FIN2010 Financial Management
Lecture 21: Capital Structure

Review

- Equity cost of capital
  - CAPM method
  - DDM method
- Debt cost of capital: yield-to-maturity
  - After-tax cost of debt $r_D = R_D(1 - T_C)$
- WACC = $\frac{E}{E+D} r_E + \frac{D}{E+D} r_D$
- Limitation of using firm level WACC
  - Does not account for differences in risk
  - Does not account for differences in capital structure.
    - A firm's equity cost changes with the degree of financial leverage (DFL).
- Project WACC
  - Pure play approach
  - Subjective adjustment approach

Agenda

- Motivation
- Capital structure in a perfect world
  - MM I proposition
  - MM II proposition
- Capital structure in an imperfect world
  - The effect of tax
  - Other effects

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- Motivation
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  - The effect of tax
  - Other imperfections

Motivation

- Key question: what capital structure a firm should choose?
  - Capital structure: the relative proportions of debt, equity, and other securities that a firm has outstanding

- Goal: maximize firm value $= \sum_{i=1}^{t} \frac{Free\ cash\ flows_i}{(1+WACC)^i}$
  - Managers only have limited control on future cash flows
  - But they can freely set capital structures to minimize the WACC
  - We want to know how $\frac{D}{E}$ ratio affects the WACC

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Modigliani and Miller Theory - Overview

- Nobel Prize in Economics in 1985
- MM theory states that $V_L = V_U$ under the perfect capital markets:
  - Competitive market: investors and firms can trade the same set of securities at competitive market prices which is equal to PV(CF).
  - No friction: there are no taxes, transaction costs, bankruptcy costs, or issuance costs. No limits on borrowing.
  - Perfect information: everyone has the same information. Furthermore, a firm's financing decisions do not change the cash flows generated by its investments, nor do they reveal new information about them.

The total value of a firm is equal to the market value of the total cash flows generated by its assets and is not affected by its choice of capital structure.

M&M Theory - Intuition

- Miller once described the MM propositions in an interview this way:
  - *People often ask: can you summarize your theory quickly? Well, I say, you understand the M&M theorem if you understand why this is a joke: The pizza delivery man comes to Yogi Berra after the game and says, " Yogi, how do you want this pizza cut, into quarters or eighths?" And Yogi says, "Cut it into eight pieces. I'm feeling hungry tonight."*
- Everyone recognizes that's a joke because obviously the number and shape of the pieces don't affect the size of the pizza.
- Similarly, the stocks, bonds, preferred stocks issued don't affect the aggregate value of the firm. They just slice up the underlying earnings in different ways.

Example

- Consider Macy's which had earnings before interest and taxes of approximately $2.8 billion in 2014 and interest expenses of about $400 million. In a perfect world without tax:

	With Leverage	Without Leverage
EBIT	$2,800	$2,800
Interest expense	-400	0
Income before tax	2400	2800
Taxes (0%)	0	0
Net income	$2,400	$2,800
Interest paid to debt holders	400	0
Income available to equity holders	2400	2800
Total available to all investors	$2,800	$2,800

MM Theory - Proof

- MM established the result with the following argument:
  - In the absence of taxes or other transaction costs, the total cash flow paid out to all of a firm's security holders is equal to the total cash flow generated by the firm's assets.
  - Therefore, the firm's securities and its assets must have the same total market value.
  - Assume two firms have the same total cash flow but different capital structure. If their values are different, there will be arbitrage opportunities, and arbitrageurs will quickly wipe out the value differences.
    - Arbitrage – finding two assets that are essentially the same and buying the cheaper and selling the more expensive.

MM Theory – The Role of Arbitrage

- Consider two firms that are identical in every respect except capital structure:

Firm NL
- EBIT = $10,000 each year forever
- No financial leverage
- R_E = 15%

Firm L
- EBIT = $10,000 each year forever
- $30,000 of debt, market value of debt = par value
- R_D= 12%
- R_E=16%

- Assume no tax, no NWC, no CAPEX. Is there an arbitrage opportunity? If so, how can you take advantage of it?
- **Solutions:**

Firm NL
- Cash flows available to shareholders = $10,000
- Market value of equity = $10,000 / 0.15 = $66,667
- Total firm value = $66,667 + $0 = $ 66,667

Firm L
- Cash flows available to shareholders = $10,000-$30,000*12% = $6,400
- Market value of equity = $6,400 / 0.16 = $40,000
- Total firm value = Debt + Equity = $40,000 + $30,000 = $ 70,000

There is an arbitrage opportunity!

