PRINCIPLES OF FINANCE

WEEK 8

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Last week

Do you remember

- The cost of debt-funded capital
- The impact of the choice of capital structure on the cost of capital and firm value (Modigliani Miller)
- Deviations from Modigliani Miller assumptions

Outline of today's lecture

In class

- Revisit the results of Modigliani Miller but with taxes
- Is there an optimal capital structure?
- The trade-off and pecking-order theories

Recording: None

Application: Capital structure of Apple and Tesla

Capital Structure in Imperfect Capital Markets

The interest tax deduction

- Corporations pay taxes on their profits *after* interest payments are deducted
- In contrast, dividend payments are not tax deductible.
- This creates an incentive to use debt.
  - The deductibility of interest expense does not change the firm's pre-tax cash flow.
  - But interest expense reduces the amount of corporate taxes.
- The tax shield of interest expense is one advantage of debt financing.

Interest tax shield - Example

- Safeway, Inc.

Total Sales	600 000
Cost of Goods Sold	300 000
Gross Profit	300 000
Selling, general and administrative expenses	50 000
Research and Development	50 000
Depreciation	75 000
Operating Income	125 000
Other income	0
Earnings before interest and taxes (EBIT)	125 000

- Corporate tax rate $\tau_C = 30\%$, cost of debt $r_D = 10\%$,

Interest tax shield - Example

	Case 1: Zero Debt	Case 2: 500 000 of Debt
EBIT	125 000	125 000
Interest Expenses (10% p.a.)	0	50 000
Pretax Income	125 000	75 000
Tax	37 500	22 500
Net income	87 500	52 500
Total available to all investors = (debtholders and equityholders)	87 500	102 500

- Safeway's debt obligations reduced the value of its equity
- But the total amount available to all investors is $ 15000 higher with leverage
  - Annual tax shield from debt $\tau_C \times (r_D \times D) = 30\% \times 50000 = 15000$
- Hence the total value of the company (combined value to debtholders and equityholders) is higher with leverage

Interest tax shield - Example

- Where does the gain come from?
- Without leverage:
  - Total amount available to investors: after tax cash flow to (unlevered) equity holders $EBIT \times (1 - \tau_C)$
- With leverage:
  - Cash flow to debt holders: $r_D \times D$;
  - Cash flow to equity holders: $(EBIT - r_D \times D) \times (1 - \tau_C)$
  - Total amount available to investors is

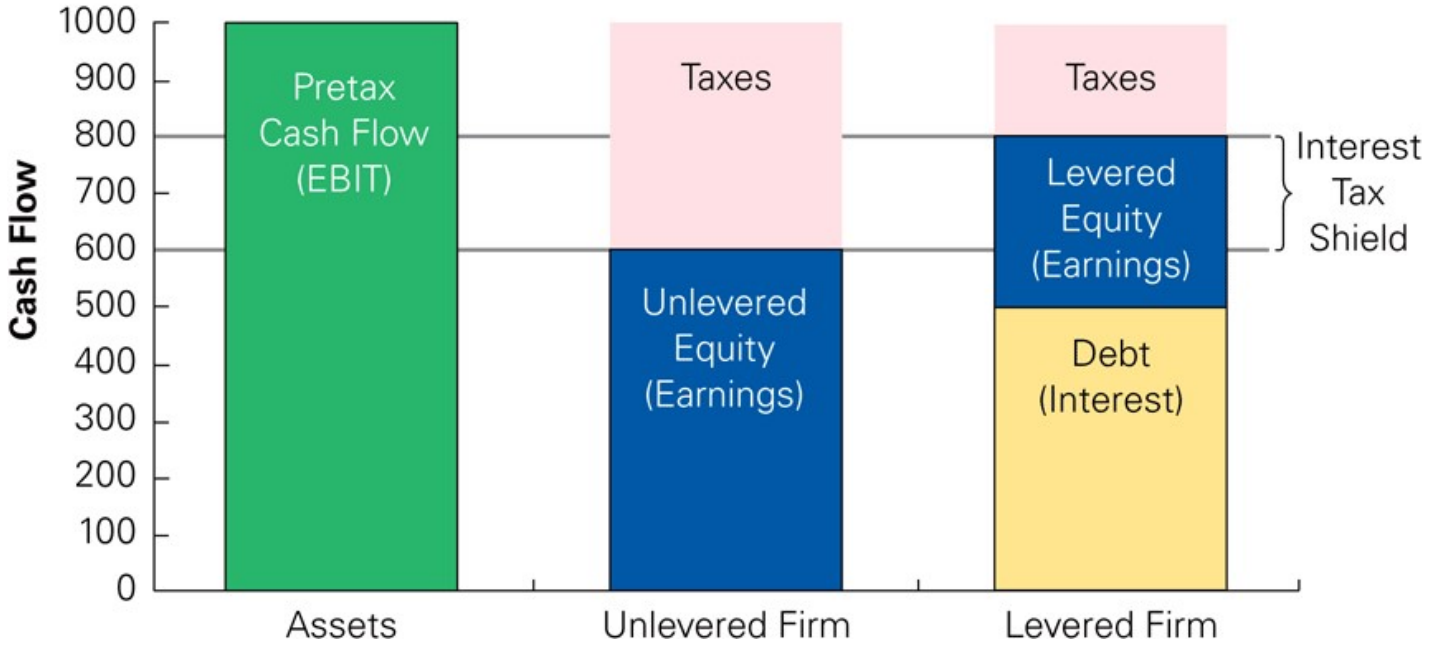
  $(EBIT - r_D \times D) \times (1 - \tau_C) + r_D \times D = EBIT \times (1 - \tau_C) + \mathrm{r_D} \times D \times \tau_C$

