Advanced Corporate Finance

Week 1
Nikunj Kapadia
Capital Structure

The MM Propositions
Definitions

- $V^U$ = Value of unlevered firm (without debt)
- $V^L$ = Value of levered firm (with debt)
- $R^U$ = Cost of capital of unlevered firm
- $R^L$ = Cost of capital of levered firm
- $D$ = Value of debt
- $E$ = Value of equity
- $R^E$ = Cost of equity
- $R^D$ = Cost of debt
- $t$ = tax rate
The MM Propositions

• Under certain assumptions, the capital structure is irrelevant.
  – Proposition 1: The value of the levered firm is the same as the value of the unlevered firm (see spreadsheet, MM proposition 1.xls): $V^U = V^D$
  – Proposition 2: The firm’s overall cost of capital cannot be reduced by substituting equity for (cheaper) debt: $R^U = R^L$
MM in the Real World

• More importantly clarifies what may cause capital structure to matter in the real world. Here is a list of assumptions that are required for MM to hold, but do not hold in practice:
  – Taxes.
  – Costs of bankruptcy and financial distress.
  – Agency costs
  – Asymmetry of information (inefficient markets)
  – Impact of financial structure on growth/future cash flows.
  – Irrational markets
Illustration

• The following example illustrates the Miller and Modigliani Proposition 2 that the cost of capital for a levered firm (firm with debt) is the same as that of an unlevered firm (firm with no debt) when there are no taxes.
Illustration (1/5)

• An all-equity firm:
  – Earnings = $10 million a year to perpetuity.
  – The firm pays all its earnings as dividends.
  – Number of shares outstanding = 10 million.
  – Cost of capital = 10%
  – Thus, price of each share = 1/0.1 = $10.
  – Value of firm = value of equity = $10*10 M = $100 M.
Illustration (2/5)

• Firm has an opportunity to invest in a new project:
  - Cost of project = $4 million.
  - Expected cash flow each year from project = $1 million.
  - Thus, NPV of project = $4 / 0.1 - 4 = $6 million.
  - New firm value = $100 + $6 = $106 million.
  - Value of equity = firm value = $106 million.
  - Price of share = $106 / 100 = $10.60.
• **Equity Financing:** Firm finances project by raising $4 million of new equity.
  
  – Number of new shares issued at stock price of $10.60 = 4,000,000 / 10.60 = 377,358 shares.
  
  – Total number of shares = 10,377,358.
  
  – Market value of equity = $10.60 x 1,377,358 = $110 million.
  
  – Total earnings = 10 + 1 = $11 million.
  
  – Cost of equity = 11/110 = 10%.
  
  – Cost of capital = cost of equity = 10% (as firm is all equity).
Illustration (4/5)

- **Debt Financing:** Firm finances project by raising $4 million of new debt at interest rate of 6%.
  - Value of equity = 106 million.
  - Value of debt = $4 million.
  - Value of firm = value of equity + value of debt = $106 + $4 = $110 million.
  - Earnings before interest = 10 + 1 = $11 million.
  - Interest = $4 M x 6% = $240,000.
  - Earnings after interest = $11-0.24 M = $10.76 m.
  - Cost of equity = 10.76/106 = 10.15%.
  - WACC (R_L) = (106/110) x 10.15 + (4/110) x 6 = 10%.
  - Cost of capital for levered firm equals that of unlevered firm.
Illustration (5/5)

• Proposition 1 of MM: Value of Levered Firm = Value of Unlevered Firm = $110 M.
  – In our example, the firm value is $110 M irrespective of whether it is financed by equity or debt.
• Proposition 2 of MM: Cost of capital of levered firm is 10% = cost of capital for unlevered firm (cost of equity increases to offset low cost of debt).
  – Using the WACC, we can write the cost of equity as:
  – \( R^E = R^U + (D/E) \times (R^U - R^D) \), where \( D \) = market value of debt, \( E \) = market value of equity.
  – That is, as the firm increases the debt ratio, the cost of equity increases to keep the overall cost of capital constant.
Taxes

- Interest payments are tax-deductible.
- Thus, there are benefits to leverage as firm saves on taxes.
- Total present value of all tax benefits to perpetuity = Corporate Tax Rate x Amount of Debt = tD.
- MM Proposition 1 with taxes: Value of levered firm = value of unlevered firm + tax benefits.
  \[ V^L = V^U + tD \]
- MM Proposition 2 with taxes:
- \( R^E = R^U + (D/E) \times (1 - t) \times (R^U - R^D) \).
Costs of Financial Distress

- **Direct costs**
  - Legal and other costs of liquidation and reorganization (estimated to be 1-3% of firm's value)

- **Indirect costs of financial distress**
  - Impaired ability to conduct business
Costs of Agency (1/3)

