Corporate Finance

Lecture 8.1: Capital Structure:

M&M Theorem, Cost of Capital (without tax)

Yuan Shi ©

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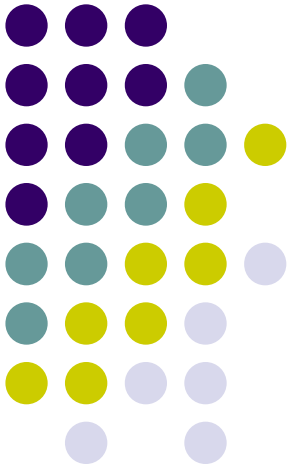

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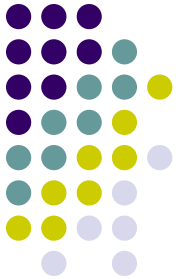
Cost of Equity and Debt

- The "Cost of capital" for a company is a weighted average of the cost of debt and equity.
- In the absence of taxes:

$$WACC = \frac{E}{V} \cdot E(R_E) + \frac{D}{V} \cdot E(R_D)$$

- Equity is more risky than debt.
- So, typically, $E(R_E) > WACC > E(R_D)$.

A Puzzle



- A company's cost of equity is 13% (R=13%) and its cost of debt is 10% (YTM=10%)
- Does this mean that it is cheaper for this company to finance its projects with debt rather than equity?
- Should this company issue debt and buy back stock shares?
- Could this company lower its WACC by increasing D/V and decreasing E/V?

SML Revisited

The answer is: **Not Necessarily!**

Basic Idea: **Equity is riskier than Debt**.

- This is why the return on equity should be higher than on debt

As long as both the return on equity and the return on debt are **on the SML**, the firm should be **indifferent** to issue debt vs. equity

- If investors are getting a *"fair" return* according to the SML, the firm should not care whether it issues debt or equity

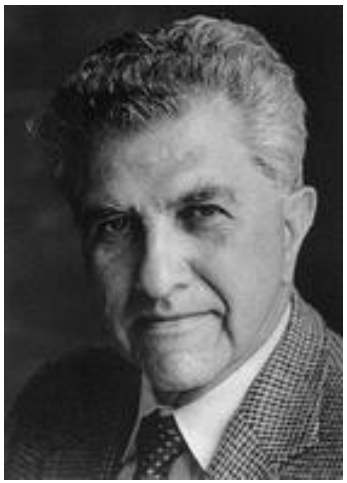
The M&M Theorem

Proposition I:

Without frictions, the Value of the Firm does NOT depend on its Capital Structure.

Franco Modigliani

Nobel Prize
1985



Merton Miller

Nobel Prize
1990

Intuition

Firm value is **like a pie**

- Stems from cash flows assets generate
- Then split between debt-holders and stockholders

But the size of the pie does not depend on how it is sliced

If financial markets work well, firms *cannot* increase value by tinkering with capital structure