- When a firm uses debt, the total amount available to investors is increased by the amount of interest tax shield $\mathrm{r_D} \times D \times \tau_C$

Valuing the interest tax shield

- When a firm uses debt, the interest tax shield provides a corporate tax benefit each year:

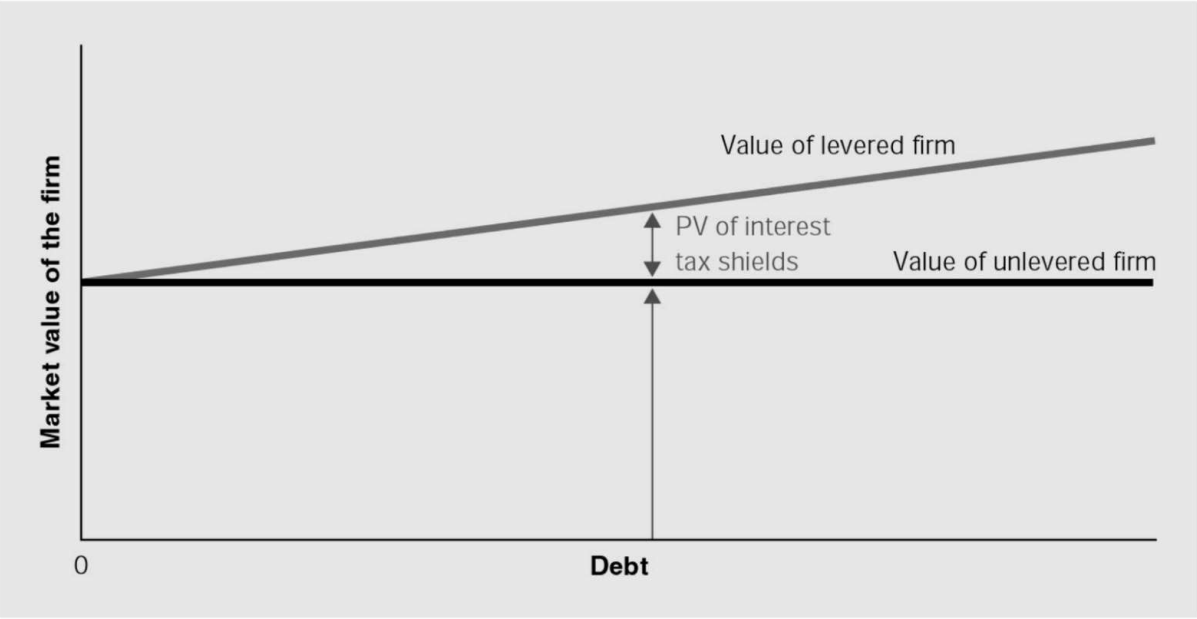
$$\begin{pmatrix}\text{Cash Flows to Investors}\\ \text{with Leverage}\end{pmatrix} = \begin{pmatrix}\text{Cash Flows to Investors}\\ \text{without Leverage}\end{pmatrix} + \text{(Interest Tax Shield)}$$



MM proposition 1 with taxes

- In the presence of taxes, the total value of the levered firm is higher than the value of the firm without leverage due to the present value of the tax savings from debt:

$$V_L = V_U + PV(TS)$$



MM proposition 1 with taxes

- We can re-write this formula in terms of expected returns:

$$Er_E + D\ r_D = V_U r_U + PV(TS)\ r_T$$

Where r_T is the expected return associated with the interest tax shields.

