The impact of different financing structures on investor risk

Marco Cometto

OECD/NEA, Nuclear Development Division

OECD/NEA Workshop on "Electricity price and Nuclear New Build", Paris, 19 September 2013

General background

Objectives

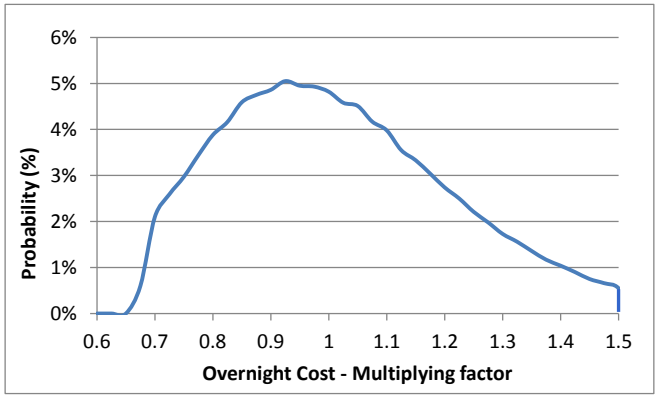
- More realistic model of the choices of a private investor, taking into account the effect of taxes and the capital structure of the project
- Representing the main sources of risk associated with a NPP project
- Effect of the financial leverage on the NPV and on the risk for equity and bond-holders
- Comparison of technologies with different capital/operating costs

Financial model

- Detailed cash-flow model which takes into account
  - Taxes (35%)
  - Depreciation (MACRS) and tax shield on debt
  - Models explicitly the net cash flow to the firm and to equity-holders
- Static Discounted Cash Flow Model (*Adjusted Present Value*)
  - Cost of capital (5%→15% in nominal term)
  - Debt ratio (30% → 70%)
  - Cost of debt (5% → 7%)

Sources of Risks in a NPP project

- ***Construction risk***
  - ✓ Uncertainty regarding overnight costs
  - x Uncertainty on length on construction period (IDC)

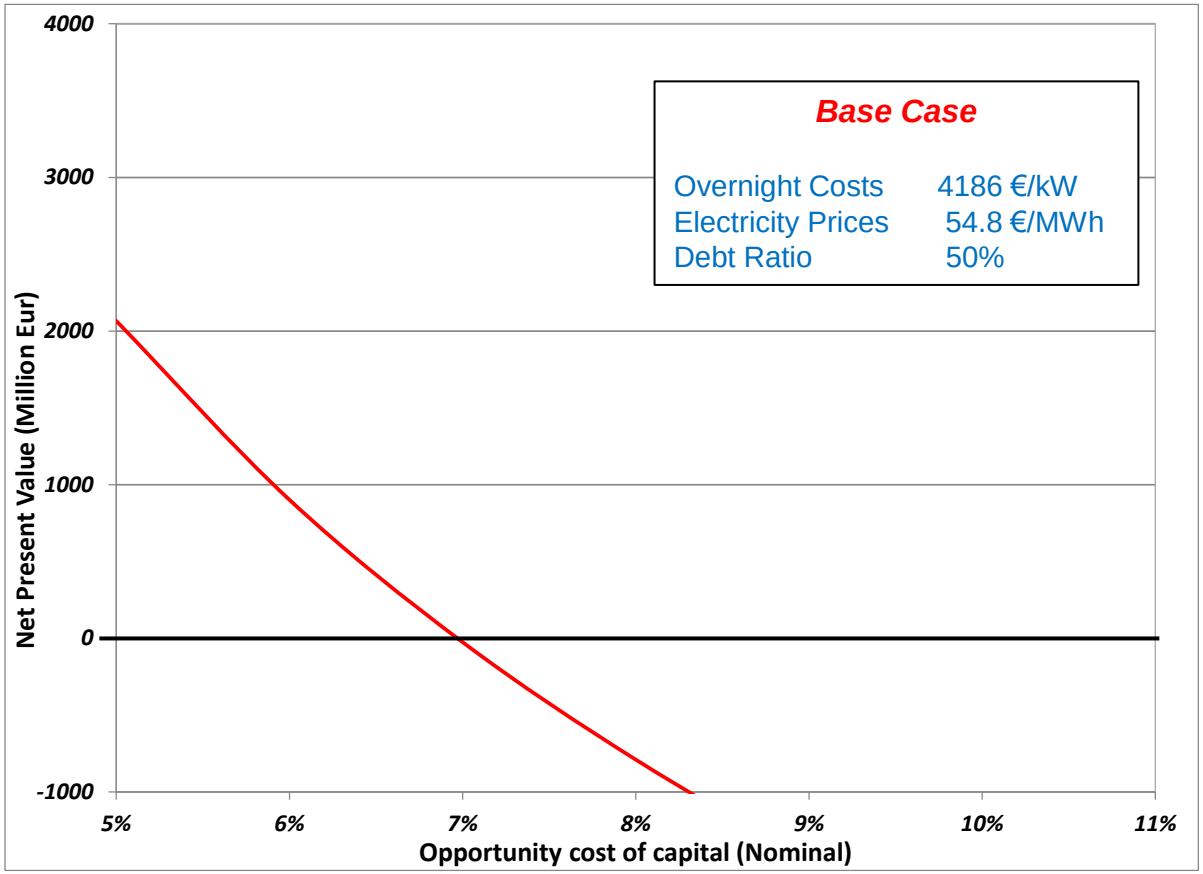


- ***Operational risk***
  - ✓ Load factor: triangular distribution between 75% and 95%