Example of Arbitrage

- How can one arbitrage?

Action	Cash flow now	Cash flow in each of the future years
Sell firm L's stock	40000.00	-6400.00
Sell firm L's bond	30000.00	-3600.00
Buy firm NL's stock	-66667.00	10000.00
Total	3333.00	0.00

- What if you only have limited capital? You can arbitrage a fraction of the total amount, say 1%.

Action	Cash flow now	Cash flow in each of the future years
Sell 1% of firm L's stock	400.00	-64.00
Sell 1% of firm L's bond	300.00	-36.00
Buy 1% of firm NL's stock	-666.67	100.00
Total	33.33	0.00

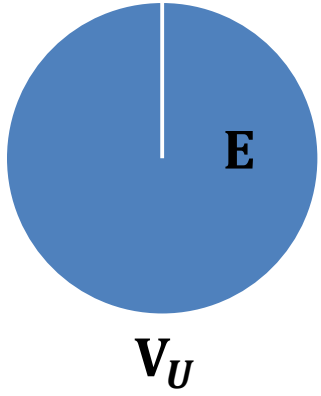
As arbitrageurs take advantage of the opportunity, any value differences will be eliminated. Therefore, all capital structures are equally as acceptable

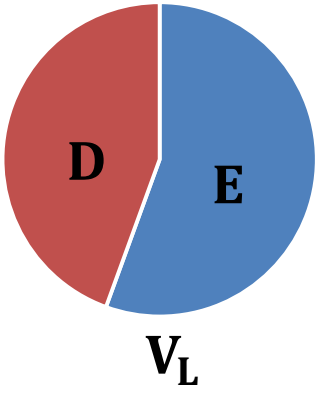
MM I – Capital Structure and Firm Value

- Modigliani-Miller Proposition I (MM I) states that, in a perfect world, the total market value of the firm's securities is equal to the market value of its assets, whether the firm is unlevered or levered.

$$\mathbf{V_U = A = V_L = E + D}$$

  - Therefore, capital structure should not affect firm value.
  - Notations
    - V_U : Market value of equity for an unlevered (no debt) firm
    - A: Market value of the firm's assets
    - V_L : Total market value of a levered (with debt) firm
    - E: Market value of equity in a levered firm
    - D: Market value of debt in a levered firm





Capital Structure and WACC

- What is the impact of capital structure on WACC?
  - Firm value=$\sum_{i=1}^{t} \frac{Free\ cash\ flows_i}{(1+WACC)^i}$ + $cash_0$
  - If capital structure does not affect firm value according to MM I, it must be that capital structure does not affect WACC either.

MM II – Capital Structure and R_E

- Therefore, the cost of capital for a levered firm must equal to the cost of capital for an unlevered firm:

$$\frac{E}{E+D}r_E + \frac{D}{E+D}R_D = r_U \quad \Longrightarrow \quad r_E = \underbrace{r_U}_{\text{Business risk}} + \frac{D}{E}\underbrace{(r_U - R_D)}_{\text{Additional risk due to leverage}}$$

  - Interpretation: the levered equity return equals to the unlevered equity return plus a premium due to leverage.
  - The amount of the premium depends on the amount of leverage, measured by the firm's market value debt-equity ratio, D/E.
  - r_E: cost of equity in a levered firm
  - R_D: cost of debt in a levered firm
  - r_U: cost of equity in an unlevered firm

- MM Proposition II:
  - The cost of capital of levered equity is equal to the cost of capital of unlevered equity plus a premium that is proportional to the market value debt-equity ratio.

A Common Mistake

Consider an entrepreneur with the following investment opportunity. For an initial investment of $800 this year, a project will generate cash flows of $1400 in strong economy and $900 in weak economy. Both scenarios are equally likely. Given the risk level of the project, the firm estimates that the equity cost of capital will be 15% if it uses 100% equity. At the same time, it can borrow at 5% interest rate.