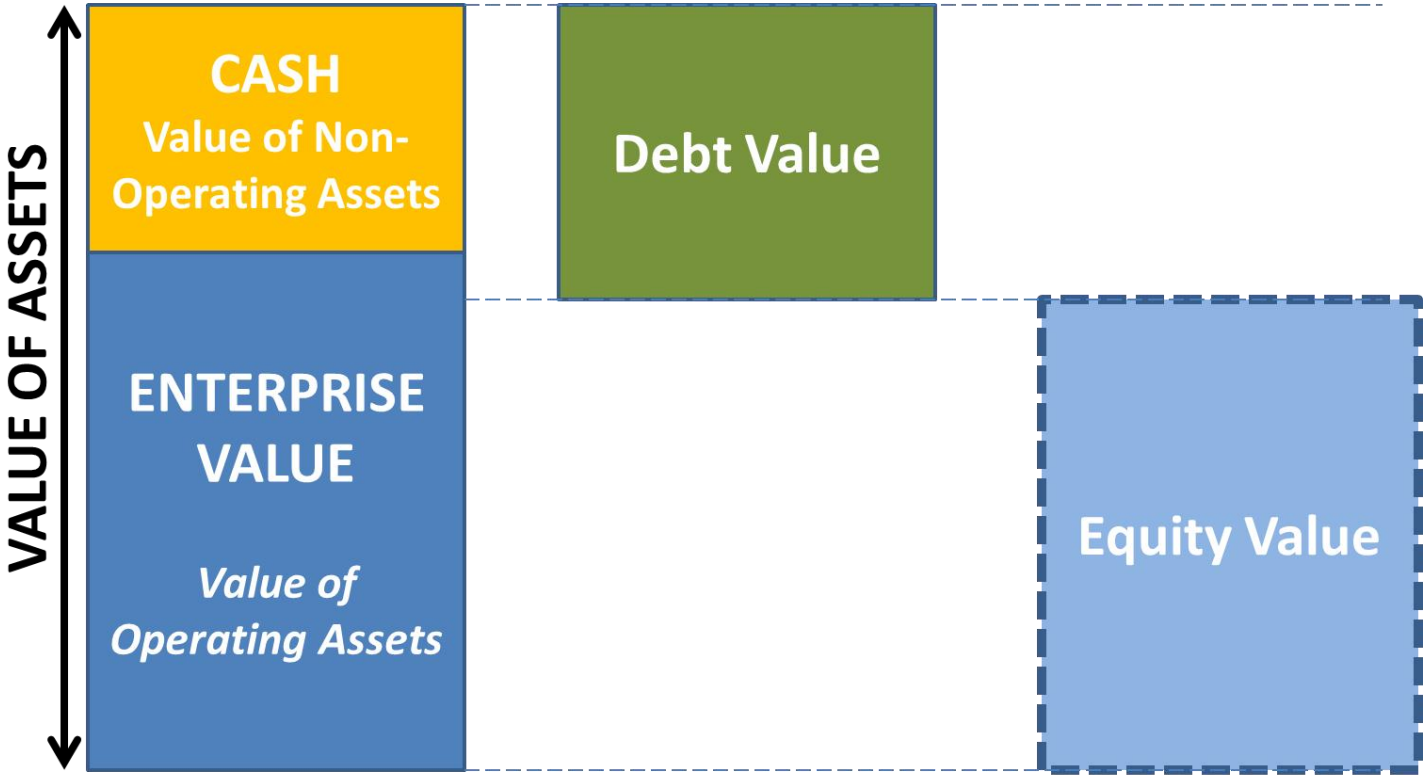
Intuition

"Think of the firm, as a gigantic tub of whole milk. The farmer can sell the whole milk as is. Or he can separate out the cream and sell it at a considerably higher price than the whole milk would bring. (That's the analogy of a firm selling low-yield and hence high-priced debt securities.) But, of course, what the farmer would have left would be skim milk with low butterfat content and that would sell for much less than whole milk. That corresponds to the levered equity. The M and M proposition says that if there were no costs of separation (and, of course, no government dairy support programs), the cream plus the skim milk would bring the same price as the whole milk."