• Agency costs due to risk-shifting:
  – Equity can be viewed as an option on value of firm with a strike equal to face value of debt.
  – Option values increase with volatility.
  – Therefore, firm has incentive to take large risky projects as bond-holders ("shift risk"). In an extreme case, firm may even take negative NPV projects.
Costs of Agency (2/3)

• Agency costs due to under-investment.
  – Suppose firm has positive NPV projects but very high debt.
  – The positive NPV projects are not sufficiently profitable for the equity holders to take home money after paying off the debt-holders.
  – Equity-holders have no incentive then to take these positive NPV projects. Firm value declines.
Costs of Agency (3/3)

• Agency cost: Free cash flow.
  – Managers with a small equity position have an incentive for wasteful behavior.
  – The greater the available free cash flow, the greater the opportunity for wasteful behavior (for example, firms with high free cash flow are more likely to make bad acquisitions than firms with low free cash flow).
  – In this case, the presence of debt is good for the firm as it reduces the free cash flow.
Asymmetry of Information

• Asymmetry of information refers to the possibility that the information possessed by the firm may be different from the information possessed by the market or investors.
  – Although managers can signal the information they have, there may not be a credible way to do so.

• The riskier the security that is issued, the more important is the impact of asymmetry of information (e.g. it is more important when a firm issues equity than debt.)
Impact of Financing on Investment Decision

• Sometimes the method of financing will impact the growth of the firm, or the kind of investments a firm can make.
  – For example, a firm may have restrictive debt covenants that reduce its flexibility to manage its operations.
Rational and Efficient Markets

• If markets are not efficient, then it may be possible for managers to time the market, e.g., issue stock when its over-priced.
• This also applies if there is a bubble in the market.
Valuation

Three Methodologies:
Adjusted Present Value
Flow to Equity
WACC
Problem Setup (1/2)

• Consider evaluating the following project:
  – Cash inflow = $140,000 a year for perpetuity
  – Investment = $475,000
  – Corporate tax rate = t = 34%
  – Cost of capital for unlevered firm = \( R^U = 20\% \)
  – Target debt ratio (if debt is used) = 25\%. 
Problem Setup (2/2)

- Unlevered after tax cash flow of project = 140,000 \times (1-0.34) = $92,400.
- Present value of project = 92,400/0.2 = $462,000.
- NPV of non-levered project = 462,000 – 475,000 = -$13,000.
- Project will not be taken if it has to be financed by equity. However, it is possible to take the project if its financed by debt as you save on taxes.
- We shall now evaluate this project with debt (debt ratio of 25%) by each of the valuation methods.
Method 1: Adjusted Present Value Method

- Adjusted Present Value = NPV of non-levered project + net present value of financing side effects (taxes, etc.).

- We finance the project by $126,229 of debt, and have tax benefits (we ignore other side effects) of $42,918.

- Thus, APV = -13,000 + 42,918 = $29,918.

- Why is debt level set at $126,229?
  - \( V^L = V^U + \text{tax benefits} = (475,000 - 13,000) + 0.34 \times 0.25 \times V^L \).
  - Thus, solving algebraically value of levered assets = $504,918.
  - Debt = 0.25 \times 504,918 = $126,229.
Method 2
Flow to Equity

• Flow to Equity = PV of the cash flow to equity holders, discounted at cost of equity.

• NPV = Flow to equity – equity investment.

• \( R^E = R^U + \frac{(D/E)}{1 - t} \times (R^U - R^D) \) = 0.20 + (0.25/0.75) x (1 - 0.34) x (0.20 - 0.10) = 22.2%.

• Levered cash flow to equity = \([140,000 - (10\% \times 126,229)] \times [1-0.34] = $84,069.\)

• Value of levered cash flow to equity (FTE) = 84.069/0.222 = $378,689.

• Amount of equity investment = (475,000-126,229)= $348,771.

• NPV = $378,689 - $348,331 = $29,918.
Method 3
WACC

• *Discount the unlevered cash flow at WACC.*
• $NPV =\text{Present value of unlevered cash flow} - \text{initial investment}$.
• WACC = weighted average cost of capital = \(0.25 \times (1 - 0.34)(0.10) + 0.75 \times 0.222 = 18.30\%\).
• Unlevered after tax cash flow of project = $92,400.
• Present value of project = \( (92,400)/0.183 = $504,918\).
• NPV = $504,918 – 475,000 = $29,918.$
Estimating Cost of Capital Using the Beta

• \( \text{Beta}_{\text{Equity}} = [1 + (1 - \text{tax rate}) \times (\text{Debt/Equity})] \times \text{Beta}_{\text{unlevered firm}} \)

• We can now determine the discount rate using the familiar equation:
  – Return for stock = \( R_f + \text{Beta} \times (R_m - R_f) \)
  – \( R_m \) = required return for market portfolio
  – \( R_f \) = riskfree rate
Example of Use of Beta

• A firm is planning a new investment in a project that it intends to finance completely through equity. Currently, its capital structure has $100 M of debt and $200 M of equity. The firm’s equity beta is 2. What beta should one use to estimate the cost of capital for project?
• Use the unlevered beta.
• Solve, $2 = [1 + (1 - 0.34) \times (100/200)] \times \beta_{\text{unlevered firm}}$, 
• Therefore, $\beta_{\text{unlevered firm}}$ is 1.50.
Options

A Quick Overview
What Is a Derivative Asset?