- ***Electricity market risk***
  - ✓ Short-term variability of prices
    - First-order auto regressive model: $P_{t+1} = P_t + \alpha(\mu - P_t) + \varepsilon_t$ (random component)
    - Possibility to suspend production when electricity prices are below variable costs
  - ✓ Long-term changes in the price trajectory
    - Parametric study (-30% → +30%, i.e. ±16 €/MWh)
    - Creation of 4 scenarios of possible electricity price variations (low to high price risk)
  - x No correlation with fuel prices → Results are not representative for gas/coal PP

Financing NPP in centralEurope
Base case

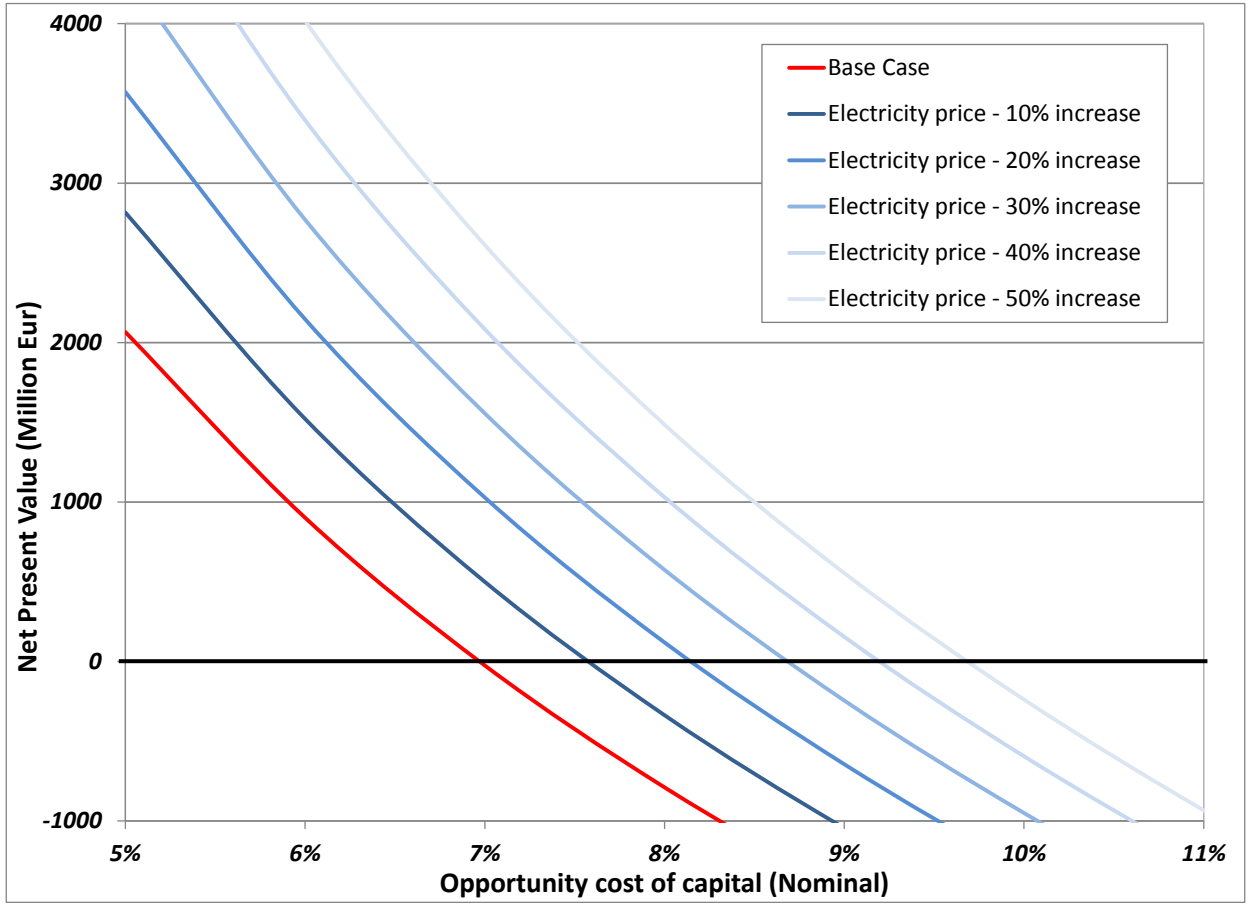
Net Present Value of a NPP investment – assuming a 50% debt ratio



- With current wholesale electricity prices (and prevailing construction costs) it is unlikely that a new NPP could be financed without governmental support.

