Real investments II

Corporate Finance and Incentives

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Investing in risky projects

There are two main methods for evaluating risky projects - i.e. projects where the future cash flows generated are uncertain

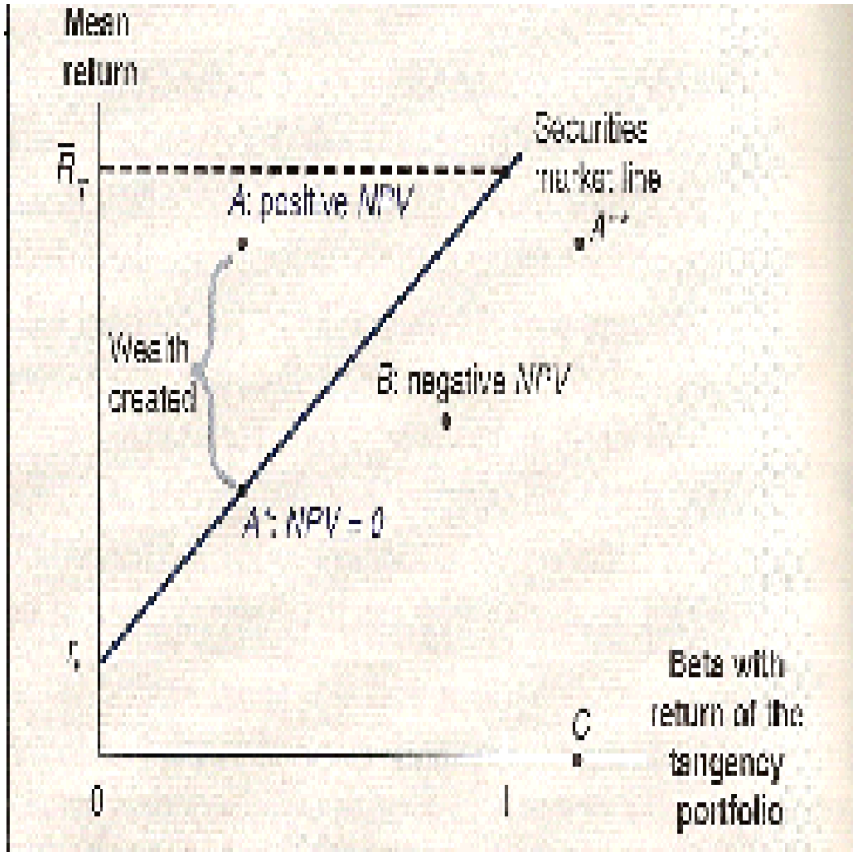
- The risk-adjusted discount rate method
  - Forecast expected cash flows
  - Find a risk-adjusted discount rate and discount the expected cash flows to find the PV
- The certainty equivalent method
  - Risk is accounted for by adjusting the expected cash flows
  - The PV is computed by discounting by the risk-free interest rate

The methods are theoretically identical, but applicable under different circumstances

Risk-adjusted discount rate method

Discount the projects expected future cash flows at the project's cost of capital.

The cost of capital is the expected return that investors require for holding an investment with the same risk as the project.



Risk-adjusted discount rate method

1. Compute expected future cash flows $E\left(\widetilde{C}\right)$
2. Compute the β of the project
3. Compute the expected return of the project from the security market line formula
4. Find the PV by discounting the expected cash flow by the expected return

$$PV = \frac{E\left(\widetilde{C}\right)}{1 + r_f + \beta\left(\overline{R}_T - r_f\right)}$$

Finding the discount rate

- To find the project beta, we try to find the beta of a project or company with similar risk profile.
- Using fx. the CAPM we can find the equity beta of a comparison company.
- However, the equity beta is sensitive to the overall capital structure of the company.
- Since the cash flows we are evaluating have been unlevered to get values which are not affected by the choice of financing, we must perfom a similar adjustment of the project beta.
- We want a beta which reflect the overall riskiness of the project - one which is not affected by the financing choice.
- The cash flows that are discounted, are the cash flows from the projects assets, which do not have debt interest payments subtracted. It is therefore inappropriate to discount with a rate which is based on the return of leveraged equity.

The balance sheet

The value of a company equals the sum of the companies liabilities and equity

$$A = D + E$$

The beta of a portfolio is the weighted average of the betas of the underlying assets

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

The effect of leverage on equity beta

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

Opportunity cost of capital

The return on a portfolio is the weighted average of the returns on the underlying assets

$$\bar{r}_A = \left(\frac{D}{D+E}\right)\bar{r}_D + \left(\frac{E}{D+E}\right)\bar{r}_E$$