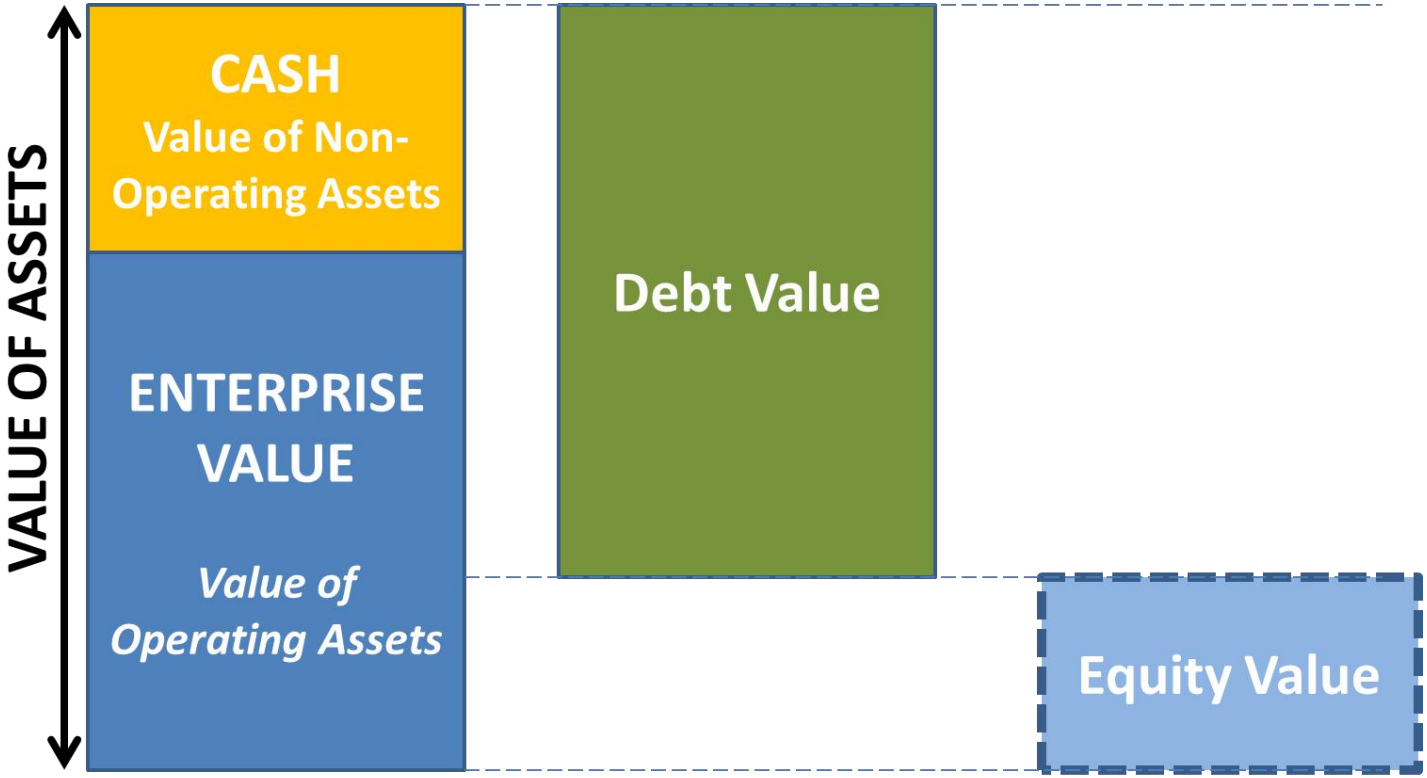
"Think of the firm, as a gigantic pizza, divided into quarters. If now you cut each quarter in half into eighths, the M and M proposition says that you will have more pieces but not more pizza."