- The relation between r_E, r_D and r_U will depends on the expected return r_T, which depends on the risk of the tax shield.

Unlevered cost of capital

- We can infer the unlevered cost of capital in each case
- When debt levels are set according to a fix schedule, we can discount the pre-determined interest tax shield using the debt cost of capital, $r_T = r_D$
  - With a fix schedule, the amount of debt will not fluctuate. In this case, the risk of the tax shield is similar to the risk of the debt payments.

- When the firm maintains a target leverage ratio (debt-equity ratio is constant), its future interest tax shields should be discounted at the project's unlevered cost of capital, $r_T = r_U$
  - If the project does well, its value will be higher, it will support more debt and the interest tax shield will be higher. The tax shield will vary with the value of the project. Hence it has similar risk to the project's cash flows.

Unlevered cost of capital

- When debt levels are set according to a fix schedule ($r_T = r_D$)

$$Er_E + D\, r_D = V_U r_U + PV(TS)\, r_D$$

Re-arranging yields

$$r_U = \frac{E}{E + D - PV(TS)} r_E + \frac{D - PV(TS)}{E + D - PV(TS)} r_D$$

- When the firm maintains a target leverage ratio ($r_T = r_U$)

$$Er_E + D\, r_D = (V_U + PV(TS))r_U = (E + D)r_U$$

And therefore r_U is as in last lecture:

$$r_U = \frac{E}{E + D} r_E + \frac{D}{E + D} r_D$$

Interest tax shield with permanent debt

- Suppose (for simplicity) that a firm borrows debt *D* and keeps the debt permanently.
- If the firm's marginal tax rate is τ_c, and if the debt has a discount rate of r_D, then the interest tax shield each year is $\tau_c \times r_D \times D$, and the tax shield can be valued as a perpetuity:

$$PV(\text{Interest Tax Shield}) = \frac{\tau_C \times Interest}{r_D} = \frac{\tau_C \times (r_D \times D)}{r_D}$$

$$= \tau_C \times D$$

Here we discount the tax shield using the cost of debt (fix debt schedule: $r_T = r_D$)

Tax benefit of debt in the discount rate

- The tax benefit of debt can also be calculated by adjusting the cost of debt (rather than cash flows)
- Suppose that a firm with a 28% tax rate borrows $100,000 at 10% interest per year. Then the net cost is

Interest expense	$r_D \times D$	10 000
Tax savings	$-\tau_C \times (r_D \times D)$	- 2 800
Effective after-tax cost of debt	$r_D(1-\tau_C) \times D$	7 200

- With interest tax shield, the effective after-tax cost of debt is not $r_D = 10\%$ but $r_D(1-\tau_C) = 7.2\%$

Weighted Average Cost of Capital with taxes

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

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

- This WACC is the effective cost of capital of the levered firm, after taking into account the tax benefit of the interest tax shield.

When and how to use the WACC?

- The WACC reflects the market risk of a firm
- When a project has similar market risk as the average market risk of the firm's investments, the WACC is the cost of capital of this project
- When a project is tied to specific funding terms (example of student loan), then the cost of capital of the project depends on these terms
- Discounting of FCF using the WACC: assumes that the debt-equity ratio remains constant. This means the firm may have to repurchase or issue debt in order to maintain a constant leverage (D/E) over time (remember that E will move a lot due to stock price movements)
- Otherwise, the WACC varies with time.

WACC example

ABC Corporation maintains a debt-equity ratio of 0.85, has an equity cost of capital of 12% and a debt cost of capital of 7%. ABCs corporate tax is 28%. ABCs free cash flow (FCF) is expected to be $10M and the growth rate of the company is expected to be 4%.