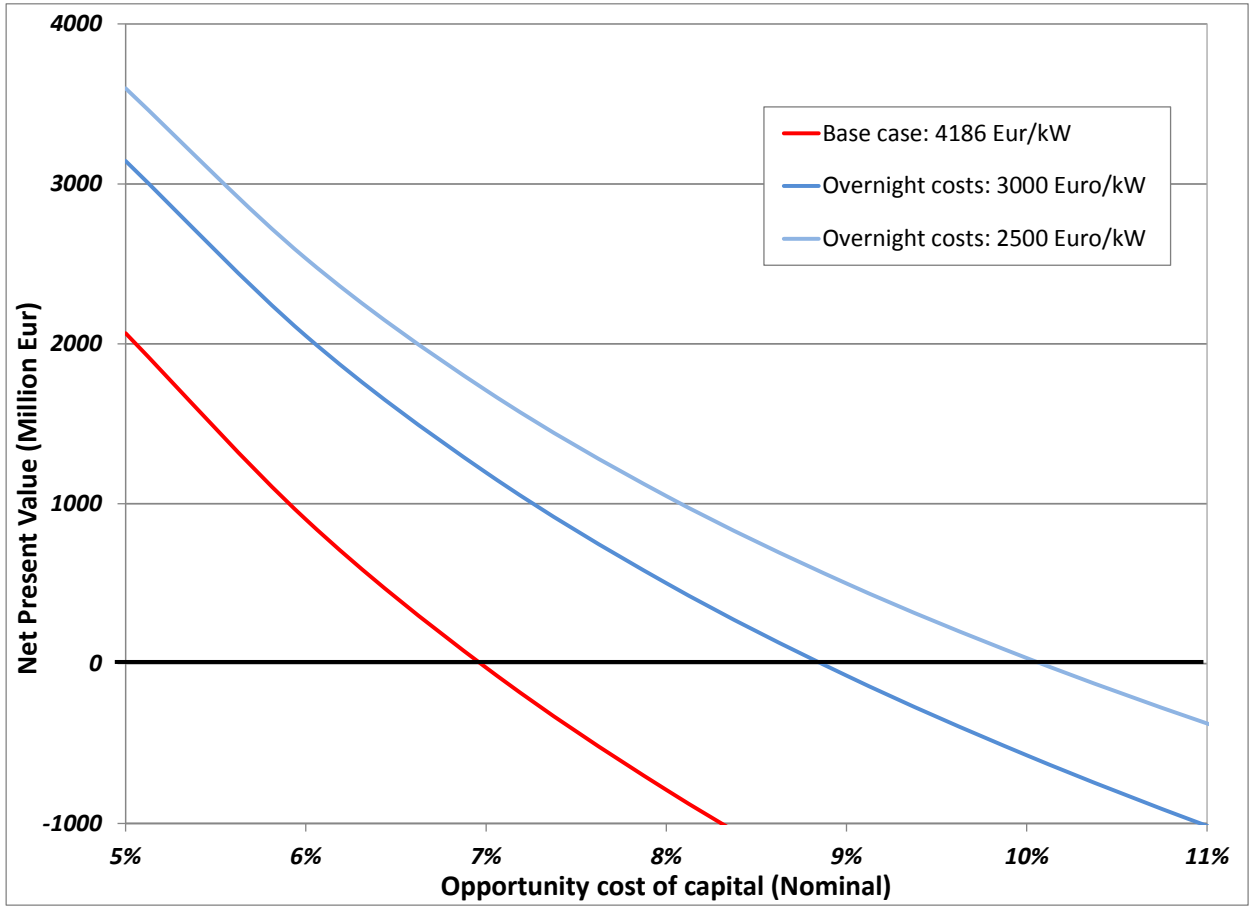
Financing NPP in continental Europe
Sensitivity to electricity price

Net Present Value of a NPP investment – sensitivity to electricity price



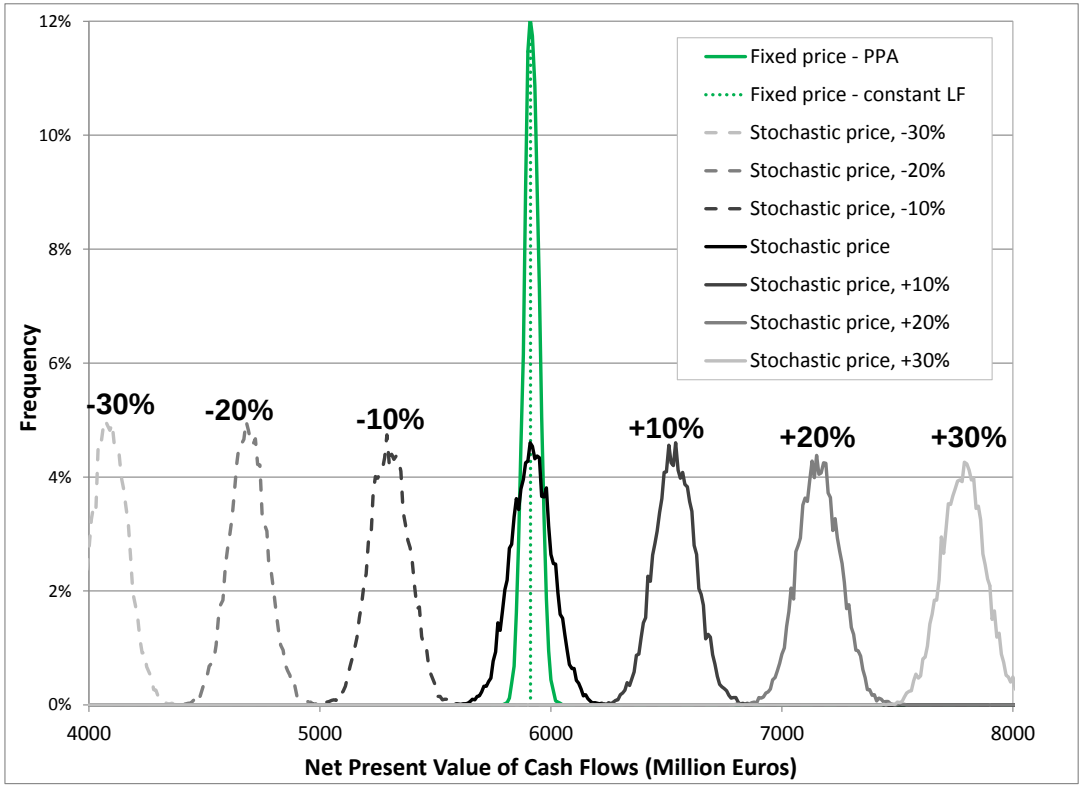
Financing NPP in continental Europe
Reduction in Overnight costs