-- Merton Miller

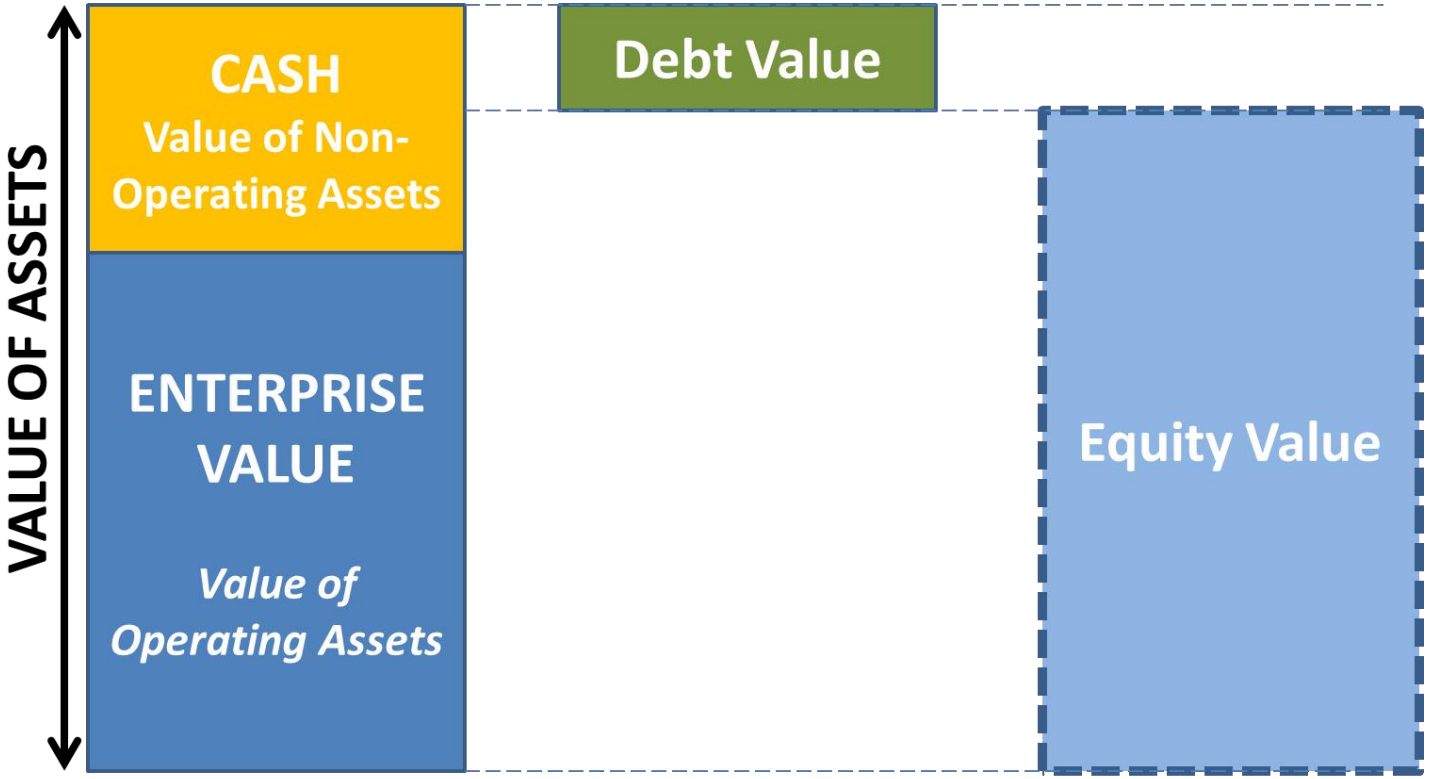
Splitting the Pie



More Debt


VALUE OF ASSETS
CASH
Value of Non-Operating Assets
ENTERPRISE VALUE
Value of Operating Assets
Debt Value
Equity Value

Less Debt

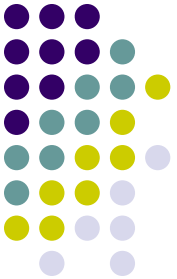

VALUE OF ASSETS
CASH
Value of Non-Operating Assets
ENTERPRISE VALUE
Value of Operating Assets
Debt Value
Equity Value

Irrelevance

What does "*No Frictions*" mean?

- No *tax shield* (no taxes, or interest is paid after tax)
- No consequences of *financial distress* for assets
- Well functioning financial markets
  - Individuals can borrow and lend at the same rate as corporations
  - No information asymmetry and agency frictions

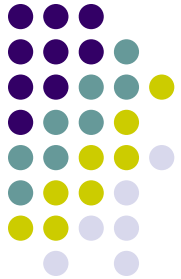
JELLYBEANS, INC.



- Consider a firm with *expected* cash flows of $650,000 forever, **zero debt**, and cost of equity of 13%.
- Firm has 500,000 shares. Jellybeans pays all its cash flows as dividends.
- **Assume no taxes.**
- Current value of the firm:

$$V = E = \frac{\$650{,}000}{0.13} = \$5m$$

Recapitalization



CEO considers changing capital structure:

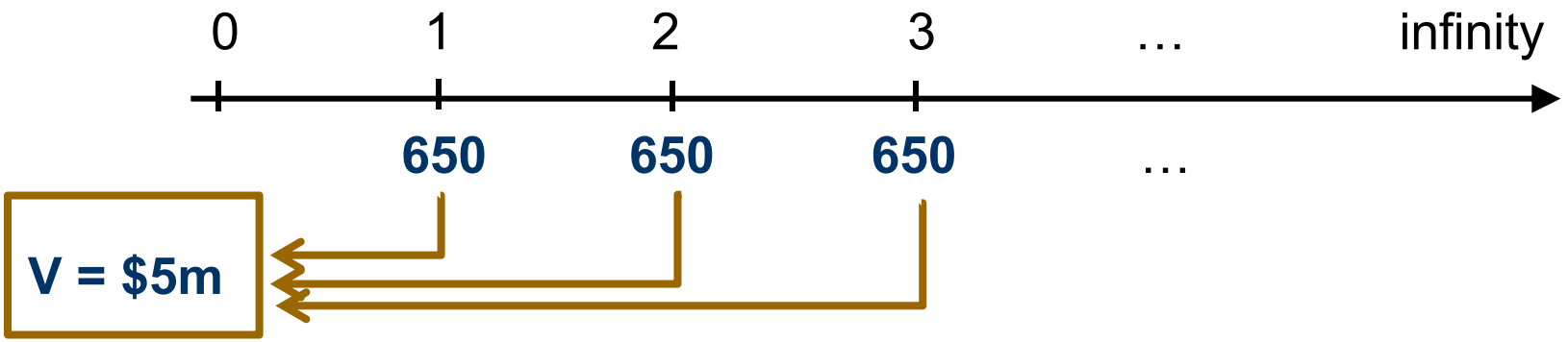
- Borrow $2.5m long-term debt (which will be rolled over in future) at 10% interest.
- Use it to repurchase half of the shares (= one-time dividend), proportionally from its shareholders

What happens to the value of the firm and its equity?

