(1.02)^2 + 0.3688/(1.02)^3 = 1.0638 \text{M}. \]

APV turns out to be: (0.156M).

Based on these calculations, Rock should not go ahead with the Zizanic project regardless of how it is financed.
In this question, full credit was given only to students who explained why they were using a certain discount rate rather than another.

Answer Question 6:

a) Rock is facing a typical case in which his investment provides access to a real option. By deciding to invest in Zizanic, he can secure the 3-year right of making a decision on whether to invest in the sequel or not. He has almost all the data he needs to value the real option: he knows how much he should pay for Zizanic 2 (K = strike price); he knows how much the project is worth today (S_0); he knows how much time he has to make up his mind (T = 3 years); he knows the relevant discount rates to apply. He is only missing information on the volatility of the value of the project. He does have volatility information for comparable firms. Clearly these volatility estimates will be substantially lower than the volatility of a single movie because the firms are somewhat diversified relative to a single project. However, the volatility provides a starting point to develop a reasonable volatility estimate.

b) If we assume that the movie business is very volatile, and we use a \( \sigma \) of 50%, the value of the option will be (assuming exercise in 2005). I don’t expect you to be able

\[ \text{Please note that the savings from the tax shield are discounted at the risk free rate, } 2\% \text{ (2-year government notes).} \]
to calculate the Black-Scholes value in your answer here. What I hope you do is think about the option value boundaries. $C > S - PV(x) \Rightarrow C > 1.95 - 1.88 = .07$. If you think about the values of $N(d1)$ and $N(d2)$ you can probably get an even better guess. In addition, some discussion of the importance of volatility to the estimates is also important.

If you had a computer you could have calculated the Black-Scholes value:

- $PV$ (exercise price) = $2M/(1.02)^3 = \$1.884M$
- $PV$ (call value) = $N(d1) \times S_0 - N(d2) \times PV(K) = N(d1) \times 1.95 - N(d2) \times 1.884$. $d1 = \log [S_0 / PV(K)]/(\sigma \times T^{1/2}) + (\sigma \times T^{1/2})/2$; $d2 = \log [S_0 / PV(K)]/(\sigma \times T^{1/2}) - (\sigma \times T^{1/2})/2$. $d1 = 0.4727$; $d2 = -0.3932$. Therefore $PV$ (call value) = $N(0.4727) \times 1.95 - N(-0.3932) \times 1.844 = 0.6818 \times 1.95 - 0.347 \times 1.844 = \$0.69M$

**NOTE:** In this question credit was given only to the students who talked about the volatility (always the most important variable in option pricing), realized that the volatility could be estimated from the data provided, and showed that they were aware that a single project is always more volatile than a whole firm!

c) The value of the option should be added on top of the DCF value identified previously. This makes the investment worth more! Accounting for real options makes the investment a profitable one!

**Answer to question 7:**

- First, if Mom & Dad sell their other holdings they will be less diversified and their required rate of return will increase, since CAPM is based on the assumption that investors are diversified. This will cause an increase in hurdle rates, and the firm will forego many investment opportunities. Selling the company to a diversified investor increases its value.
- Second, in an M&A transaction there might be potential to create value by introducing better management, cutting costs, exploiting synergies.
- Third, several studies have showed that, on average, the significant premiums are paid in M&A transactions. Though there is no assurance that Asteroid is a good target for an acquisition.
1) Apex has been maintaining a very low leverage. Its D/E ratio is below 1% if we consider LT and ST debt only, and about -35% if we subtract cash from debt.

Two factors may have contributed to this capital structure.

• First, Apex’s sustainable growth rate of about 13.5% exceeds its actual growth rate of about 12%. Thus, retained earnings more than cover their investment and Apex has never had to resort to outside debt financing. The sustainable growth rate itself is explained by high margins (about 15%) and asset turnover, offsetting the mechanical effect of low leverage.

• Second, management has probably not been trying to voluntarily increase Apex’s leverage. Their conservative financial policy is certainly deliberate.

2) Apex has a high net income, is paying taxes and thus could benefit from tax shields. Moreover, Apex’s expected costs of distress seem too low to justify its current capital structure. Indeed:

• Cash-flow volatility: Low, due to safe business strategy.