Net Present Value of a NPP investment – sensitivity to Overnight costs



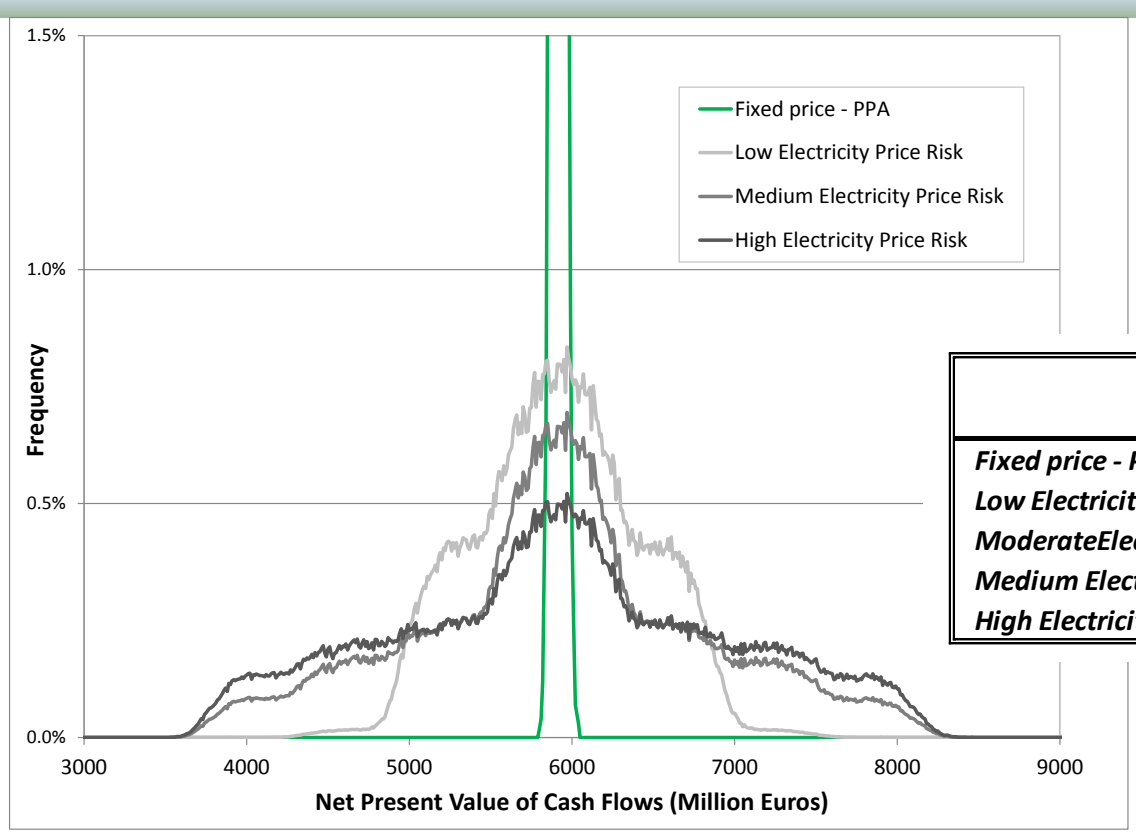
- A combination of increase in electricity prices and reduction of construction costs is needed to make a NPP project viable in continental Europe.

NPV distribution of cash flows after commissioning (I)



	Change in electricity price						
	-30%	*-20%*	*-10%*	*Zero*	*+ 10%*	*+ 20%*	*+30%*
Low Electricity Price Risk	0%	1%	25%	48%	25%	1%	0%
Moderate Electricity Price Risk	1%	5%	20%	48%	20%	5%	1%
Medium Electricity Price Risk	5%	10%	15%	40%	15%	10%	5%
High Electricity Price Risk	8%	12%	15%	30%	15%	12%	8%

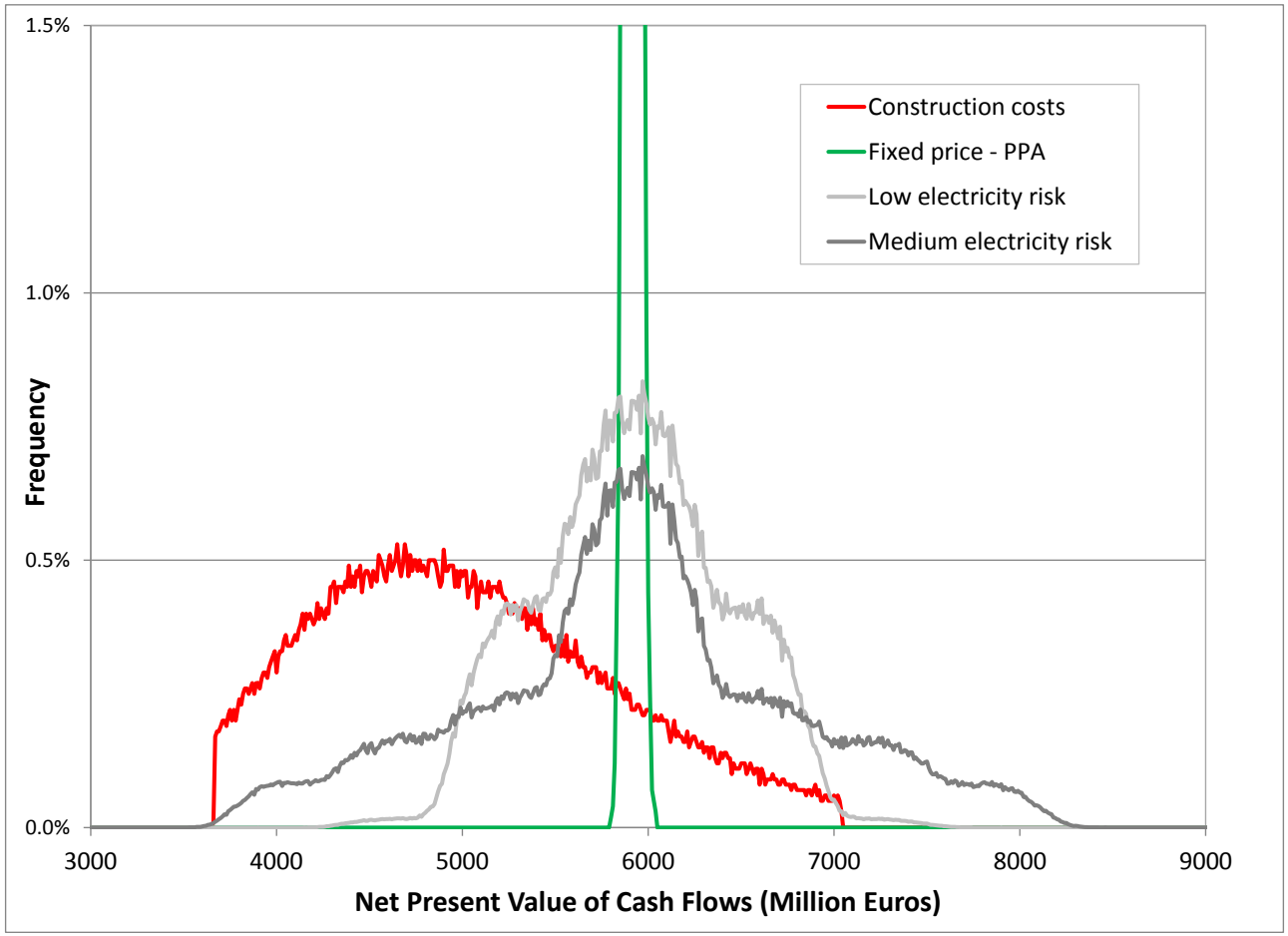
NPV distribution of positive cash flows after commissioning (II)