- In this case, isn't debt a cheaper and better source of capital than equity? Consequently, would the firm value be higher when the firm uses more debt?

A Common Mistake

- **Solution:**
  - No! As the firm issue more debt, the firm's equity becomes riskier. Equity cost of capital will increase with the increase in leverage. As a result, the WACC will remain the same, so does the firm value.
  - If the firm is all-equity financed, the expected return on unlevered equity is 15%.
  - If the firm is financed with $500 of debt, the expected return of the debt is 5%.
  - Therefore, according to MM Proposition II, the expected return on equity for the levered firm is
    - Unlevered firm value=$\frac{50\%*1400+50\%*900}{1+15\%}$=1000 = levered firm value
    - Equity value of a levered firm =firm value - value of debt=500
    - $r_E = 15\% + \frac{500}{500}(15\% - 5\%) = 25\%$

Example

Suppose the entrepreneur in the example on Page 15 borrows $700 when financing the project. According to MM Proposition II, what will be the firm's equity cost of capital?

- Recall that the expected return on unlevered equity is 15% and cost of debt is 5%.

- **Solution**
  - $V_U = V_L = E + D$
  - $1,000 = E + $700 → E = $300
  - Then,

$$r_E = 15\% + \frac{700}{300}(15\% - 5\%) = 38.33\%$$

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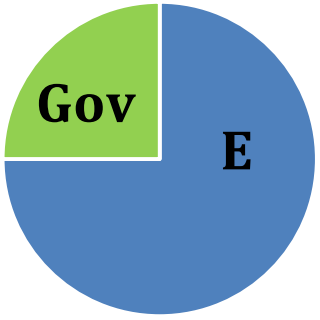
Capital Structure in an Imperfect World

- M&M theorem argues that in a perfect world, capital structure choice does not affect cash flows, firm value, and WACC.
- Perfect world definitions:
  - Competitive market
  - No frictions, i.e., no taxes, transaction costs, issuance costs, bankruptcy costs, etc.
  - Perfect information
- We will then look at imperfections in the real world and how these imperfections affect firms' capital structure choice.

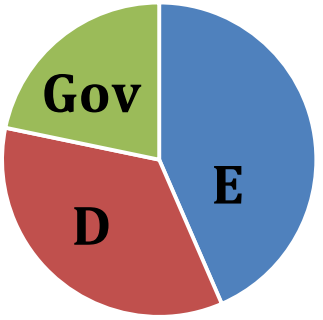
The Effect of Tax

- Perfect world condition # 2: No friction. There are no taxes, transaction costs, issuance costs, bankruptcy costs, etc.

- Real world: corporations pay taxes on their profits. The tax is paid after interest payments are deducted and before dividend payments are deducted.
- Consequence: debt offers a tax advantage.
  - Note: debt itself does not make the pie bigger. It simply reduces that amount that the government takes away in the form of taxes.



$\mathbf{V}_U = \boldsymbol{E}$



$\mathbf{V}_\mathbf{L} = \boldsymbol{D} + \boldsymbol{E} > \boldsymbol{V}_U$

The Effect of Tax on Cash Flows

- Consider Macy's which had earnings before interest and taxes of approximately $2.8 billion in 2014 and interest expenses of about $400 million. Macy's marginal corporate tax rate was 35%.

	With Leverage	Without Leverage
EBIT	$2,800	$2,800
Interest expense	-400	0
Income before tax	2400	2800
Taxes (35%)	840	980
Net income	$1,560	$1,820
Interest paid to debt holders	400	0
Income available to equity holders	1560	1820
Total available to all investors	$1,960	$1,820

- Macy's debt obligations reduced the value of its equity. But the total amount available to all investors was higher with leverage.

The Interest Tax Shield

- Without leverage, Macy's was able to pay out $1820 million in total to its investors. With leverage, Macy's was able to pay out $1960 million in total to its investors. Where does the additional $140 million come from?