• Any asset that “derives” its value from another underlying asset is called a derivative asset.

• The underlying asset could be any asset - for example, a stock, bond, commodity (like oil or gold) or another derivative asset.

• Examples: options, futures/forwards.
Options: Call, Put

- An option is a derivative asset that gives you the option to buy or sell the underlying security on or before a certain date (called the maturity or the exercise date) at a certain pre-determined price (called the strike or exercise price.).
- Call: if the above option gives you the option to buy the asset, the option is called a call.
- Put: if the above option gives you the option to sell the asset, it is called a put.
Exercise Differences

• European vs. American Option: If the option gives you the flexibility of exercising it any time before maturity, it is called an American option. If the option can only be exercised at maturity, then it is called an European option.
Example: QQQQ

• Option on the Nasdaq 100 (QQQQ): This is the most liquid equity contract, with bid-ask spreads for near-money options of a penny. The specifications of the contract are as follows:
  • Strike: in 1 points intervals around the current price.
  • Maturity: Trading stops on the third Friday of the month.
Example: Option on Crude Oil

- Options on crude oil are traded on the NYMEX (New York Mercantile Exchange). Contracts specifications are:
  - Strike: 21 strikes are offered for trade in $0.50 or $1.00 increments. (but only 3-4 are actively traded at any time.).
  - Maturity: the future contract matures on the 3 business day prior to the 25th of the month, and the option contract usually matures on the Friday immediately before the maturity of the futures contract.
Payoff Diagrams

• The pricing of an option depends on its payoff when the option is exercised.

• Consider an option on a stock, S, with a maturity T and a strike (or exercise price) X.

• Payoff at maturity: if $S_T$ is the stock price at maturity, what is the payoff at maturity of the option - i.e., what is the $ amount that you would gain or lose at maturity?

• Call Payoff: $\text{Max}(0, S_T - X)$.

• Put Payoff: $\text{Max}(0, X - S_T)$. 
Portfolio to the Payoff Diagram

• Draw the graph of the payoff at maturity of a European call option and a European put option.
• Draw the graph of the payoff at maturity of a portfolio that is long 1 call and long 1 put.
• Draw the payoff at maturity of a portfolio that is long 1 call and short 1 put.
• In general, if we know the payoffs on the call, put, stock and bond, we can easily draw the payoff diagrams of any portfolio of a call, put, stock or bond.
Payoff Diagram and Trading Strategy.

• Portfolios of calls, puts and the underling stock allows the investor to implement different trading strategies. The simplest way to understand the trading strategies that can be implemented by different portfolios is to graph the payoff at maturity of that portfolio.

• Example: if you expected stock prices to go up in the near future, what would you buy? Answer: a call.

• Example: if you expected stock prices to go down, what would you buy? Answer: a put.
Payoff Diagram and Trading Strategy.

• Example: If you expected a large movement in the stock price but were not sure whether the market would go up or down, what would you buy? Answer: a straddle (a portfolio of 1 call + 1 put). (To understand this, graph the payoff diagram at maturity.)

• Example: suppose you were long 1 call at a strike of 95, short 2 calls at a strike of 100, and long 1 call at a strike of 105. What would the graph of the payoff at maturity look like and why would you want to buy such a portfolio?
Factors That Determine the Option Price

• Market Factors
  – Stock price
  – Interest rate
  – Volatility

• Contract factors:
  – Exercise price/Strike
  – Exercise date
Equity As an Option (1/2)

- Equity may be viewed as a call on the value of the firm, with a strike equal to the face value of debt.
  - If firm value is below the face value of debt, then option is not exercised (equity holders get nothing).
  - If firm value is above the face value of debt, equity holders pay the debt, and take the remaining value of firm.
Equity As an Option (2/2)

• Equity may be viewed as owning the firm plus owning a put option with a strike equal to the face value of debt, and owing debt.
  – If firm value is below the value of debt, then put is exercised and firm is now owned by bond-holders.
  – If firm value is above the face value of debt, the put is not exercised, and equity holders pay the debt (and keep control of firm).
Embedded Options in Capital Projects

• Most projects have embedded options.
  – Timing option, option to wait to invest on project.
  – Option to abandon the project.
  – Growth options, option to expand.
Illustration

• You own a gold mine.
• Cost of extraction = $350 an ounce.
• Production = 50,000 ounces a year.
• Cost of abandoning an open mine = $1 M.
• Cost of opening a closed mine = $2 M.
• Price of gold fluctuates.
• When will you open or close the mine (i.e. what should the gold price be for you to open a closed mine, or close an open mine)?