	Average [Mio €]	*StDev* [Mio €]	[%]
Fixed price - PPA	5900	33	1%
Low Electricity Price Risk	5900	479	8%
ModerateElectricity Price Risk	5900	618	10%
Medium Electricity Price Risk	5900	877	15%
High Electricity Price Risk	5900	1018	17%

- Risk as uncertainty of future cash flows (once the plant has been build)
- PPA (or long term contract) reduce significantly the variability of future cash flows
- Investors could be interested in this cash flow profile? At which discount rate?
- What could be the premium that they are willing to give-up for it?

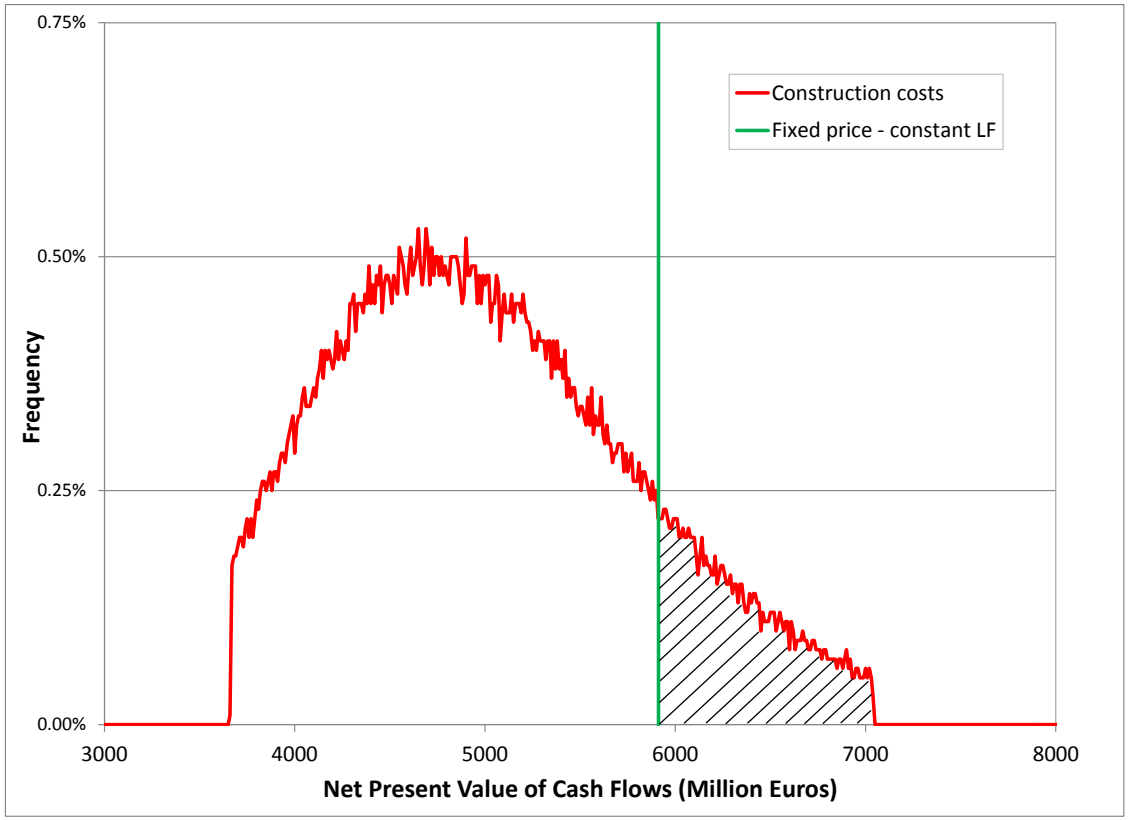
NPV distribution of cash flows Before and after commissioning



	StDev [%]
Construction Risk	15%
Fixed price (PPA)	1%
Low Electricity Price Risk	8%
ModerateElectricity Price Risk	10%
Medium Electricity Price Risk	15%
High Electricity Price Risk	17%

- StDev of construction costs is of a similar magnitude of electricity market risk (Medium and High scenarios)

Risk and value of electricity price stability



- Risk can be defined as the probability that the NPV of the project is negative (*shortfall risk*) – risk that the revenues are insufficient to cover the costs.