WACC with tax shield

$$r_{WACC,\ with\ shield} = \frac{1}{1.85} \times 12\% + \frac{0.85}{1.85} \times (1 - 28\%) \times 7\% = 8.8\%$$

WACC without tax shield

$$r_{WACC,\ without\ shield} = \frac{1}{1.85} \times 12\% + \frac{0.85}{1.85} \times 7\% = 9.7\%$$

WACC example

Use the two WACC to calculate the value of the firm with and without taxes

Value of the firm with tax shield

$$V^L = \frac{FCF}{r_{WACC,with\,shield} - g} = \frac{10M}{8.8\% - 4\%} = 208.3M$$

Value of the firm without tax shield (independent of leverage)

$$V^U = \frac{FCF}{r_{WACC,without\ shield} - g} = \frac{10M}{9.7\% - 4\%} = 175.4M$$

Present value of the tax shield

$$PV(\text{Interest Tax Shield}) = V^L - V^U = 208.3M - 175.4M = 32.9M$$

WACC with taxes – Fix leverage ratio

- In the case of a fix leverage (debt/equity) ratio
- The unlevered discount rate is also the pretax WACC

$$r_U = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D = Pretax\, r_{WACC} > r_{WACC}$$

MM proposition 2 with taxes – Fix leverage ratio

- Remember M&M Proposition 2:
  - $r_E = r_U + \frac{D}{E}(r_U - r_D)$
  - $\beta_E = \beta_U + \frac{D}{E}(\beta_U - \beta_D)$
- Even in the presence of corporate taxes, these formulas stay the way they are if the firm chooses a permanent **leverage ratio**

MM proposition 2 with taxes – Fix debt schedule

- In the case of a fix debt schedule (risk-free debt), the unlevered cost of capital becomes:

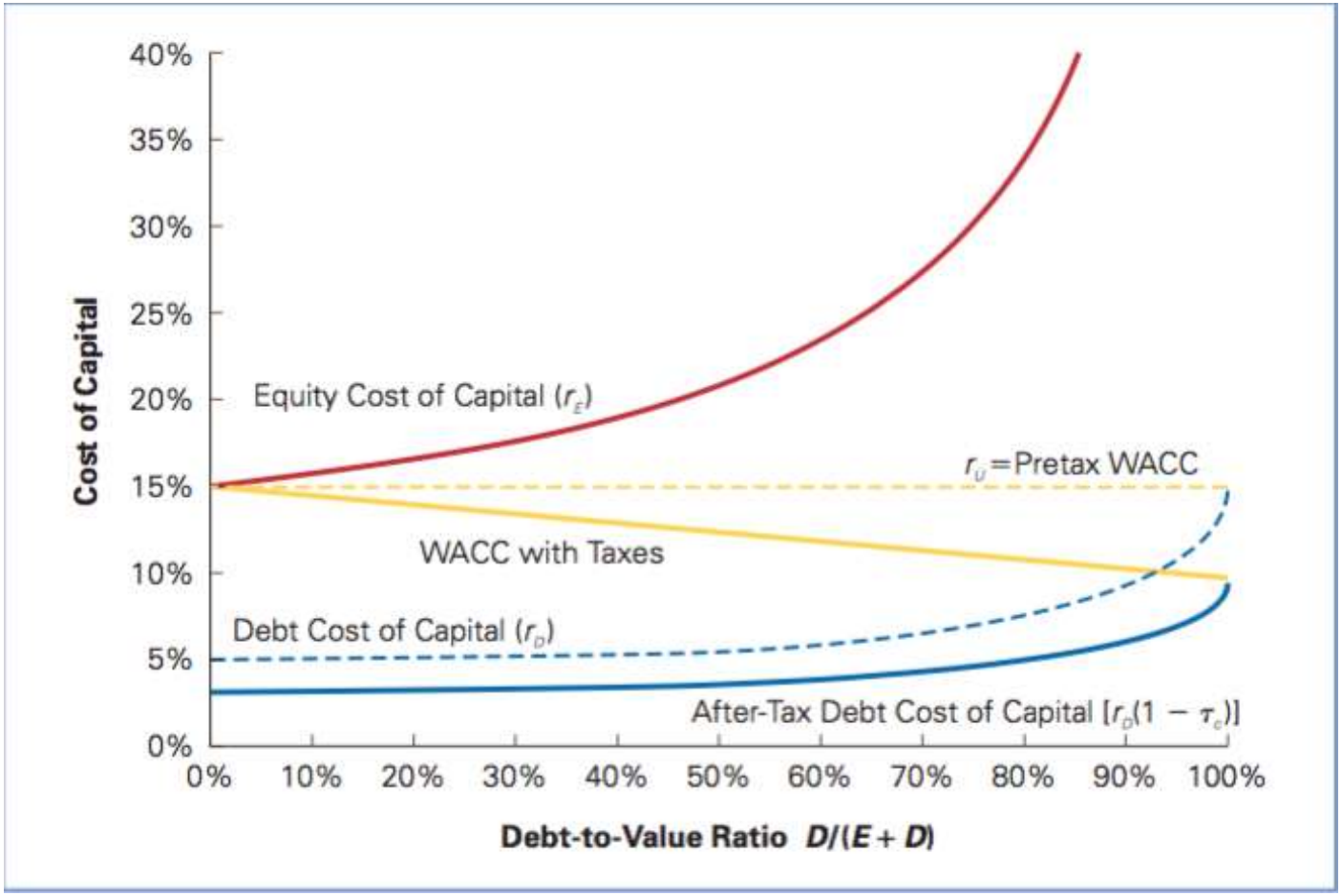
$$r_U = \frac{E}{E + D^s} r_E + \frac{D^s}{E + D^s} r_D$$