The cost of equity, debt and capital as a function of leverage

$$\bar{r}_E = \bar{r}_A + \frac{D}{E}(\bar{r}_A - \bar{r}_D)$$

Cost of debt

- Typically, it is assumed that the debt is riskless, meaning that $\overline{r}_D = r_f$
- In reality, corporate debt is never risk free, so this assumption will not hold perfectly
- However, corporate bonds typically have very low beta's, implying that (according to the CAPM) their expected rate of return must equal the risk free rate
- Therefore, the approximation $\overline{r}_D = r_f$ can be used for reasonably low leverage ratios, $D/(D+E)$
- As we saw above, for high leverage ratios, the possibility of default becomes more relevant

Cost of equity

CAPM

$$\overline{r}_E = r_f + \beta_E \left(\left(\overline{R}_M - r_f \right) \right)$$

APT

$$\overline{r}_E = r_f + \lambda_1 \beta_1 + \lambda_2 \beta_2 + .. + \lambda_K \beta_K$$

Evaluating the PV when no comparable line of business exists

Scenario based betas

- Why are betas of returns not the correct betas for the project?
  - Betas used should be the ones on the Security Market Line (i.e. NPV=0)
  - However, we don't have the NPV of the project
    - If the project in reality has a positive NPV we will overvalue the beta
- Fortunately, the betas of returns do not incorrectly classify the project as having a positive NPV when it does not or vice versa
- However, it can lead to inefficient investment decisions when projects are mutually exclusive

Certainty equivalent method

Same overall principle as the Risk-Adjusted Discounted Cash Flow Methods. However:

- CAPM & APT: Risk is accounted for by discounting with an interest rate plus a premium
- Certainty Equivalent Method:
  - Risk is accounted for by adjusting the expected cash flow
  - The present value is found by discounting at the risk free rate

Certainty equivalent method

Consider the construction of an office building that you plan to sell after 1 year for \$420.000.
The cash flow stemming from the sale is uncertain, so to find the PV we discount by a risk-adjusted rate of 12 pct.

$$PV = \frac{420.000}{1,12} = \$375.000$$

Suppose a real estate company approaches you and offers to fix the price at which they will buy the building from you at the end of 1 year. This would remove the uncertainty from the cash flow, so we would accept less than \$420.000. But how much?

Certainty equivalent method

Certainty equivalent cash flows using the security market line to price risky assets

$$\begin{aligned} CE\left(\widetilde{C}\right) &= E\left(\widetilde{C}\right) - b\left(\overline{R}_T - r_f\right) \\ b &= \frac{cov\left(\widetilde{C}, \widetilde{R}_T\right)}{\sigma_T^2} \end{aligned}$$

Present value formula

$$PV = \frac{E\left(\widetilde{C}\right) - b\left(\overline{R}_T - r_f\right)}{1 + r_f}$$

Introducing taxes

- We now want to examine how the presence of taxes affect a company's decision to invest
- The reason is not taxes per se, but rather that different financing methods are taxed differently
- In particular, there is a tax advantage to debt financing
- The reason is that interest rates are tax deductible

Assumptions

- We assume that the CAPM holds
  - We know that there are serious problems with the model, but it is used by virtually all practitioners for valuing real investments, so we will go with the flow
- We also assume that the total pre-tax cash flow of the project is independent of how it is financed
  - As we will see when we talk corporate finance, this might not hold, but it is not unreasonable, and simplifies things considerably

Taxes

Three different taxes are of interest in this respect

- Corporate taxes ("selskabsskat")
- Personal taxes on income coming from equity holdings (dividends and capital gains)
- Personal taxes on interest income (income coming from bond holdings)

Taxes

- For the purpose of this course, we assume that there are no personal taxes
- This, of course, is not the case
- However, it turns out that if the personal tax rate on income from equity equals that coming from bonds, the personal taxes have no effect on corporate investment or financing decisions, and therefore are of no interest to us
- In reality, these two tax rates are not identical, but tax law is complex, so we will not discuss it further

How taxes affect investments

- Since the company has to pay corporate tax on the payments going to its shareholders, but not on the payments going to its debtholders, there is a tax advantage to debt financing
- The question is, how do we value this tax advantage
- Later, when we introduce corporate finance, we will explore how to best take advantage of it (i.e. find out how much debt companies should have), but for now, we will take the debt level as given

The balance sheet

Assets	Liabilities and equity
Debt tax shield $T_c D$	Debt D
Unlevered assets $D + E - T_c D$	Equity E

Two main methods

Adjusted Present Value (APV)

- Using this method, the unlevered cash flows are valued first, and then the tax shield is valued separately
- This method is more versatile, and is favored by academics

Weighted Average Cost of Capital (WACC)

- Using this method, the unlevered cash flows are the only thing that is valued, and the discount rate is adjusted to account for the value of the tax shield
- This method is more commonly used in practice, but is less flexible than APV

