Capital Structure

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Finance Theory II
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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

![Graph showing debt to (debt+equity) percentage for various countries (US, Japan, UK, Canada, France, Germany) with book leverage and market leverage categories.](image-url)
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>
<td></td>
</tr>
<tr>
<td>Building construction</td>
<td>60.2</td>
</tr>
<tr>
<td>Hotels and lodging</td>
<td>55.4</td>
</tr>
<tr>
<td>Air transport</td>
<td>38.8</td>
</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
Debt $200M
Equity $800M

Issue new debt

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

Issue new equity

Assets $1.1 billion
Debt $200M
Old Eq $800M
New Eq $100M
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>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<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, \( E(A) = D(B) + E(B) \)
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

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

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

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

- $\beta_E$
- $\beta_A$
- $\beta_D$
Leverage and required returns

![Graph showing relationship between debt to equity ratio and required return.]

- $r_D$: Required return on debt
- $r_A$: Required return on equity
- $r_E$: Required return on equity with leverage

The graph illustrates how the required return on equity ($r_E$) increases with the debt to equity ratio, while $r_D$ and $r_A$ remain constant.
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

\[
r_E = r_A + \frac{D}{E} (r_A - r_D) = 0.125 + \left(\frac{0.30}{0.70}\right) (0.125 - 0.10) = 13.57%
\]

**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</td>
<td>Equity income</td>
</tr>
<tr>
<td>$100M</td>
<td>$100M</td>
<td>$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
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