Where D^s is the debt net of the predetermined tax shields. In the case of permanent debt,

$$D^s = D(1 - \tau)$$

- MM proposition 2 becomes :
  - $r_E = r_U + (1 - \tau)\frac{D}{E}(r_U - r_D)$
  - $\beta_E = \beta_U + (1 - \tau)\frac{D}{E}(\beta_U - \beta_D)$

Cost of capital



In practice, need to take into account

- Costs of financial distress (getting closer to default)
- Signalling costs.

→ Incentives to not take on too much debt.

Example

Green Manufacturing, Inc. plans to announce that it will issue $2m of perpetual debt and use proceeds to repurchase stocks. The bonds will have a 6% annual rate. Green Manufacturing currently is an all-equity firm worth $6.3m with 400,000 shares outstanding. After the sale of the bonds, Green will maintain the new capital structure indefinitely. The expected annual pre-tax earnings of Green are $1.5m. Those earnings are also expected to remain constant in perpetuity. Green is in the 40-percent tax bracket.

a) What is Green's current required return on assets? What is the stock price before announcement?

Example

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Solution: $V_U = 1.5x(1-0.4)/r_U$

$\Rightarrow r_U = 900{,}000/6.3m = 14.29\%.$

Before announcement, the stock price is $= 6.3m/400{,}000 = \$15.75.$

Example

b) What is the firm value immediately after Green announces the debt issue?

Example

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Solution: According to MM Proposition 1 with taxes,

$$V_L = V_U + \tau_C D = 6.3m + 0.4 * 2m = \$7.1m$$

Since the debt has not yet been issued, Green's equity is worth $7.1m, and the stock price is *= 7.1m/400,000 = $17.75.*

Example

c) How many shares of stock will Green retire?

Example

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Solution: The number of shares repurchased should be:

2m/17.75 = 112,676

The number of shares outstanding is *400,000-112,676 = 287,324.*

Example

d) What is the firm value and what is the cost of equity after capital restructuring?

Example

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Solution: The share price remains the same after restructuring. Then the value of equity is *287,324x17.75 = $5.1m.*

According to MM Proposition 2 with taxes

$$r_E = r_U + \frac{D}{E}(1-\tau_C)(r_U - r_D) = 14.29 + \frac{2}{5.1}(1-0.4)(14.29-6)\% = 16.24\%.$$

The Trade-Off Theory

Debt incentive versus bankruptcy costs

- Financing a project with debt leads to tax savings

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

- But it also increases the probability of going bankrupt.

Bankruptcy costs

1. Direct bankruptcy costs: legal fees, lawyers, consultants, time spent negotiating with banks…
2. Indirect bankruptcy costs: business disruption, credibility, uneasy relationship with suppliers / customers, absence of strategic flexibility, increased costs of financing…
3. ”Agency costs” of debt: milking the assets, under-investment, gambling the firm…

The possibility of bankruptcy has a negative impact on the value of the firm.