- No effect on the cash flows → no change in firm value.
- Share price is not affected as well.

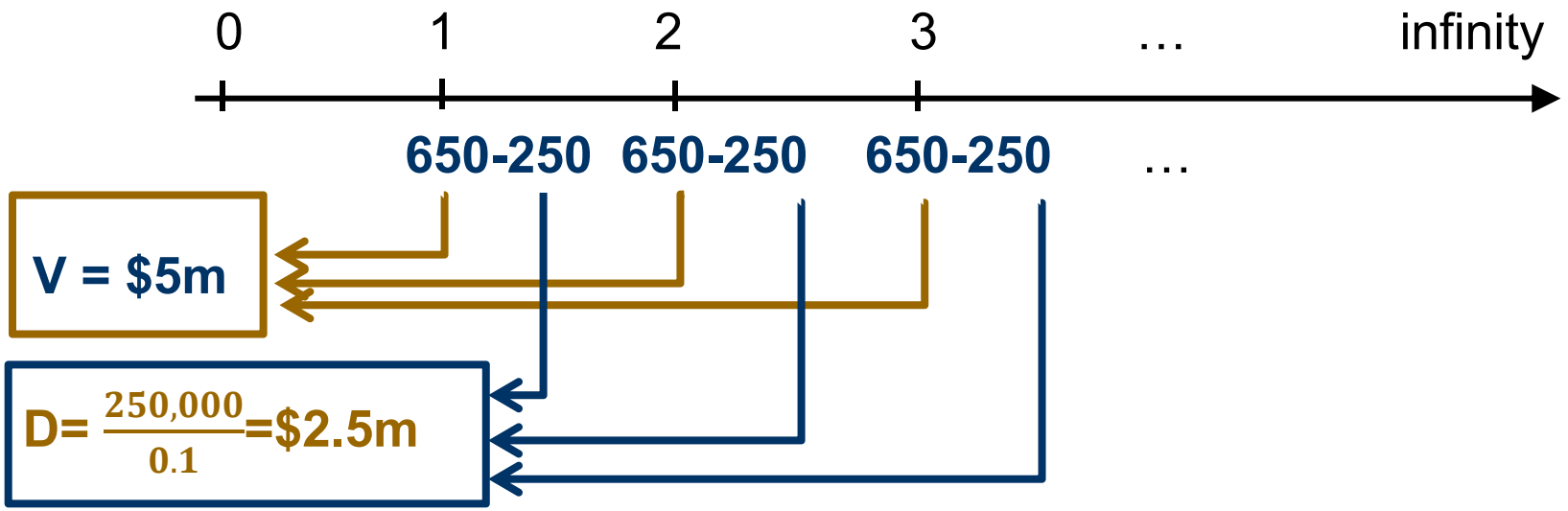
Cash Flows

Before:



Cash Flows

After:



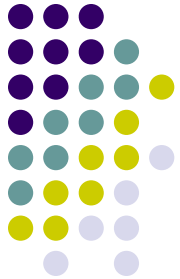
E = V – D = $5m - $2.5m = $2.5m

- Equity holders got $2.5m cash and are left with $2.5m equity

Share Price

	Current	Proposed
Asset	$5,000,000	$5,000,000
Debt	$0	$2,500,000
Equity	$5,000,000	$2,500,000
Debt/Equity	0	1
Share price	**$10**	**$10**
Shares outstanding	500,000	250,000
Interest rate	n/a	10%

JELLYBEANS, INC.



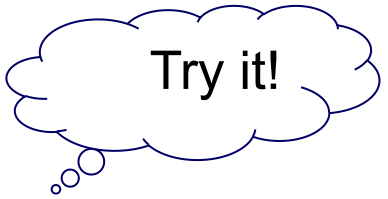
- How about **EPS** and **ROE**?
  - Before EPS: $650k/500k=$1.3, ROE: $650k/$5m=13%
  - After EPS: $400k/250k=$1.6, ROE: $400k/$2.5m=16%
- EPS and ROE rise, but no effect on the stock price.
- What changed?
  - **Risk of the shareholder equity.**
  - The variabilities of EPS and ROE also go up.
  - Equity holders are *indifferent*, since *risk* and *expected return* both increased.