Adjusted present value

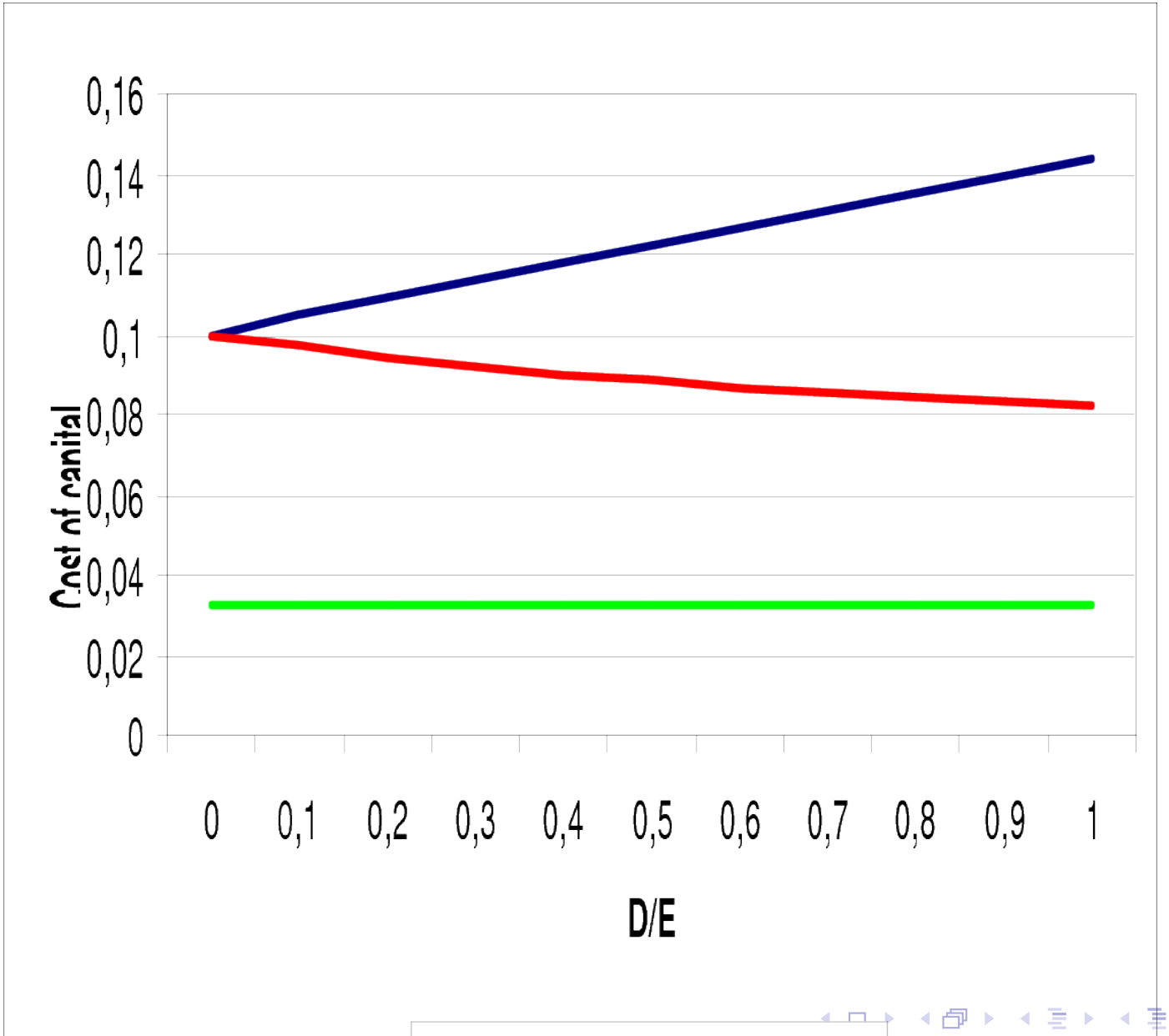
1. Find the present value of the project's unlevered cash flows
2. Find the present value of the tax subsidies coming from the project

Weighted average cost of capital

- When using WACC, the value of the tax shield is accounted for in the discount rate used to value the unlevered cash flows, rather than valuing the tax shield separately
- This makes WACC simpler than APV

$$WACC = \frac{E}{E+D}\bar{r}_E + \frac{D}{E+D}(1-T_c)\,\bar{r}_D$$

WACC, Cost of Equity, and Cost of Debt with taxes



Weighted average cost of capital

- Using this as the discount rate for the unlevered cash flows of the project, WACC gives the same value as when valuing the tax shield separately (APV)
- Thus, WACC requires fewer calculations than APV, with the same result, which is advantageous

Problems with WACC

- When the debt level changes over time (for instance, if part of the debt is paid off) the WACC formula no longer works
- If the company is not certain that it can use the tax shield (for instance, if it is uncertain that profits will be positive), WACC has to be adjusted: T_C used in WACC must then be lower than the actual tax rate on corporate earnings

Cost of capital

- One should always use the cost of capital for the project, not the company, to see whether a project will add value to the company (debt and equity holders)
- So even if a company has an overall cost of capital of 10%, adopting a riskless project with a return of 8% (which, at least at the present, is higher than the risk free rate) still adds value to the company