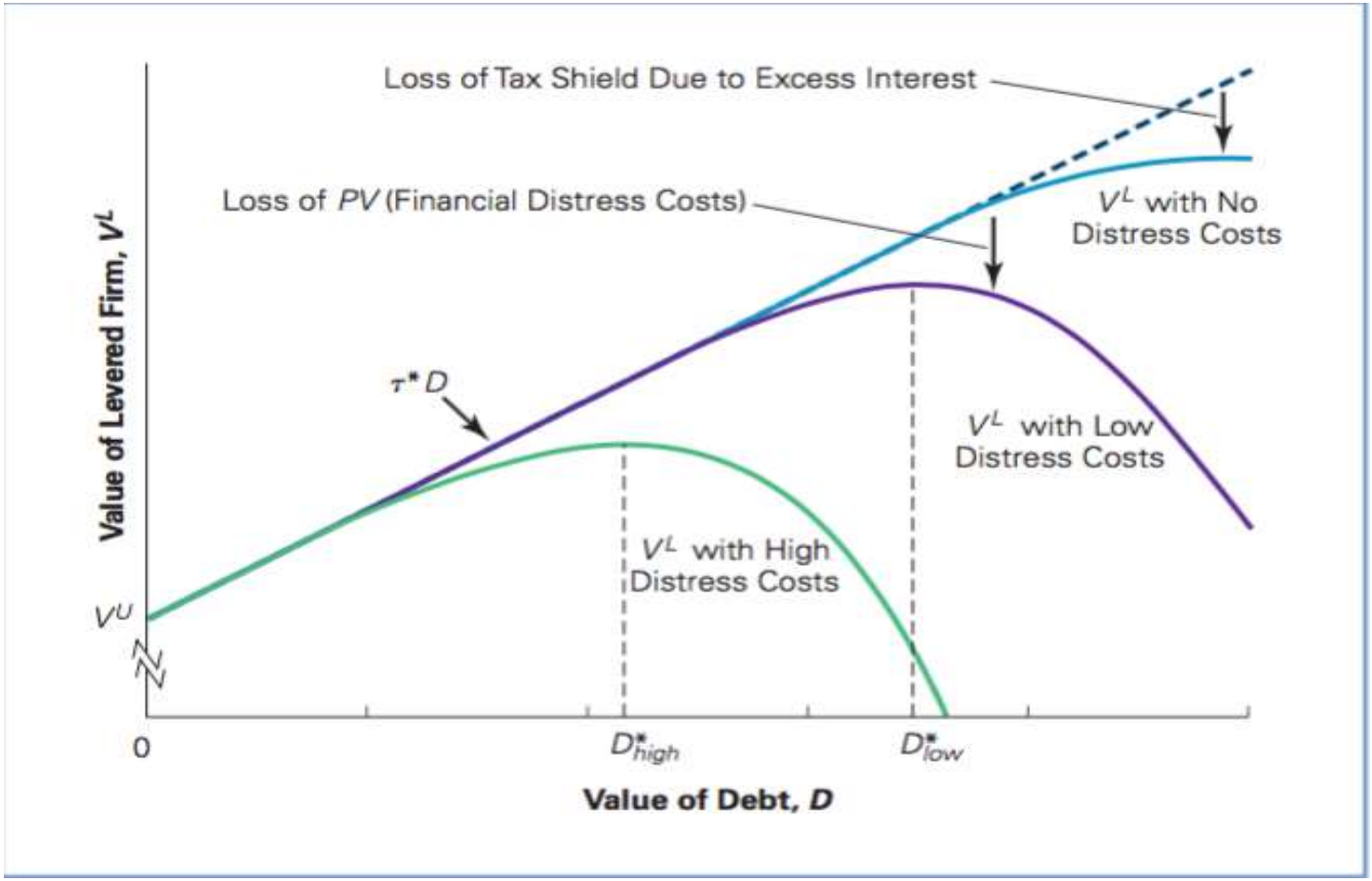
The trade-off theory

- In the presence of taxes and bankruptcy costs, the total value of the levered firm is equal to the value of the unlevered firm plus the present value of debt tax shields minus the present value of financial distress costs

$$V_L = V_U + PV(TS) - PV(DC)$$

- There is a trade-off between the tax benefits of debt and the costs of financial distress.