Cash Flow Variability

BEFORE	Recession	Expected	Expansion
EBIT	$300,000	$650,000	$1,000,000
Interest	$0	$0	$0
Net Income	$300,000	$650,000	$1,000,000
EPS	$0.60	$1.30	$2.00
ROE	6%	13%	20%

AFTER	Recession	Expected	Expansion
EBIT	$300,000	$650,000	$1,000,000
Interest	$250,000	$250,000	$250,000
Net Income	$50,000	$400,000	$750,000
EPS	$0.20	$1.60	$3.00
ROE	2%	16%	30%

Exercise

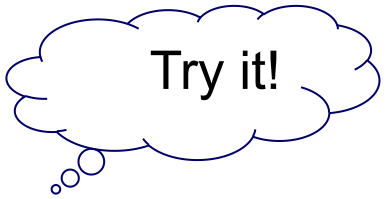


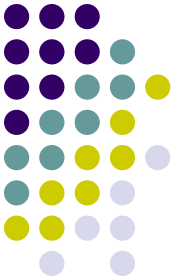
Ch16-16 MM Proposition I Levered, Inc., and Unlevered, Inc., are identical in every way except their capital structures. Each company expects to earn $18 million before interest per year in perpetuity, with each company distributing all its earnings as dividends. Levered's perpetual debt has a market value of $65 million and costs 8 percent per year. Levered has 1.9 million shares of stock outstanding that sell for $98 per share. Unlevered has no debt and 3.8 million shares outstanding, currently worth $71 per share. Neither firm pays taxes.

Is Levered's stock a better buy than Unlevered's stock?

- Is Levered's stock relatively underpriced compared to Unlevered?

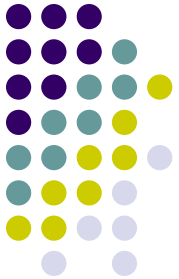
Exercise





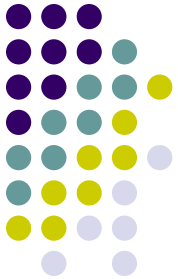
- $V_u = 3.8\,mil \times \$71 = \$269.8\,mil$
- $E_L = 1.9\,mil \times \$98 = \$186.2\,mil$
- According to M&M theorem proposition I:
- $V_L = E_L + D_L = \$65\,mil + \$186.2\,mil = \$251.2\,mil$
- So, $V_L < \mathrm{V_U}$
- According to M&M theorem, two firms with identical cash flows should have the same value in a frictionless market, regardless of their capital structure.
- So Levered's stock is relatively underpriced than Unlevered.
- In other words, the market value of Levered's equity needs to be $18.6 million higher than its current value for MM theorem to hold.

Individual Shareholders



- Capital structure is *irrelevant* for firm value in such a frictionless market.
- So should we allow managers to choose any level of capital structure discretionary?
- Before we say yes, we need to consider individual shareholders' payoffs.
- Recall that this financial market is frictionless, and individual investors can borrow and lend at the same rate as corporations.

Homemade Leverage



Suppose there is an investor who holds 1,000 shares in JellyBeans, Inc and who *dislikes leverage.*

What can she do if the management decides to change capital structure?

- When the firm was recapitalized, 500 of her shares were purchased back with $5,000 payment.
- She could lend out the $5,000 at 10% interest rate.
- Before recapitalization she was entitled to 1,000×$1.3=$1,300 of firm's profits.
- After recapitalization she is entitled to 500×$1.6=$800 of firm's profits and $5,000×10%= $500 of interest income.

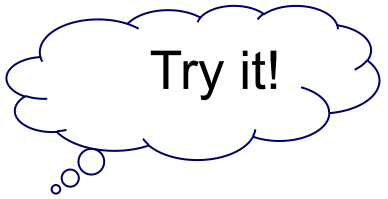
Punchline

Capital structure is *irrelevant* as long as it does not affect the **total cash flows** generated by the assets.

Investors can achieve the payoff from their desired capital structure using **homemade leverage**.

- Assuming a well-functioning financial market.

Exercise



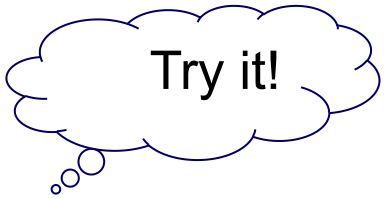
Ch16-22 Homemade Leverage The Veblen Company and the Knight Company are identical in every respect except that Veblen is unlevered. The market value of Knight Company's 6 percent bonds is $1.6 million. Financial information for the two firms appears here. All earnings streams are perpetuities. Neither firm pays taxes. Both firms distribute all earnings available to common stockholders immediately.