Risk and value of electricity price stability

Shortfall risk for a NPP project under different Electricity Market risk hypothesis

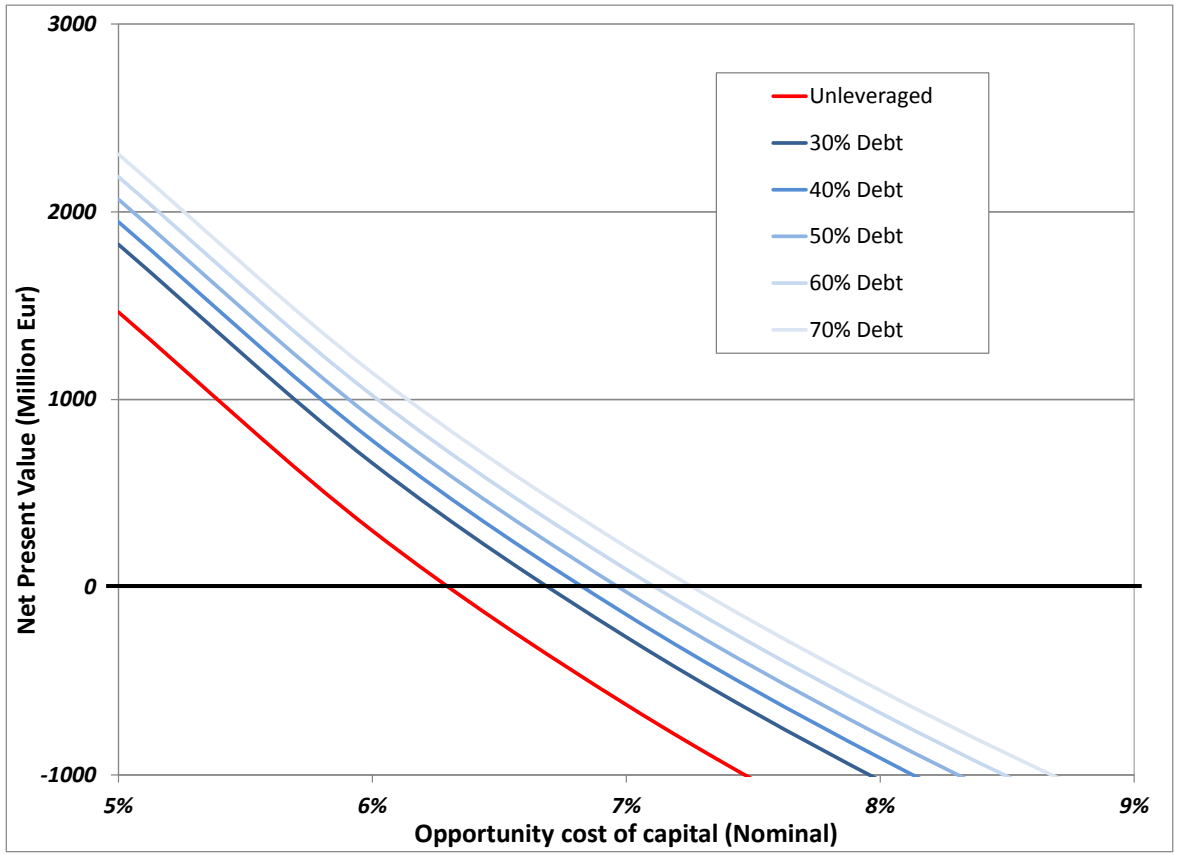
Cost of capital 5%	Probability of negative NPV				
	Fixed price	With market risk			
		High	Medium	Moderate	Low
Unleveraged	3.6%	16.1%	13.0%	8.4%	6.6%
30% Debt	0.5%	10.5%	8.0%	4.3%	2.9%
40% Debt	0.0%	9.0%	6.7%	3.4%	2.1%
50% Debt	0.0%	7.7%	5.7%	2.7%	1.6%
60% Debt	0.0%	6.6%	4.8%	2.1%	1.1%
70% Debt	0.0%	0.0%	0.0%	0.0%	0.0%

Cost of capital 6%	Probability of negative NPV				
	Fixed price	With market risk			
		High	Medium	Moderate	Low
Unleveraged	33.2%	40.4%	38.9%	36.7%	35.8%
30% Debt	20.6%	30.5%	28.2%	24.9%	23.5%
40% Debt	17.2%	27.4%	25.0%	21.5%	20.1%
50% Debt	14.2%	24.5%	22.0%	18.4%	16.9%
60% Debt	11.5%	21.8%	19.3%	15.6%	14.1%
70% Debt	9.2%	19.2%	16.7%	13.1%	11.6%

- The model allows us to estimate the shortfall risk for a nuclear new build
- PPA reduce the shortfall risk
- Still to determine what is the value of this risk reduction for an investor (*cost of capital and/or NPV*)

Impact of financial leverage (I)