• Need for external funds: Low since Apex does no R&D and grows slower than its sustainable growth rate;

• Competitive threat if pinched for cash: yes.

• Customers care about distress: not much.

• Assets hard to redepoly: Not really. Patents, brands, stores can be sold.

To increase its leverage, Apex can raise debt to buy back shares or to increase cash dividend. Share repurchases have several advantages:

• They are tax efficient relative to cash dividends.

• Investors see share repurchases as one-time events but expect cash dividends to be maintained. So if we increase dividends now and decrease them when the capital structure reaches the desired level, the market may react negatively.

3) I assume that Apex maintains a constant level of Cash. I ignore the interest payment on existing debt and on (part of) Cash (that data is not available).

• Net income (NI) = Margin * Sales(92)*(1+g) = (7%)*3798*(1+11%) = 295

• Retained earning (RE) = (1-d) * NI = (1-.6)*295 = 118

• Net worth (NW) = NW(92)+RE = 1473+118 = 1591

• Total assets (TA) = Cash + (TA - Cash)*(1+g) = 593 + (2370-593)*1.11 = 2566

• A/P = A/P * (1+g) = 884*1.11 = 981

• Debt (D) plug = TA - A/P - NW = 2566 - 981 - 1591 = -6

• External funding needs = D(93)-D(92) = -6-14 = -20

No external funding is needed. Actually, Apex has excess internal funds of 20.

4) Apex’s distress costs are much higher, and it should have little debt:

• Cashflow volatility: high, due to the more risky business environment.

• Need for external funding: Apex will incur high CAPX to doing or acquiring R&D. Its current cash is likely to be insufficient.
Indeed, even with its current cost structure, Apex is now growing faster (11%) than its sustainable growth rate (8%).

- Competitive threat if pinched for cash: yes.
- Customers care about distress: Still not much.
- Assets hard to redeploy: Not really, although more than before (more R&D).

Impediments to maintaining low leverage: As argued above, Apex’s retained earnings will not suffice. It will have to cut dividends and/or raise equity. Both are negative signals about the firm, leading to a stock price drop.

Remarks about question 1:
Leverage ratios:
- There are several possible measures of a company’s leverage ratio. They generally give similar indications on levels, trends, etc.
- Usually, when calculating debt levels, one does not take into include A/P under debt (although it is ST debt in nature) for several reasons:
  - First, after netting against A/R, it is usually not very significant.
  - Also, when calculating the debt level in order to estimate a tax shield, A/P should not be included because they are non-interest bearing and thus provide no tax shield.

Explaining Apex’s current capital structure:
- Typical mistakes include not noticing the question, explaining low leverage ratio by “the company has little debt” and the like.
- High margins are not sufficient to explain low leverage. High relative to what? It is precisely to answer this question that we introduced the concept of sustainable growth: A firm will not need to resort to outside finance (and hence will not need to raise debt) when its actual growth rate is below its sustainable growth rate.
  - A very fast growing firm could have both high margins and high leverage.
  - Moreover, margins are only one factor of the sustainable growth rate. For instance, a firm with high margins and very low asset turnover could have a low sustainable growth rate.
- Finally, growing slower than one’s sustainable growth rate leads to lower leverage only if management does not actively try to increase leverage, be it because they are unable to do so, (rightly or wrongly) unwilling to do so, or just ignore the issue.

Remarks about question 2:
- When arguing about an optimal capital structure:
  - Start by checking that the firm can use the tax shield of debt (that’s usually quick);
  - Please go through all items of the checklist (since it is a checklist)
- How to go through the checklist and conclude:
  - Go through all items of the checklist. Don’t write a novel.
  - You are not expected to provide a “correct” evaluation of each item on the list. You have only limited (though carefully chosen) information about the firm and its industry. For instance, there was no penalty for arguing that Apex has volatile cash-flows.
- You are, however, expected to reach conclusions in line with your evaluations. For instance, arguing that high leverage is warranted because of high cash-flows volatility was penalized.