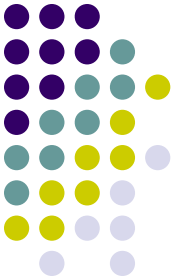
	Veblen	Knight
Estimated Operating Income	$610,000	$610,000
Interest		$96,000
Market Value of Equity	$4,400,000	$3,550,000
Market Value of Debt		$1,600,000

An investor who can borrow at 6 percent per year wishes to purchase 5 percent of Knight's equity. Can he increase his dollar return by purchasing 5 percent of Veblen's equity if he borrows so that the initial net costs of the two strategies are the same?

- An investor has the money to purchase 5percent of Knight, and can borrow at 6%.
- With the same initial investment, if he buys 5% of Veblen, will his annual dollar return be higher?

Exercise





5 percent of Knight

- Initial cost of investment: $3.55\ mil \times 5\% = \$177.5\ mil$
- Future cash flows per year: $(610k - 96k) \times 5\% = \$25{,}700$

5 percent of Veblen

- Initial cost of investment: $4.4\ mil \times 5\% = \$220\ mil > \$177.5\ mil$
- Finance through personal debt: $220 - 177.5 = \$42{,}500$
- Future cash flows per year: $610k \times 5\% - 42.5k \times 6\% = \$27{,}950$

So, with the same initial cost, the investment in Veblen produces a higher dollar return in the future.

This can be seen from the value of two firms too:

- $V_{Veblen} = \$4.4mil$
- $V_{Knight} = 3.55 + 1.6 = \$5.15mil$
- So Veblen is relatively underpriced than Knight
- Investors will sell Knight's stocks and use homemade leverage to profit from investing in Veblen, which will eventually push up (down) Veblen's (Knight's) share price until M&M theorem proposition I holds.

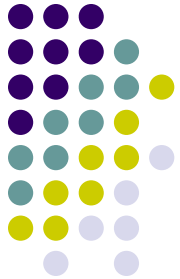
More Intuition

- In the Jellybean Inc. example, leverage goes up and the equity becomes more risky.
- The *return on equity* increases from 13% to 16%.
- From CAPM, we know that expected return can increase only if β increases.
- So, **did the β of equity increase?**

Equity Beta

- Answer is "**YES**".
- Think of a Firm as a **portfolio** of its Debt and Equity.
  - All the firm's cash flows go to either the Debt holders or Equity holders.
  - $\beta_{port} = \sum_{i \in port} w_i \beta_i$
- Therefore, $\beta_A = \frac{E}{E+D}\beta_E + \frac{D}{E+D}\beta_D$
  - Here, E is the market value of firm's equity, D is the market value of its debt, and E+D is the market value of the firm.
- Alternatively, $\boldsymbol{\beta_E} = \frac{E+D}{E}(\beta_A - \frac{D}{V}\beta_D) = \beta_A + \frac{D}{E}(\beta_A - \beta_D)$
  - β_D is usually small (zero if the debt is risk-free).

Leverage and Beta



- *Beta of the firm's assets* depends on the risk of firm's cash flows.
- *In absence of frictions*, cash flows do not change with leverage level.
- So, *Beta of firm's assets* is a constant (β_A does not change with D/E).
- Thus, if D/E is higher (i.e. the firm has more debt), *Beta of equity* is higher .
- Debt makes equity riskier by increasing β_E.

Leverage and Beta

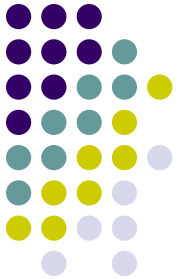
- The *Beta of firm's cash flows* is the firm's **Asset Beta**
  - It is also the beta of the Equity of a firm with No Debt, since Asset=Equity if the firm had no debt.
  - Thus, it is also often called the **Unlevered Equity Beta**.
- With risk-free debt ($\beta_D = 0$), the *(levered) Equity Beta* is

$$\beta_E = \left(1 + \frac{D}{E}\right) \cdot \beta_A$$

- With risky debt ($\beta_D > 0$), the *Equity Beta* is

$$\beta_E = \beta_A + \frac{D}{E}(\beta_A - \beta_D)$$

The M&M Theorem



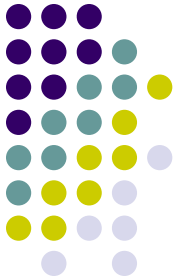
Proposition II (without Taxes):

The *expected return on equity* of a levered firm increases in proportion to leverage (D/E):

$$r_E = r_A + (r_A - r_D) \cdot \frac{D}{E}$$

- r_A the return on assets if the firm had no debt.
  - Any increase in expected return is exactly offset by an increase in risk.
  - Firm value does not change with leverage in absence of taxes and other frictions.