Impact on NPV

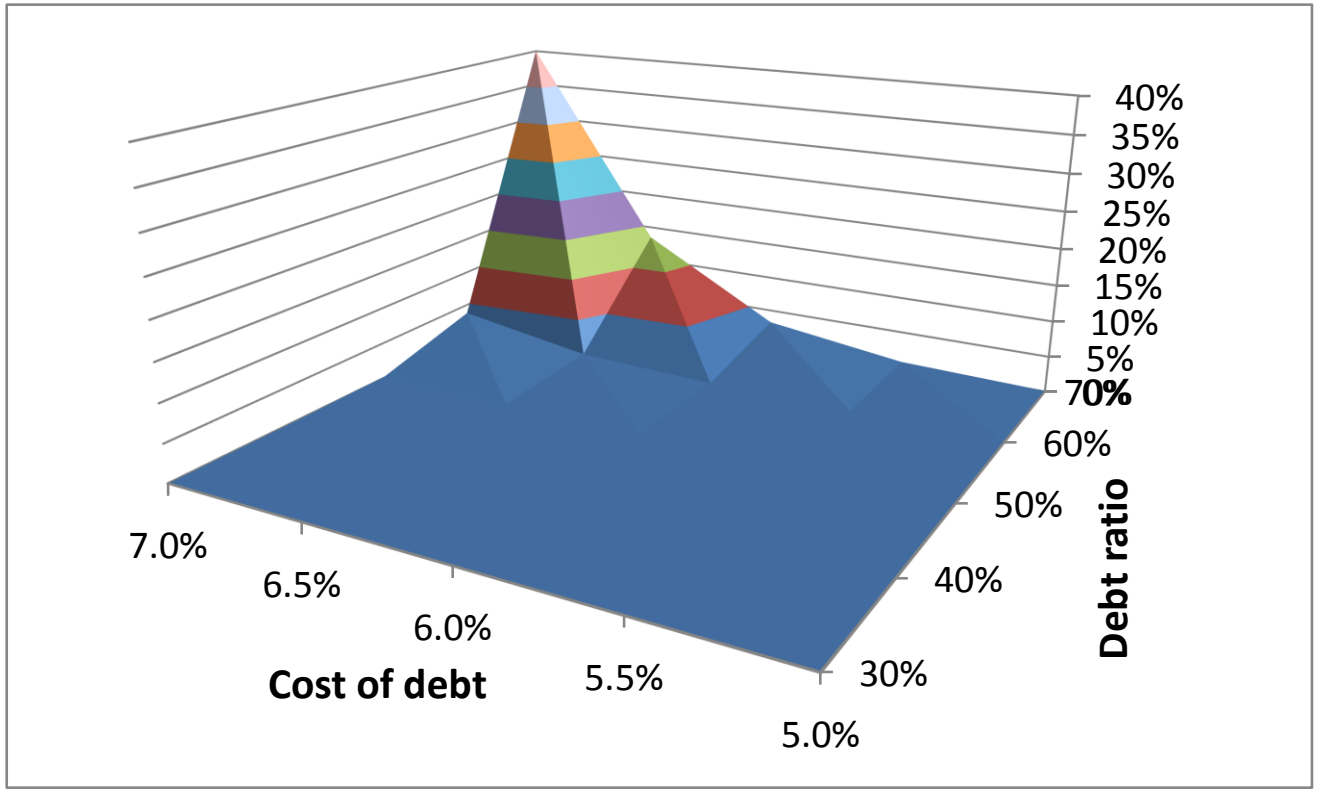


- APV= Value if all equity financed + PV of Tax shield on debt.
- Leverage increases the NPV of a project
- Leverage increases risk for both bond- and equity-holders

Impact of financial leverage (II)

Risk for a bond-holder

No changes in construction costs, no construction delays; electricity market risk– base case)

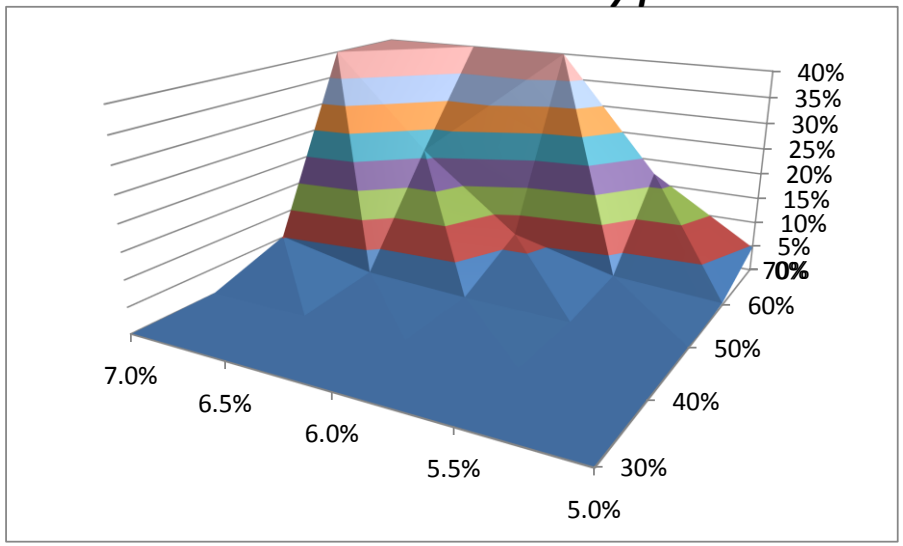


- **Metric for risk**: the net cash flow to the firm is insufficient to meet debt obligations at least once in the project lifetime.