- Interest Tax Shield
  - The reduction in taxes paid due to the tax deductibility of interest
  - In Macy's case, the interest payments provided a tax savings of 35% × $400 million = $140 million.

$$\text{Interest Tax Shield} = \text{Corporate Tax Rate} \times \text{Interest Payments}$$

Interest Tax Shield - Example

Computing the Interest Tax Shield

Problem

Suppose that shown below is the income statement for D.F. Builders (DFB). Given its marginal corporate tax rate of 35%, what is the amount of the interest tax shield for DFB in years 2012 through 2015?

DFB Income Statement ($ million)	2012	2013	2014	2015
Total sales	$3369	$3706	$4077	$4432
Cost of sales	−2359	−2584	−2867	−3116
Selling, general, and administrative expense	−226	−248	−276	−299
Depreciation	−22	−25	−27	−29
Operating income	762	849	907	988
Other income	7	8	10	12
EBIT	769	857	917	1000
Interest expense	−50	−80	−100	−100
Income before tax	719	777	817	900
Taxes (35%)	−252	−272	−286	−315
Net income	$467	$505	$531	$585

Solution

($ million)	2012	2013	2014	2015
Interest expense	−50	−80	−100	−100
Interest tax shield (35% × interest expense)	**17.5**	**28**	**35**	**35**

Thus, the interest tax shield enabled DFB to pay an additional $115.5 million to its investors over this period.

The Effect of Tax on Firm Value

- Effect of tax on cash flows
  - $\text{Cash Flows to Investors with Leverage} =$
    $\text{Cash Flows to Investors without Leverage} + \text{Interest Tax Shield}$
- As a result, the effect of tax on firm value

$$V^L = V^U + PV(\text{Interest Tax Shield})$$

- This is the MM Proposition I with Taxes:
  - The total value of the levered firm exceeds the value of the firm without leverage due to the present value of the tax savings from debt.
  - The value of interest tax shields is computed as the present value of the stream of future interest tax shields the firm will receive.

Value of Interest Tax Shield

- Value of interest tax shield depends on firms' debt policies:
  - Fixed interest payments
  - Fixed debt amount
  - Fixed debt ratio

Value of Interest Tax Shield – Fixed Interest Payments

Valuing the Interest Tax Shield without Risk

Problem

Suppose DFB plans to pay $100 million in interest each year for the next 10 years, and then to repay the principal of $2 billion in year 10. These payments are risk free, and DFB's marginal tax rate will remain 35% throughout this period. If the risk-free interest rate is 5%, by how much does the interest tax shield increase the value of DFB?

Solution

In this case, the interest tax shield is 35% × $100 million = $35 million each year for the next 10 years. Therefore, we can value it as a 10-year annuity. Because the tax savings are known and not risky, we can discount them at the 5% risk-free rate:

$$\begin{aligned} PV(\text{Interest Tax Shield}) &= \$35 \text{ million} \times \frac{1}{0.05}\left(1 - \frac{1}{1.05^{10}}\right) \\ &= \$270 \text{ million} \end{aligned}$$

The final repayment of principal in year 10 is not deductible, so it does not contribute to the tax shield.

Value of Interest Tax Shield – Fixed Debt Amount

- Assumption: (1) the firm's marginal tax rate is constant
  (2) the debt is perpetual, and the amount is fixed

$$\text{PV}(\text{Interest Tax Shield}) = \text{PV}(\tau_c \times \text{Future Interest Payments})$$
$$= \tau_c \times \text{PV}(\text{Future Interest Payments})$$

- If the debt is fairly priced, no arbitrage implies that its market value must equal the present value of the future interest payments.

PV(Future Interest Payments)= Market value of debt = D

  - The intuition is the same as mortgage remaining balance:
    PV(Future Payments) = Remaining amount owed

- Therefore:

$$PV(\text{Interest Tax Shield}) = \tau_c \times D$$

The Effect of Tax on WACC

- Another way to understand the tax benefit of debt is that using debt can reduce a firms' after-tax cost of capital and thus increase firm value.