Cost of Capital Revisited



- **In absence of taxes and other frictions:**

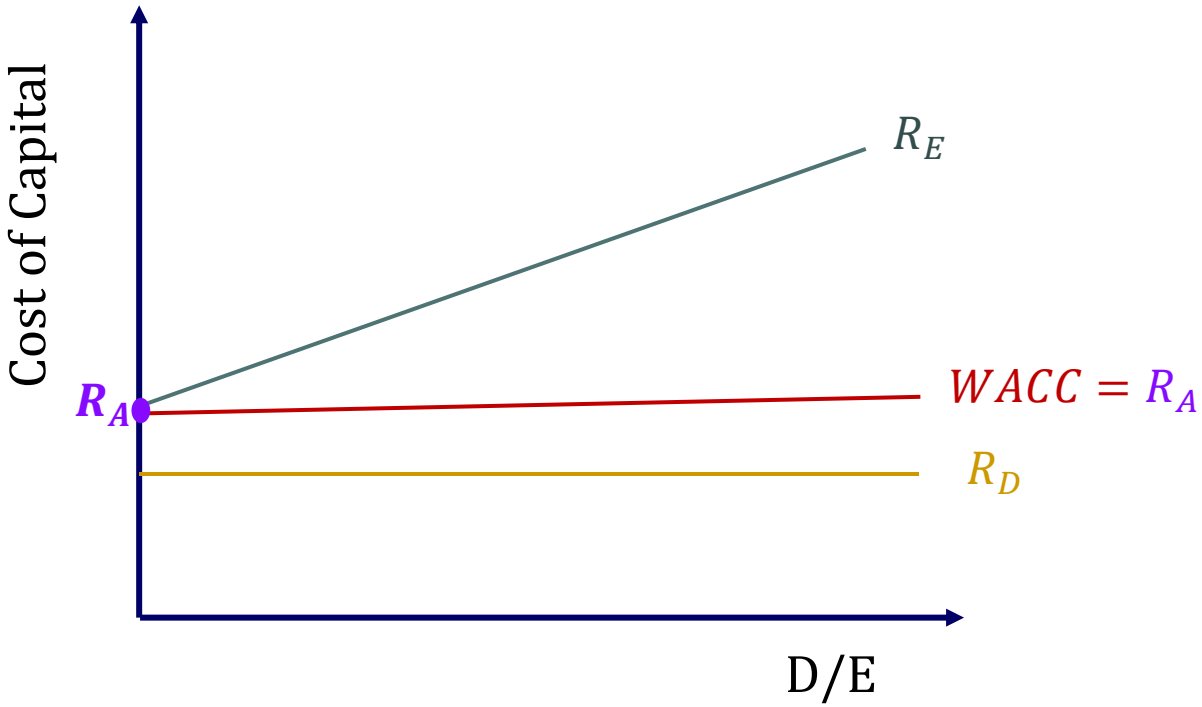
$$WACC = \frac{E}{V} \cdot r_E + \frac{D}{V} \cdot r_D (= r_A \; by \; M\&M\#2)$$

  - where $V = E + D$

- Recall: WACC is the *discount rate* for firm's cash flows. Why?
  - Cash flow of firm = dollar return to equity holders+ dollar return to debt holders (CF= $r_E \times E + r_D \times D$)
  - Value of Firm $V = CF/r$ (or, $r = CF/V$)
  - Thus $r = r_E \times \frac{E}{V} + r_D \times \frac{D}{V} = WACC$

Connections

In absence of taxes and other frictions:



Debt and WACC

Let us go back to the JellyBeans example.

- The WACC under the original capital structure was 13% (the cost of equity).
- The WACC under the new capital structure is

$$WACC = \frac{1}{2} \times 16\% + \frac{1}{2} \times 10\% = 13\%$$

- If the WACC did not change, the value of the firm will not change (since EBIT is not affected by capital structure)