Lecture 18
The Modigliani-Miller Theorem With No Taxes

Q 1: Does capital structure matter?
Q 2: Does dividend policy matter?
Readings:
   - BM: chapters 16, 17 & 18
   - Reader: Lecture 18
Distinguishing Firm Risk and Market Risk (One Last Time)

- In real applications, firm risk and market risk often become entangled over time periods.

- For example, suppose you are running a shipping service that faces two risks:
  - Your ship might sink.
  - Your cargo might have a higher or lower market value.
  - Which is market risk? Which is firm risk?

- Now let us recognize that if the ship sinks, then your goods will not get to market.
  - Does this change your mind regarding what is market risk?

- This all matters because it determines the proper discount rate: risk free or with risk premium!
Indian Spice Ship in Year 1675: Example

Assumptions:
- There is 40% chance ship will sink before it can return to England.
- If ship does not sink, you can sell the spices in one year.
- Spice prices are related to market events and have a β of 2.
- The spices cost 1,000, the ship costs 10,000.
- If the ship returns, you sell spices for 20,000 and ship for 10,000.
- $r_f = .05$ and $r_m = .15$?

What discount rate to use for computing spice PV?
- Key Point: Whether or not the ship sinks has nothing to do with the spice market. The ship sinking is all idiosyncratic risk.
- Answer: The discount rate on the spices (using the spice β) is:
  \[ r = r_f + 2(r_m - r_f) = .05 + 2(.15 - .05) = .25. \]
The net present value of the spices equals:
\[ PV_s = -1,000 + \frac{0.6(20,000) + 0.4(0)}{1.25} = 8,600. \]

Since the ship is always worth 10,000 it has a beta of zero.

Therefore, ship has a present value of:
\[ -10,000 + \frac{0.6(10,000) + 0.4(0)}{1.05} = -4,285.71. \]

The expected value of the project is:
\[ PV = 8,600 - 4,285.71 = 4,314.29 > 0. \]

You should set sail.
Modigliani Miller Theorem
(Why corp. fin. may not matter)

Assuming "perfect capital markets", Modigliani and Miller found, without taxes, the total value of a firm is unaffected by its security structure.

- I.e. Whether or not an investment makes sense does not depend on how we are going to raise the money to pay for it.

Why is this true?

- A firm's cash flow is like a pizza: to change the firm's capital structure is to change the size of individual pizza slices.
- This does not change the overall size of the pizza.
- Nor does it change the overall value of the firm.
Modigliani and Miller and Pizza (continued)

- Pizza:
  - We might have an unsliced pizza, but want slices: We can then always cut it up ourselves.
  - Or, we have have a bunch slices, but want a whole pizza: we can always stick them back together.

- Moral: We should be willing to pay the same price for one whole pizza or an equivalent bunch of slices.

- The M&M argument applied to corporate leverage:
  - Individual investors can modify any corporate leverage, so that their own portfolio has the personally desired level of leverage.
M&M Proposition 1: Leverage Cannot Influence Firm Value

Consider two firms, U (unlevered) and L (levered), identical except for capital structure.

- Firm U is all equity financed, and is worth a total of $V_U$.
- Firm L is levered, with equity worth $E_L$ and debt of $D_L$. Its total value is $V_L = E_L + D_L$.

Can $V_U$ and $V_L$ be different?

- No, for exactly the same reason as the pizza.
- I.e. given either firm, we can create the other our self.
Proposition 1: Proof

Format of the MM Argument:
- If 2 investment positions provide exactly the same cash flow, then..
  - The market value of the 2 positions must be identical.

Firms U and L have the same net operating income (NOI) (Reader calls this profits).

(1) If you buy 1% of the Equity in Firm U:
  - Cash flow = (1%)(NOI)

(2) If you buy 1% of Equity in L + 1% of debt in L:
  - Cash flow = (1%)(NOI – interest) + (1%)(interest) = (1%)(NOI)

Since the cash flow of (1) and (2) are identical,
Value (1% U equity) = Value (1% L equity + 1% L debt)
\[ V_U = V_L (= E_L + D_L) \]
### Replication of Firm L Equity

1. **We can buy firm L equity directly.** Cash flow:

<table>
<thead>
<tr>
<th>Investment</th>
<th>Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity of L</td>
<td>0.01 $V_L$</td>
</tr>
<tr>
<td>(0.01(NOI - Interest)</td>
<td></td>
</tr>
</tbody>
</table>

2. **Or borrow (1%)($D_L$) + buy 1% firm U equity:**

<table>
<thead>
<tr>
<th>Investment</th>
<th>Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity of U</td>
<td>0.01 $V_U$</td>
</tr>
<tr>
<td>(0.01(NOI)</td>
<td></td>
</tr>
<tr>
<td>Borrowing</td>
<td>-0.01 $D_L$</td>
</tr>
<tr>
<td>-(0.01)(Interest)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.01 $(V_U-D_L)$</td>
</tr>
<tr>
<td>(0.01)(NOI-Interest)</td>
<td></td>
</tr>
</tbody>
</table>

Again we see: $V_L = V_U - D_L$; or $V_U = V_L + D_L$
MM Proposition 2: Dividend Irrelevance

The MM theorem can be extended to show that a firm's dividend policy does not influence its value.

Our demonstration uses the following example:
- Initially firm will pay dividend stream such that: Value (equity) = PV(dividends)
- Now suppose firm raises its dividend at date 0
- Extra dividend is funded by new debt issued at date 0.

Question: Does this financial action influence the value of the firm’s equity?
Dividend Irrelevance Proof

More precisely:
- Firm initially plans to pay dividends with PV (dividends)
- Now firm decides to pay additional date 0 dividend of M.
- It must also issue M dollars worth of debt. So….

Value (equity) = PV(dividends) + M - PV(debt).
- But PV(debt) must equal M (otherwise the people purchasing the new securities would not give the firm M dollars). Thus,

Value (equity) = PV(dividends) + M – M = PV (dividends)

Nothing has changed.

Lesson: A firm can arbitrarily alter its dividend stream without altering its value.
Key Assumptions for MM Propositions

- Individual investors must be able to borrow at same terms as firm.
  - An investor can thus transform unlevered firm U equity into a levered position by borrowing and using the extra cash to buy firm U equity on margin.

- Individual investors must be able to lend at same terms as firm.
  - An investor can thus transform levered firm L equity into an unlevered position by selling some of the L equity and lending out the proceeds of the sale.