The trade-off theory



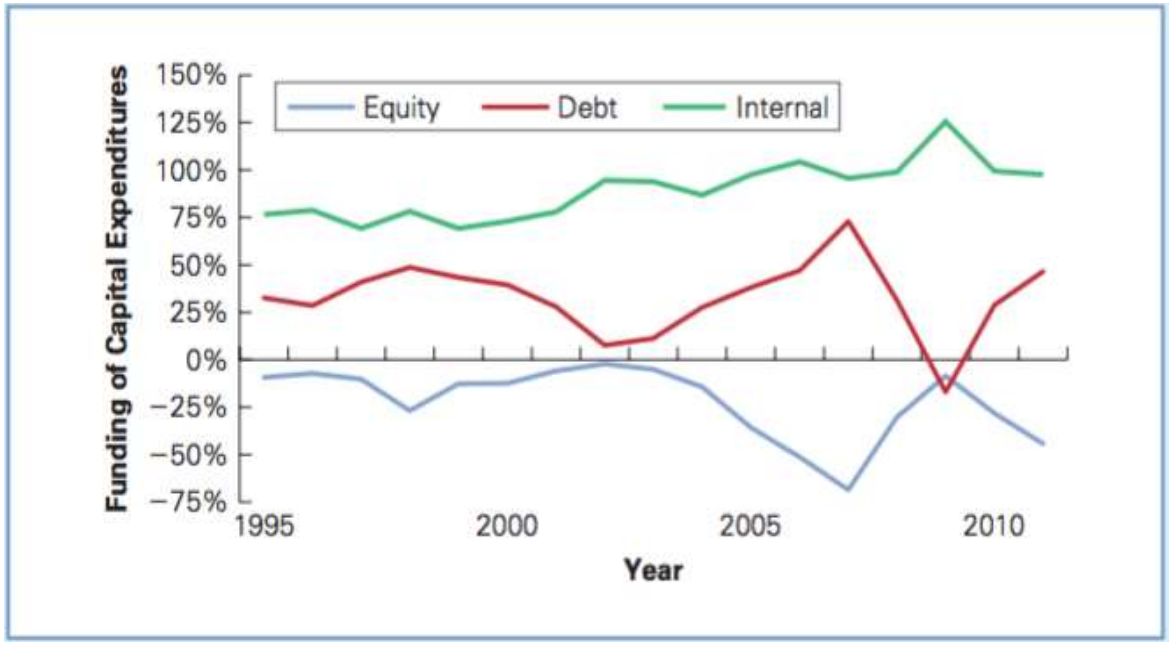
The Pecking-Order Theory

Pecking-order theory

- Starts with **asymmetric information**, which means that managers know more about their company's prospects, risks and value than outside investors
- Managers who believe that the firm's equity is underpriced will not want to issue new equity
- Therefore they have a preference to fund investment using retained earnings, or debt, rather than equity (which would mean, selling parts of the company at a price that is too low)
- On the other hand, managers who believe that the firm's equity is overpriced will want to exploit that by issuing new stocks
- The choice of managers can be interpreted as a signal of managers' confidence in future performance.

Pecking-order theory

- This leads to a **pecking order**, in which investments are financed first using retained earnings, then by new issue of debt, and finally with new issue of equity



Trade-off theory versus pecking-order theory

- In practice, the debt ratios of firms seem to depend on 4 factors:
  - Size: Large firms tend to have higher debt ratios
  - Tangible assets: Firms with higher ratios of fixed assets to total assets have higher debt ratios
  - Profitability: More profitable firms have lower debt ratios
  - Market to book: Firms with higher ratios of market-to-book value have lower debt ratios.
- In line with the trade-off theory:
  - Large companies with tangible assets are less exposed to costs of financial distress, as expected they borrow more
  - Growth firms face high costs of financial distress, as expected they borrow less.
- In line with the pecking-order theory:
  - More profitable firms use less debt because they can rely on internal financing
  - Market-to-book is interpreted as a measure of profitability

Conclusion on the course

How to calculate the value of a firm?

How to calculate the value of an investment?

How to value securities?

How to account for timing?

W2
- Forecast cash flows
- Evaluate risk and infer discount rate
- Calculate NPV (IRR)

How to decide whether to undertake an investment /project?

W1
- Do it if NPV > 0

How should a project / company be financed?

How to account for the project financing when calculating the NPV?

How can one evaluate risk? W3

How is risk linked to expected returns? W5

What is the optimal portfolio? W4

- Only systematic risk matters (beta)
- Rational investors only holds efficient portfolios
- This gives us the link between risk and return (CAPM)

Do the value of a firm and of its equity depend on capital structure? W7

W8
- If there are no taxes, capital structure not matter (MM). The value of a firm and cost of capital don't change (but the cost of equity does)
- If there are taxes, there are incentives to take on debt. But beware costs of financial distress and signalling.

How can one hedge part of the market risk? (or speculate)

W6
- Options