- You are not expected to propose a precise optimal capital structure (like 21.7% leverage) but to give to an idea of the range that is consistent with your evaluation.

• Some students suggested that a gain of raising debt is to pay down A/P.

- It may be good to replace A/P with debt if debt is cheaper, i.e., if you are actually incurring an implicit interest rate on A/P (by paying late) that exceeds what your bank would charge you instead (as in the Wilson Lumber case).

- Even when the implicit interest rate actually incurred on late A/P does not exceed that on debt, substituting debt for A/P may increase your tax shield. Indeed, the penalty on A/P is an implicit interest payment, i.e., not counted as interest in your income statement, hence not tax deductible.

- Note however that both arguments hold only if you are actually incurring the implicit interest rate on A/P. In the case of Apex, we have no information about this. However, given that they have plenty of cash, it is unlikely that they are paying late, thereby incurring a high implicit interest rate. Note also that the first point is not really an argument in favor of increasing leverage. Rather, it is an argument for decreasing A/P: Using cash to repay A/P in time is just as good as raising debt.

Remarks about question 3:
- There is no unique way of forecasting financing needs. Moreover, your forecast will depend on the assumptions you make. So, here again, the emphasis is to be put on:

  - Clarity: Be totally explicit about the assumptions you make (e.g. write “I assume that Total assets grow with Sales”). Many students handed in a page with numbers all over with various arrows and stuff over-written.

  - Consistency: Find the correct result given your assumptions

• Most students chose to make the assumption that Total Assets grow with Sales. This is reasonable in some situations (e.g. maybe in the Wilson Lumber case), the idea being that assets (including some cash) are necessary to generate the sales. However, it is unlikely that all of Apex’s cash is necessary for generating sales, i.e., a substantial fraction of Apex’s cash is excess cash. It is even less likely that they need to increase cash. So assuming a constant level of cash is already very conservative.

• Note that whatever your assumption about Cash, “Cash” minus “External funding need” should be somewhat close to what we suggest, i.e., 593−(−20) = 613. Indeed, a $1 increase of Cash mechanically translates into a $1 increase in funding need. For instance, if you chose to grow Cash with Sales at 11%, you effectively get an additional funding need of 593*0.11 = 65, hence an overall funding need of 20+65=45.

• Again, you were not graded on the assumptions you made, but on whether your forecast was consistent with them (when we were able to decipher them!).
Asteroid Pictures, Inc.

“If Rock messes his first movie deal up, Asteroid will come crashing down to earth.”
- A Wall Street stock analyst

Asteroid Pictures is a movie studio that was founded in 1948 in Hollywood, California by Maxwell Roid. Over the past fifty years the company has been quite successful. It has produced over 200 movies and has grown into a Fortune 500 company. Its trademark, a giant rock flying through space towards the earth at supersonic speeds, is recognized worldwide and its slogan – “it’s the end of the world as you know it!” – is second only to “got milk?” in popularity among consumers.

Earlier this month, after over 68 years in the movie business, Maxwell Roid decided to step down from the helm of the company and he handed the control of the studio over to his grandson, Max (Rock) Roid III. Rock is a recent graduate with a business degree from a top-notch university but has little experience in the movie business. As the head of the movie studio, Rock’s primary responsibility will be to determine which pictures the studio should produce. Despite his lack of experience, Rock is confident that the skills he learned in his finance classes would enable him to successfully manage this multi-billion dollar business.

On his first day as the new studio president, Rock is asked to decide if the studio should go forward with its plans to produce a new movie. The movie, entitled “Zizanic,” is a fictional drama about two young lovers aboard a famous zeppelin that crashed. Given the recent popularity of drama meets disaster films, the industry buzz is that the movie has great promise.

Rock has a sinking feeling in his stomach. He realizes that he has a decision to make. By the end of the day he has to determine if the studio should go forward and make the movie. Otherwise, the writers can take the script to another studio. Assume that once Rock tells the writers he will make the movie, he cannot back out of his decision. In other words, he cannot buy the script and then not make the movie or pass on the script and then change his mind to make the movie. Rock is given a thick file folder full of information about the “Zizanic” project to review carefully.