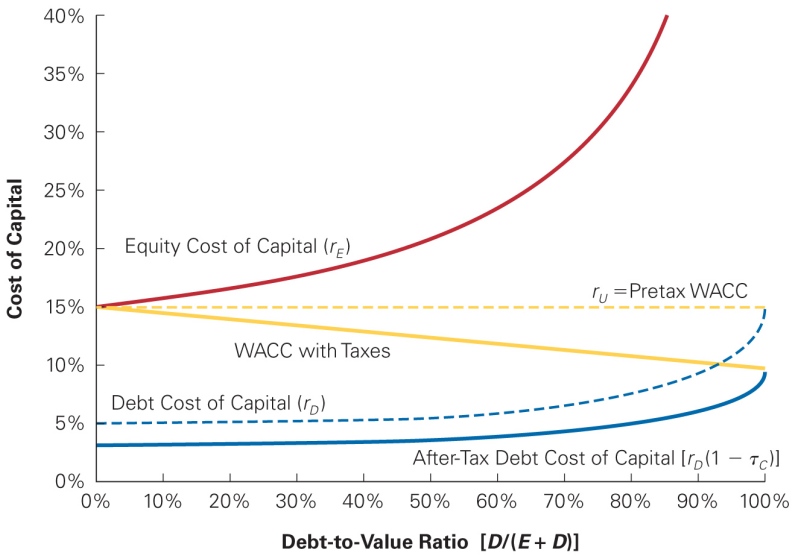
$$\text{After-tax cost of capital } r_{wacc} = \frac{E}{E+D} r_E + \frac{D}{E+D} R_D \times (1 - \tau_c) \qquad (1)$$

- With tax-deductible interest, the effective after-tax borrowing rate is $R_D(1 - \tau_c)$ and the weighted average cost of capital becomes:

Re-arranging equation (1) generates:

$$r_{wacc} = \underbrace{\frac{E}{E+D} r_E + \frac{D}{E+D} r_D}_{\text{Pretax WACC}} - \underbrace{\frac{D}{E+D} R_D \tau_c}_{\text{Reduction due to interest tax shield}}$$

- $\frac{E}{E+D} r_E + \frac{D}{E+D} R_D$ is called pretax WACC because it is a firm's WACC w/o considering the tax effect.



Use of Pre-tax WACC

Last lecture, we argue that if McPuter's plans to use 40% debt instead of 18.5% as Dell does, we cannot directly use Dell's WACC as an appropriate discount rate for capital budgeting. How to make adjustment then?

- They should have the **same pre-tax WACC**!
  - McPuter's pretax WACC = Dell's pretax WACC = R_U
    = 0.8147*9.71%+0.1853*4.5%
    = 8.745%
  - McPuter's after-tax WACC = 8.745% - 40%*4.5%*27% = 8.26%
  - According to MM II:

McPuter's $R_E = R_U + \frac{D}{E}(R_U - R_D)$

= 8.745% + 40%/60% *(8.745%-4.5%) = 11.58%

Which rate should I use in capital budgeting?

Not required for the exam, but useful for the group project.

- WACC method: ignore financing costs in cash flow estimation, and then use after-tax WACC
  - Assumption: the project's capital structure is constant over its life span
  - More commonly used because it is convenient
- Adjusted Present Value (APV) method: include financing costs (i.e., interest expense in each year), and use pre-tax WACC
  - More complicated, but flexible

- For more information, please refer to the textbook by Berk DeMarzo, Chapter 18

Example

Valuing the Interest Tax Shield with a Target Debt-Equity Ratio

Without considering interest expense

Problem

Western Lumber Company expects to have free cash flow in the coming year of $4.25 million, and its free cash flow is expected to grow at a rate of 4% per year thereafter. Western Lumber has an equity cost of capital of 10% and a debt cost of capital of 6%, and it pays a corporate tax rate of 35%. If Western Lumber maintains a debt-equity ratio of 0.50, what is the value of its interest tax shield?

Solution

We can estimate the value of Western Lumber's interest tax shield by comparing its value with and without leverage. We compute its unlevered value by discounting its free cash flow at its pretax WACC:

$$\text{Pretax WACC} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D = \frac{1}{1+0.5} 10\% + \frac{0.5}{1+0.5} 6\% = 8.67\%$$