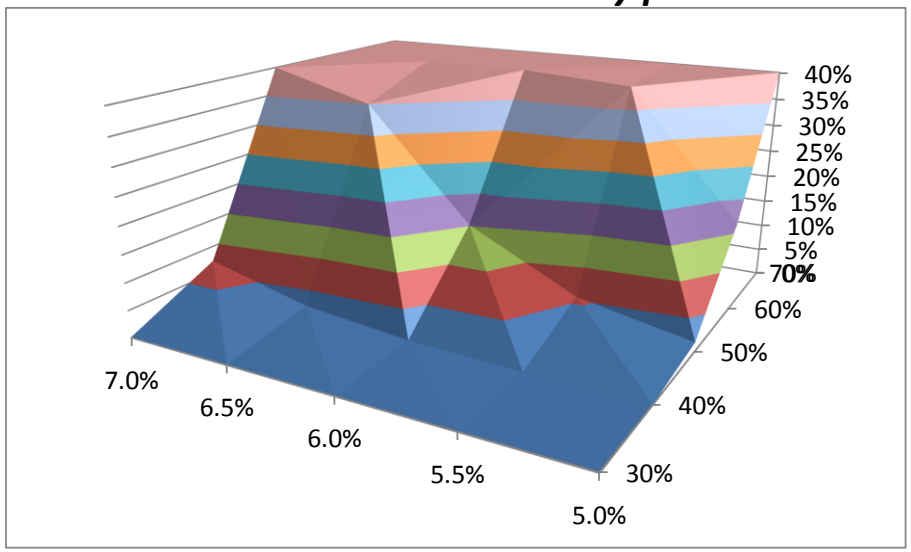
Impact of financial leverage (II)

Risk for a bond-holder

10% decrease in electricity prices



20% decrease in electricity prices



- At low debt ratios risk for bond-holders is rather limited, even for unexpected electricity price falls.
- At 70% DR and above, electricity market risk for bondholders starts to be significant.
- Take into account the risk of cost overruns and construction delays (to be done).
- Are other metrics for risk more appropriate?
- Still to determine the respective risk for an equity holder.

Conclusion

- With current electricity market prices (and overnight costs) no new nuclear build could be envisaged in continental Europe without strong governmental support.
- PPA (CfD) reduce the risk for investors (both equity and bond-holders), and thus the opportunity cost of capital.
- Risk for bondholders is very limited at low debt ratios (30-50%) even under adverse electricity market conditions.

  At higher leverage, bondholders assume a part of project risk.
- Stochastic models give a good representation of investor's risks in a NPP project (but as in all models results are as good as the assumptions taken).

Thank you for your attention

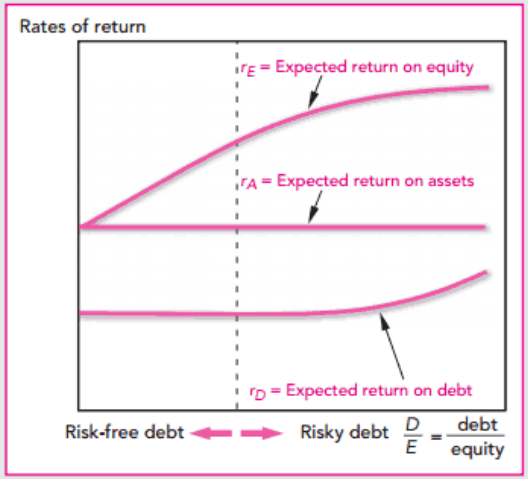
Assumptions on cost and technology

Teachnical assumptions		
Plant size [MWe]	1000	
Construction Time [years]	7	
Plant operation life [years]	60	
Load Factor [%]	85%	Stochastic
Economic assumptions		
Overnight Cost (Real) [€/kWe]	4186	Stochastic
Decommisioning cost - fraction of overnight	15%	
Total O&M Cost [€/kWh]	10.57	
Fraction of fixed O&M Costs	95%	
Fuel Cost [€/kWh]	4.72	
Back-end Costs [€/kWh]	1.58	
Average electricity prices [€/MWh]	54.78	Stochastic
Financial assumptions		
Inflation rate	2%	
Increase in electricity prices	2%	
Opportunity cost of capital	5% to 15%	Parameter
Cost of debt	5% to 7%	Parameter
Debt ratio	30% to 70%	Parameter
Tax rate	35%	
Debt repayment (years)	60	
Depreciation length (years)	15 (MACRS)	

Rates of return

FIGURE 17.2

MM's proposition II. The expected return on equity r_E increases linearly with the debt–equity ratio so long as debt is risk-free. But if leverage increases the risk of the debt, debtholders demand a higher return on the debt. This causes the rate of increase in r_E to slow down.



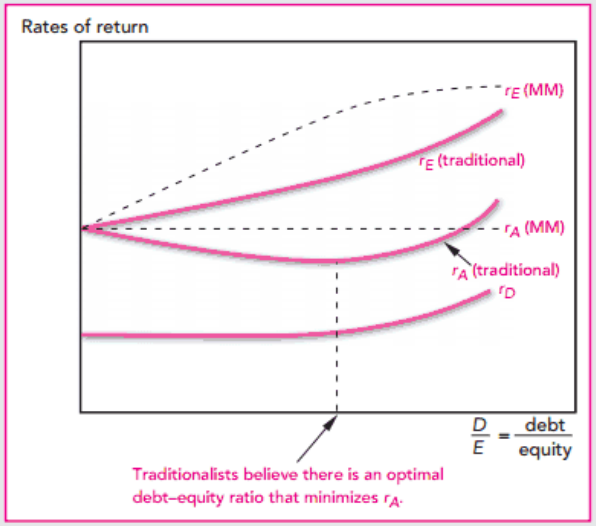


FIGURE 17.5

The dashed lines show MM's view of the effect of leverage on the expected return on equity r_E and the weighted-average cost of capital r_A. (See Figure 17.2.) The solid lines show the traditional view. Traditionalists say that borrowing at first increases r_E more slowly than MM predict but that r_E shoots up with excessive borrowing. If so, the weighted-average cost of capital can be minimized if you use just the right amount of debt.

* Source: Brealey and Myers, "Principles of corporate finance" 7th ed.