The Asteroid Files
Asteroid Pictures is privately held but recent estimates put the equity market value at $2 billion and book value of debt equal to $1 billion and an average coupon of 5.5%. While Rock’s family owns a significant portion of Asteroid Pictures, Inc. they have a well diversified portfolio of wealth. Recent gyrations in credit markets have pushed the asteroid bond prices down to a market value of $93.50 / $100 of face value. Asteroids’ current credit rating is thought to be BBB. The company’s marginal tax rate is 40%. Assume the company has other divisions that have positive pre-tax income. So if pre-tax income is negative, it can be used to reduce the taxable income of these other divisions.

The studio has already invested $1.5 million into the movie by purchasing the right to buy the script and bringing in actors and actresses to audition for the parts. If Asteroid buys the script they would have to pay the script writers an additional $3 million when they start shooting the movie. The movie would be shot on location in four different countries and production costs are expected to be $50 million, all of which would be required to be paid by the company when shooting for the movie began. Production costs include paying the director and the cast (the star, Dino Dicapria, alone would get $5 million), travel and lodging costs expenses, and any fees associated with the use of the property where they would be shooting. Also included in the $50 million in production costs is $3.2 million for the crew (e.g., make-up people, grips, carpenters) who are currently under contract with the studio and will get paid money regardless if Asteroid decides to make this picture or not. Not included in the production costs are the costumes used in the movie. These costumes originally cost $500,000 and were purchased for a previous movie Asteroid made several years ago. Asteroid has already agreed to sell these costumes to a wax museum in Florida for $300,000. They plan to invest the funds from the sale of these costumes in a project with relatively the same level of risk as the Zizanic movie. If they make the movie they will have to postpone the sale of the costumes for one year.

The studio’s marketing people are estimating the movie would gross $45 million in the first year of release. In the following year, when Zizanic is released on video, they expect to sell 500,000 videotapes. In the third year, video sales are projected to be 250,000 videotapes. After year three, revenues from the movie should be close to 0. These videotapes would be sold for $20 each and the cost to making the videotape would be $4 each. The company will require $100,000 worth of videos in inventory beginning 1 year from today.

The Internal Revenue Service will allow Asteroid to depreciate the cost of the script and incremental production costs. The company plans on depreciating these costs to zero over three years using the straight line method of depreciation. Also, the company expects to sell items from the production of the movie for $1,000,000 in year three and consider this to be the salvage value from the project.

The company also expects that once the movie is released, the video sales of the other movies they have made previously starring Dino Dicapria should also increase. If the studio does not make Zizanic, these other videos have annual net profits of $2 million a year and would remain at that level forever. If they do make the Zizanic, in the first three years following the release of Zizanic the net profits from these other videos are predicted to increase to $3.5 million. After year three, net profits of the videos for other movies would return to $2 million a year. Mr. Dicapria has made three movies for another studio, not associated with Asteroid and the video sales
of these movies are also expected to increase by $500,000 per year for three years following the release of the Zizanic.

Rock also found a table of information about other companies in the folder labeled Table 1.

### TABLE 1
Zizanic Project Data

<table>
<thead>
<tr>
<th></th>
<th>MGM / Mirage Casinos</th>
<th>Disney</th>
<th>Pixar</th>
<th>Harrahs’ Casinos</th>
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</thead>
<tbody>
<tr>
<td>Book Equity</td>
<td>2.7 B</td>
<td>23.3 B</td>
<td>.629 B</td>
<td>1.5 B</td>
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<tr>
<td>Book Debt</td>
<td>5.2 B</td>
<td>14.6 B</td>
<td>0.0 B</td>
<td>3.5 B</td>
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<td>Average Coupon on LT Debt</td>
<td>6.7%</td>
<td>5.8%</td>
<td>n.a.</td>
<td>7.0%</td>
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<tr>
<td>Shares Outstanding</td>
<td>155 M</td>
<td>1.95 B</td>
<td>.05 B</td>
<td>.11B</td>
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<tr>
<td>Stock Price per share</td>
<td>$33.00</td>
<td>$18.15</td>
<td>57.70</td>
<td>$39.00</td>
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<td>YTM on Recent Debt Issue</td>
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<td>5.0%</td>
<td>0</td>
<td>5.8%</td>
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<td>Bond Rating</td>
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<tr>
<td>Tax Rate</td>
<td>35%</td>
<td>35%</td>
<td>35%</td>
<td>35%</td>
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<tr>
<td>Annualized Volatility</td>
<td>.40</td>
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<td>P/E</td>
<td>19</td>
<td>28</td>
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<td>P/Sales</td>
<td>1.3</td>
<td>1.4</td>
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<td>Proportion in Film Business</td>
<td>50%</td>
<td>20%</td>
<td>90%</td>
<td>0.0%</td>
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<tr>
<td>Equity Beta (estimated w/ daily returns)</td>
<td>90</td>
<td>1.10</td>
<td>1.00</td>
<td>.80</td>
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<tr>
<td>Equity Beta (Estimated w/ monthly returns)</td>
<td>1.20</td>
<td>.95</td>
<td>1.30</td>
<td>.90</td>
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### Current Credit Market Conditions