Because Western Lumber's free cash flow is expected to grow at a constant rate, we can value it as a constant growth perpetuity:

$$V^U = \frac{4.25}{8.67\% - 4\%} = \$91 \text{ million}$$

To compute Western Lumber's levered value, we calculate its WACC:

$$\text{WACC} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D (1 - \tau_c)$$

$$= \frac{1}{1+0.5} 10\% + \frac{0.5}{1+0.5} 6\%(1 - 0.35) = 7.97\%$$

Thus, Western Lumber's value including the interest tax shield is

$$V^L = \frac{4.25}{7.97\% - 4\%} = \$107 \text{ million}$$

The value of the interest tax shield is therefore

$$PV(\text{Interest Tax Shield}) = V^L - V^U = 107 - 91 = \$16 \text{ million}$$

WACC method:
CF w/o interest expense,
discounted by after-tax WACC

APV method:
CF w interest expense,
discounted by pre-tax WACC
First year cash flow:

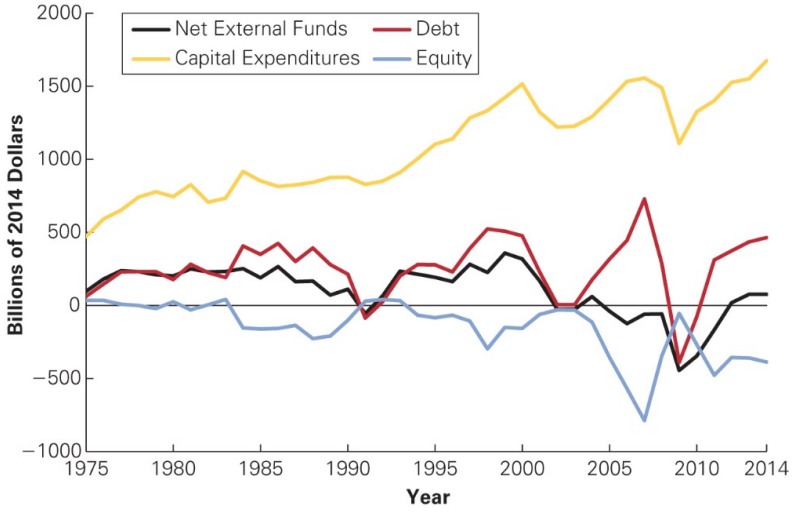
$$= 4.25 + \frac{D}{D+E} \cdot 107 \cdot 6\% \cdot 35\% = 5.00$$

Firm value:

$$V^L = \frac{5.00}{8.67\% - 4\%} = 107$$

Capital Structure in Reality

- Debt has tax advantage over equity.
- In reality, do firms prefer debt over equity?

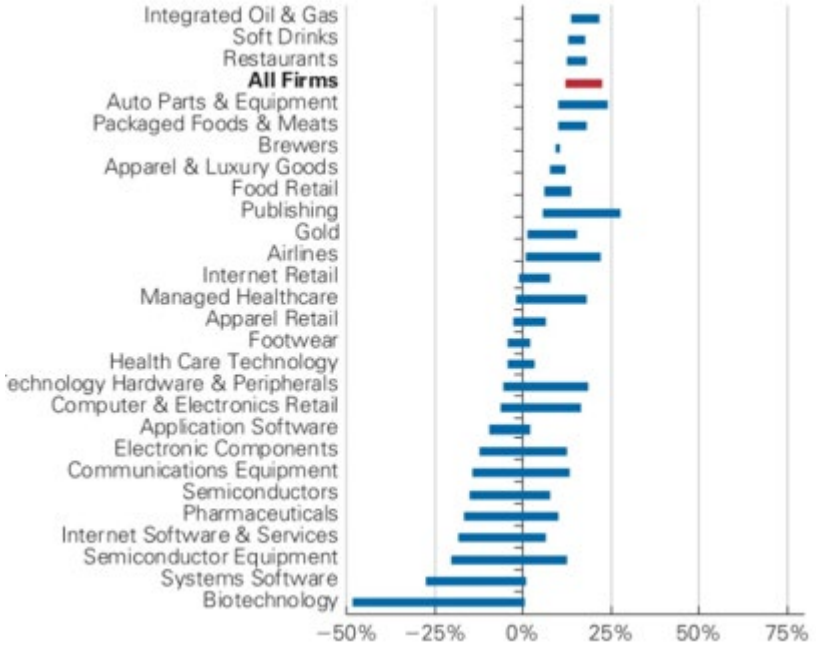


Net External Financing and Capital Expenditures by U.S. Corporations, 1975–2014

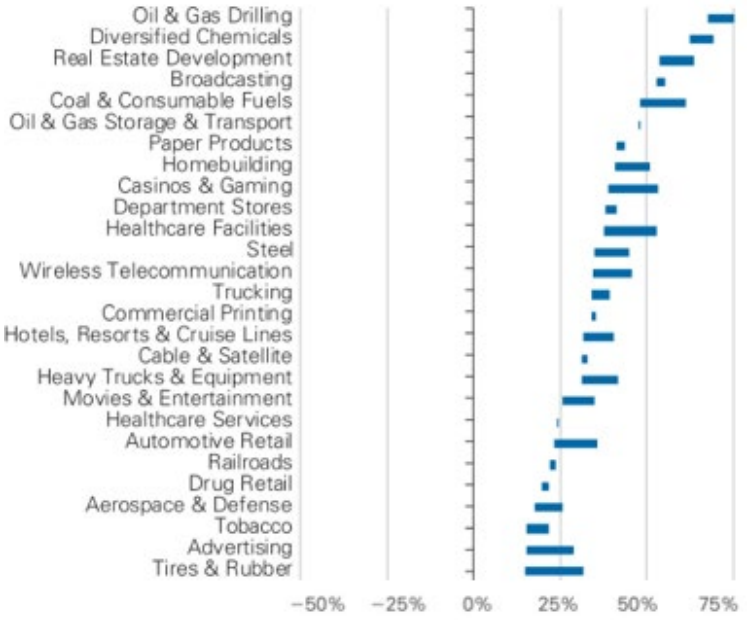
Source: Federal Reserve, *Flow of Funds Accounts of the United States*, 2014.

- Firms seem to prefer debt when raising external funds, although not all investment is externally funded.
  - When firms raise new capital from investors, they do so primarily by issuing debt.
  - In most years, aggregate equity issues are negative, meaning that on average, firms are reducing the amount of equity outstanding by buying shares.

Capital Structure in Reality



Net debt to enterprise value



Total debt to enterprise value

- For most firms, debt make up less than half of the capital structure of most firm.
- The use of debt varies greatly by industry: firms in growth industries like biotechnology or high technology carry very little debt, while oil firms, automakers, have high leverage ratios.

Capital Structure in Reality

Questions

- If debt provides a tax advantage that lowers a firm's weighted average cost of capital and increases firm value, why does debt make up less than half of the capital structure of most firms?
- Why does the leverage choice vary so much across industries, with some firms having no net leverage?
- To answer these questions, we need to consider the limits to the tax benefit of debt and some potential disadvantages for using debt.

Limits to the Tax Benefit of Debt

- To receive the full tax benefits of leverage, a firm need not use 100% debt financing, but the firm does need to have taxable earnings.
  - This constraint may limit the amount of debt needed as a tax shield.
- For example:

	No Leverage	High Leverage	Excess Leverage
EBIT	$1000	$1000	$1000
Interest expense	0	-1000	-1100
Income before tax	1000	0	-100
Taxes (35%)	-350	0	0
Net income	650	0	-100
Tax savings from leverage	$0	$350	$350

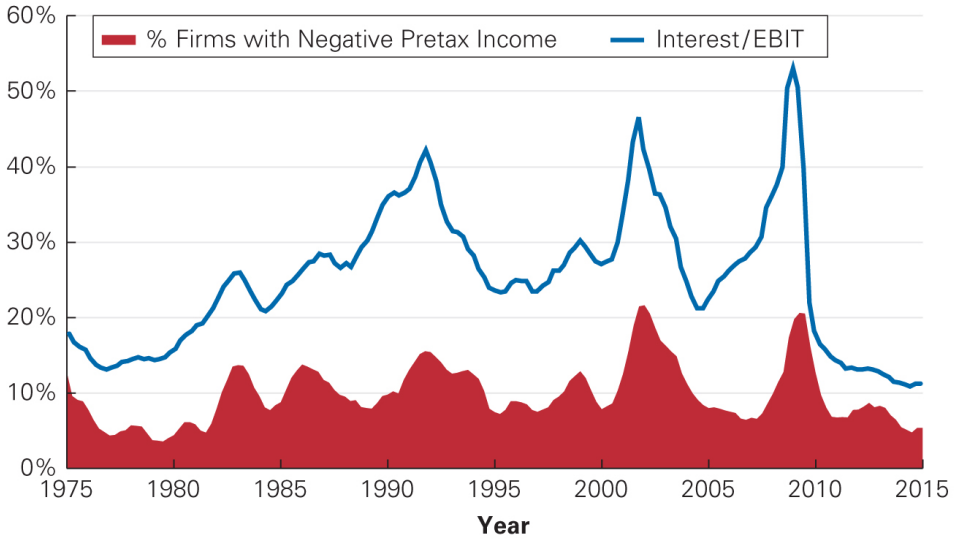
  - With no leverage, the firm receives no tax benefit.
  - With high leverage, the firm saves $350 in taxes.
  - With excess leverage, the firm still saves $350. This means there is no tax saving from the extra $100 interest expense.

Optimal Level of Debt

- Interest payment = EBIT
  - At the optimal level of leverage, the firm tax shield covers all of its taxable income, and thus the firm pays 0 tax.
- What does this conclusion tell us about the optimal leverage ratio (debt/equity) in a firm's capital structure?
  - For young firms, they often do not have any taxable income. In this case, a tax-optimal capital structure does not include debt. Leverage ratio=0.
  - Only when these firms matures and becomes profitable, will it have taxable cash flows. Then it should add debt to its capital structure. Leverage ratio goes up.

Capital Structure in Reality

- In reality, do firms fully take advantage of tax shield of debt?



- The figure reveals two important patterns:
  - Firms have used debt to shield a greater percentage of their earnings from taxes in more recent years (mirroring the increase in the effective tax advantage of debt).
  - Firms have far less leverage than our analysis of the interest tax shield would predict (the low leverage puzzle).
    - Interest payment is far less than EBIT.

The Low Leverage Puzzle

- It would appear that firms, on average, are under-leveraged.
- However, it is hard to accept that most firms are irrational and acting sub-optimally.
- In reality, there must be some other considerations in the choice of debt versus equity.

Other Considerations (Not Required)

- Bankruptcy risk: a big disadvantage to using debt
- Agency problems
  - Asset substitution: managers may accept negative NPV projects when leverage is high.
  - Debt overhang: managers may reject positive NPV projects when leverage is high
  - Wasteful investment: managers may invest in negative NPV projects. High leverage can potentially alleviate the problem.
- Tradeoff theory: $V^L = V^U + PV(\text{Interest Tax Shield}) - PV(Financial\ Distress\ Costs) - PV(Agency\ Costs\ of\ Debt) + PV(Agency\ Benefits\ of\ Debt)$
- Information asymmetry: different parties have different information
  - Because of information asymmetry and adverse selection problem, stock prices drop whenever the firm chooses to issue equity, making equity financing very costly for firms.
- Pecking order theory:
  - Because of information asymmetry, managers will prefer to fund investments by first using retained earnings, then debt, and equity only as a last resort.
- If you are interested, FIN4210 (Corporate Finance) will further elaborate on this topic.

Summary

- Capital structure in a perfect world:
  - MM I: capital structure does not affect firm value
  - MM II: $R_E = R_U + \frac{D}{E}(R_U - R_D)$
- Capital structure in an imperfect world – the effect of tax:
  - Debt offers a tax advantage
  - Interest tax shield = interest payment * tax rate
  - Value of interest tax shield for permanent debt = market value of debt * tax rate
  - $V_L = V_U$ + PV(interest tax shield)
  - After-tax WACC $r_{wacc} = \frac{E}{E+D} r_E + \frac{D}{E+D} R_D - \frac{D}{E+D} R_D \tau_c$
  - The optimal point for tax saving is when interest payment = EBIT
- Firms don't seem to fully take advantage of the tax saving benefit of debt. Why? There are other pros and cons for using debt vs. equity.

Next Lecture—Ethics in Finance

- What is Ethics?
- Ethics Problems in Finance
  - Deceiving your Clients
  - Gaming the System
  - Regulatory Arbitrage
  - Favoritism
- Why is Ethics Important?
  - The Great Financial Crisis (2008)