<p>| | |</p>
<table>
<thead>
<tr>
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<tr>
<td>Ten year BB Industrial Yield</td>
<td>6.50%</td>
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<tr>
<td>Ten year AAA Industrial Yield</td>
<td>4.80%</td>
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<td>Ten year Government Yield</td>
<td>4.10%</td>
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<tr>
<td>Two year Government Yield</td>
<td>2.00%</td>
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</table>
YOUR ASSIGNMENT: DON’T LET ASTEROID CRASH TO EARTH

1) (10 points) Discuss the issues you would want to consider in evaluating the debt capacity of the Zizanic film.

2) (10 points) Using these data, estimate the WACC Rock should use in evaluating this project. Explicitly state your reasoning behind your assumptions concerning the expected market return.

3) (10 points) What discount rate or rates should Rock choose for his APV calculations?

4) Cash flows
   a) (25 points) Estimate the relevant free cash flows for Rock’s decision. Assume that the expected annual inflation rate is 0%.
   b) (5 points) If the tax authorities give Asteroid Pictures a choice in calculating annual depreciation, would they rather depreciate straight-line to zero or depreciate to a salvage value of $1,000,000, why?. {Explain, no calculations necessary}

5) (15 points) Valuation of cash flows: Do you think Rock should go forward with this movie? Calculate the NPV and the APV of the movie. What comparables could Rock look at?

6) (20 points) Rock had to take a walk to relieve the stress. When Rock returned to his office, there was a message that the writers of the movie had just called and said that they have a sequel to Zizanic already written, called “Zizanic2.” If Asteroid buys the original Zizanic script, the writers will give Asteroid the right to buy the sequel for $2 million anytime within the next 3 years. If Asteroid does not buy Zizanic, they will not be able to purchase the script for Zizanic2. The value of this script will be largely determined by the success of the Zizanic along with a number of other factors (e.g., changes in the economy, consumers’ tastes, etc.). Well placed sources inform Rock that an offer of $1.95 million is outstanding on the script for Zizanic2. However the value of the script is likely to vary wildly over the next few years.
   a) Provide an analysis of the factors that Rock should consider in evaluating the sequel and how to analyze these factors.
   b) Make a well reasoned guess concerning the value of the right to buy the Zizanic2 script?
   c) How should the analysis of Zizanic2 be incorporated into Rock’s decision?

7) (15 points) DO NOT LET THE INFORMATION IN THIS QUESTION INFLUENCE YOUR ANSWERS TO QUESTIONS ONE THROUGH SIX. Rock’s stress level is rising fast. He just got off the phone with Mom & Dad and they are selling all their other investments and buying out the other shareholders in Asteroid Pictures Inc. Now Rock’s decisions will affect Mom & Dad’s retirement lifestyle. One mistake and Mom and Dad will move in with Rock. He frantically calls an M&A advisor who seems to be quite confident that they can sell Asteroid for a substantial premium to its current market value. Explain why this may be? {No calculations necessary.}
Answer Question 1:

Answer Question 2:
<table>
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<th>Description of Item</th>
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Question 3 continued
Question 4
Question 5:
Question 6: